International Energy Agency

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Moldova 2022

Energy Policy Review

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Foreword

Moldova is one of the focus countries of the EU4Energy programme, which is being implemented by the IEA, Energy Community Secretariat and the Energy Charter Secretariat. The EU4Energy programme includes Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. It was designed to support the goals and aspirations of its eleven focus countries to implement sustainable energy policies and foster regional cooperation on energy-sector development. One of the key ways the programme does this is by conducting in-depth policy reviews of individual countries, updating and extending the analysis contained in the IEA's 2015 regional review, Energy Policies Beyond IEA Countries: Eastern Europe, Caucasus and Central Asia.

The energy policy agenda of the Moldova is driven by several interrelated factors. The energy self-sufficiency of Moldova is one of the lowest in the world as the country does not possess any endogenous fossil fuel resources. The need to import the vast majority of its energy supply makes its energy security a priority. As a country that signed an Association Agreement with the European Union in 2014, it has to adopt core EU legislation and develop its energy markets to further integrate on a regional and European level. In addition to that Moldova has obligations to ensure the sustainability of the energy sector and mitigating the effects of climate change.

Since the 2015 review, Moldova has made considerable efforts to diversify its supply sources. Consistent and reliable supplies of gas and electricity have been the main challenge for Moldova and the country has made notable actions to increase the security of supplies. The country is to be praised for the efforts focused on market reforms and aligning the national legal framework for energy with that of the EU. One of Moldova´s major achievements was removing cross subsidisation of electricity and gas tariffs for households, although this has been politically difficult.

Despite all these notable achievements, the Moldovan energy sector still faces major challenges which need to be addressed in a timely manner in order to improve energy security, accelerate the transition towards a more sustainable, clean and efficient energy system and support the development of free and competitive energy markets.

This review took place early in 2020 on the eve of Covid-19 pandemic outburst. It covers the period from 2016 through September 2021. From October 2021, the country´s energy sector has seen several important developments that are only touched upon briefly, but are not the focus of the analysis in this report: in March 2022 Moldova along with Ukraine carried out the emergency synchronization of its grid with ENTSO-E; the country is working to solve the issue of its accumulated debts from its gas supply deal with Gazprom and how this will affect future gas contracts; and for the first time a Moldovan company purchased quantities of gas from sources other than Gazprom, while testing the readiness of local suppliers to access the international market.

This in-depth review commends Moldova in its efforts to reform the energy sector and aims to help it achieve its energy policy goals, including the provision of affordable, safe, secure and clean energy to its population.

ENERGY INSIGHTS

ENERGY SECURITY

ENERGY SYSTEM TRANSFORMATION

ANNEXES

LIST OF FIGURES, TABLES AND BOXES

Figures

Tables

Boxes

1. Executive summary

The energy policy agenda of the Republic of Moldova (Moldova) is driven by several interrelated factors. The first key driver is high dependence on imports from limited sources and subsequent energy security considerations. Moldova's energy self-sufficiency is among the lowest in the world: only around 25% of its energy demand is covered by domestic production, consisting almost entirely of solid biomass and variable renewable energy sources. Moldova imports 100% of its gas and coal consumption, nearly all of its oil consumption and around 80% of its electricity (including electricity procured from the Moldavskaya GRES [power station] situated in Transnistria).[1]

Second, Moldova has obligations stemming from its aspirations for European integration. In 2010, the country became a member of the Energy Community and in 2014, it signed an Association Agreement with the European Union, which implies a commitment to transpose the core EU *acquis communautaire*[2] into national legislation. One of Moldova's long-term objectives is to gain access to the network of the European association for the cooperation of transmission system operators for electricity (ENTSO-E) by interconnecting its national electricity network with that of Romania.

Third, the country's energy policy integrates Moldova's international and internal commitments in the areas of climate change mitigation and environmental protection.

Since the last IEA review of Moldova's energy policies (IEA, 2015), the country has made significant progress towards meeting the three key objectives of the Energy Strategy of the Republic of Moldova to 2030: 1) ensuring the security of energy supply; 2) developing competitive markets and their regional and European integration; and 3) ensuring sustainability of the energy sector and climate change mitigation.

Commendable efforts have been made towards the diversification of supply sources and increasing the security of both electricity and gas supply. Notable actions were taken, in particular, to avoid the potential gas crisis resulting from the interruption of Russian gas supply through the Ukrainian gas network at the end of 2019. By interconnecting with Romania through the Ungheni-Chisinau pipeline, Moldova has created the possibility of alternative gas supply from Romania. The modification of the gas network to allow the reverse flows from the Trans-Balkan system, actual testing of deliveries to Ukraine and the use of its gas storage capacities have created additional possibilities of supply diversification and access to the EU markets, including potential access to liquefied natural

[1] In this publication, the statistical data related to the energy sector refer to the Republic of Moldova without Transnistria. The breakaway region of Transnistria, a strip of land between the Dniester River and the eastern Moldovan border with Ukraine, is not recognised by United Nations (UN) states. The Moldovan government considers Transnistria to be a territorial administrative unit with a special status, which is part of the Republic of Moldova, but not controlled by its government (RoM [Republic of Moldova], 2021).

[2] Acquis communautaire (French): The body of Community legislation by which all EU member states are bound. Countries joining the EU must have implemented the existing acquis communautaire by the time of accession.

gas (LNG) supplies through Greece. Moldova has adopted the full set of security of supply rules, even beyond the current Energy Community *acquis*.

The Moldovan government is also to be praised for the efforts focused on market reforms and aligning the national legal framework for energy with that of the EU. Moldova has successfully adopted several legislative acts, which transpose the EU's Third Energy Package[3] at the level of primary legislation; related secondary legislation is also being developed and partially adopted. Moldova is also on the right path to developing a sound institutional structure in the energy sector, informed by better statistical data. The National Bureau of Statistics (NBS) is commended for its efforts to improve energy data collection and reporting. Efforts have also been made to adjust national legislation in the field of renewable energy and energy efficiency and to enhance regional cooperation.

Over several years, Moldova has successfully removed cross subsidisation of electricity and gas tariffs for households, though this has been politically difficult. It has also introduced targeted support schemes for the most vulnerable consumers. The National Agency for Energy Regulation (ANRE) and the government should be praised for this major achievement. It is also encouraging that ANRE has approved market rules for the procurement of electricity on forward, day-ahead, intra-day, balancing and ancillary service markets, as well as gas market rules and network codes. Considerable progress in attracting investment to modernise the country's district heating systems is also to be noted.

After signing the Paris Agreement on climate change in 2016, Moldova was among the first countries in the EU4Energy region to develop and approve its Low Emissions Development Strategy (LEDS) in December 2016 and the National System of Monitoring and Reporting of Greenhouse Gas Emissions in 2018. The country is to be commended for its decision to set more ambitious targets in its updated nationally determined contribution (NDC2), which was submitted in February 2020. The new economy-wide unconditional target is to reduce GHG emissions by 70% below the 1990 level by 2030, instead of 64-67% as committed in the NDC1. The updated NDC raises the conditional target to 88% (compared to 78% committed in the NDC1). The government plans to update the current LEDS in order to implement the targets stated in the new NDC. Moldova is also one of the first countries in the EU4Energy region[4] that has pledged (by a Government decree adopted in December 2019) to develop, by 2022, a new mid-century Low Emissions Development Strategy, outlining the policies for accelerating GHG reductions by 2050.

Despite all of these notable achievements, the Moldovan energy sector still faces major challenges which need to be addressed in a timely manner in order to improve energy security, accelerate the transition towards a more sustainable, clean and efficient energy system and support the development of free and competitive energy markets.

[3] The European Union's Third Energy Package is the energy market legislation for an internal gas and electricity market in the European Union that was adopted in 2009. The package aims at accelerating investments in energy infrastructure to enhance cross border trade and access to diversified sources of energy. It covers the following areas: unbundling, independent regulators, cross-border cooperation and open and fair retail markets.

[4] The EU4Energy region includes the following countries taking part in the EU4Energy Programme: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

Implementation: an institutional challenge

As a matter of priority, the adoption of sound primary legislation should be followed by the adoption and effective implementation of secondary legislation and regulations. This process, which has been partially achieved, is hindered primarily by the lack of human and institutional capacity in the state institutions responsible for energy policy implementation. The number of staff seems insufficient to fulfil all the assigned responsibilities in a timely manner, and the salaries are reported to be too low to attract qualified specialists. In addition, insufficient coordination among the government institutions – and between the state bodies and other stakeholders – puts further stress on the limited human resources.

To facilitate and accelerate the implementation of the ongoing energy reforms, the government should ensure that the Energy Policy Department of the Ministry of Infrastructure and Regional Development (MIRD), the Energy Efficiency Agency (EEA) and other key institutions have sufficient capacities to fulfil the energy policy objectives. In addition, cooperation should be enhanced among the government agencies.

Proper communication and coordination between the public and private sector are of vital importance in developing fair and efficient energy markets and the related enabling environment. It is therefore necessary to develop a communication strategy to explain the key benefits and challenges of the ongoing reforms to energy stakeholders and the population. The private sector, civil society and academic community should be involved in the development of a legal and regulatory framework, for example through creation of working groups reporting to the highest levels of government and supported, where possible, by the donor/International financial institutions (IFI) community.

The energy regulator has a significant role in the further development of the energy sector. The independence, competence and accountability of ANRE are crucial for the development of the energy sector. It is therefore very important to ensure that the regulator can perform its functions without political pressure to effectively balance the needs to both protect the end users, and to attract investment to, and ensure the financial sustainability of, the energy sector. At the same time, the most vulnerable consumers should be supported by targeted social protection measures.

Development of free, liberalised, competitive markets

Moldova will derive numerous benefits from the development of free, liberalised, competitive markets for electricity, gas and oil products: these markets would stimulate investments in generation facilities and infrastructure, provide comfort to investors, suppliers, traders and consumers, contribute to overall increased energy security and decrease upward pressure on energy prices in the long run. To create such markets, the government and the ANRE should accelerate the pace of implementing the legal and regulatory provisions in line with the Third Energy Package.

It is necessary to finalise the unbundling and development of independent market operators in the electricity and gas sectors, implement transparent and fair market rules, and minimise state interference in trading. As regards electricity, providing access to neighbouring and regional markets, regional traders and suppliers will stimulate liquidity on the Moldovan market. It will be necessary to develop spot markets in order to allow market coupling with the Romanian and Ukrainian Day-Ahead/Intra-day Markets. Development of balancing markets will create a favourable environment for the optimal technical and economical operation of the energy system.

Regarding the gas sector reforms, Moldova has adopted several regulations, including the network code and market rules, as a step towards the establishment of a competitive gas market. Unbundling of network and trading activities has been implemented at the distribution level, where 12 regional Distribution System Operators (DSOs) were separated from supply activities. Unbundling at the transmission level is underway. Moldovagaz – currently a vertically integrated company controlling almost the entire chain of gas business (import, transit, transmission, wholesale supply, distribution and retail supply) – is expected to be unbundled through the Independent Transmission Operator (ISO) model.

The retail market was declared open as of the adoption of the Gas Law in 2016. Most customers had been supplied by Moldovagaz under the Public Service Obligation (PSO), but trading at non-regulated prices started in 2020 and the number of independent suppliers grew from 17 to 24.

Moldovagaz has accumulated a large debt to Russia's state-owned energy corporation, Gazprom, for the gas provided to Transnistria[5] (reportedly USD 7 billion as of the end of 2019). Although the debt does not accrue to the Moldovan government or the right bank consumers, the unsustainable business model harms Moldovagaz' credibility as a trusted, financially healthy player, especially in view of its role as a major importer, Public Service Supplier and Supplier of Last Resort. To ensure the sustainable operation of Moldovagaz and to secure uninterrupted gas supplies in the future, a solution should be found to resolve the issue of debt accumulation and to establish the gas trade according to commercial principles.

The removal of cross subsidisation of electricity and gas tariffs for households and the introduction of targeted support schemes for the most vulnerable consumers are very positive steps. There is room for further improvements and potential for innovative approaches to the distribution of benefits within the energy taxation system and for phasing out tax distortions. Also, the Public Service Obligation regime applicable to all residential gas consumers is hardly compatible with the establishment of a competitive market and needs to be gradually reduced and refocused on vulnerable customers only.

Energy security, regional market integration and diversification

Moldova is highly dependent on imports for most of its energy supplies – about 75% of energy demand is covered through the imports of electricity, gas and oil products. The sources of electricity and gas imports are not diversified and crucially depend on gas supply from Russia and electricity supply from the Moldavskaya GRES power station, which operates beyond the control of the Moldovan government. Absence of alternatives gives the monopolistic suppliers potential leverage to exert strong economic/political pressure, which may be used to limit new entrants to the market.

The security of gas and electricity supply can be enhanced through further diversification of routes/sources of supply, development of local energy production, development of cross border/regional infrastructure and harmonisation of cross-border trading rules and regulations with Romania and Ukraine, with further integration and market coupling goals

[5] The gas transmission, distribution and supply entities in Transnistria are a part of the Moldovagaz structure. The gas supplied through Moldovagaz to Transnistrian consumers (including the Moldova GRES) is not paid for and the collections go to the local budget.

for the longer-term future. Moldova's integration in the regional market and diversification process will make the relationship with Transnistria more sustainable and mutually beneficial.

Opportunities for alternative supplies of natural gas now exist, as stated above, thanks to the Iasi-Ungheni-Chisinau pipeline, possible reverse flows from the Trans-Balkan system, and the possibility to buy gas from EU markets and store it in Ukrainian underground gas storage facilities. However, Moldova still procures natural gas almost exclusively from Gazprom through the traditional route from Ukraine: the Iasi-Ungheni-Chisinau pipeline remains mostly idle, and the Trans-Balkan reverse flow has not yet resulted in any significant flow to Moldova. Such high dependence on a sole gas supplier may constitute an energy security risk, not only for the supply of gas but also for the security of the electricity supply because most of the electricity is generated from natural gas (including in Transnistria). Moreover, the throughput of gas transit pipelines has dropped dramatically after construction of the Turk Stream pipeline, which redirected the gas flows to South-East Europe away from transit through Ukraine and Moldova.

The future of the gas sector in Moldova will depend on the progress made on the full application of the EU's Third Energy Package, opening of the internal market, implementation of transparent and equitable transit regulations, as well as active engagement with neighbouring countries to encourage improved regional cooperation, interoperability, trade and exchange.

In the electricity sector, Moldova's long-term objective was to fully interconnect with the European Network of Transmission System Operators for Electricity (ENTSO-E). This was achieved significantly earlier than planned, due to Russia's invasion of Ukraine in late February 2022. After an urgent request by Ukraine and Moldova for emergency synchronisation, ENTSO-E was able to accelerate the process and successfully connect Ukraine and Moldova's power systems to that of Continental Europe. They are now disconnected from the Integrated Power System/Unified Power System of Russia (IPS/UPS). Moldova and Ukraine are now working with ENTSO-E on full synchronisation, as the current emergency mode does not allow for full-fledged commercial electricity trade. The government of Moldova, with the support of the European Bank for Reconstruction and Development EBRD), European Commission (EC), European Investment Bank (EIB) and World Bank, is pursuing interconnections with Romania through an initial back-to-back converter in Vulcanesti in southern Moldova and a 400 kV line between Vulcanesti and Chisinau. Further interconnection points are also being explored. These interconnections, along with the ENTSO-E synchronisation, will strengthen electricity security through diversification of sources and reduce Moldova's reliance on imports from Ukraine and the Transnistria region.

Another challenge for the electricity sector is the integration of variable renewable energy (VRE) sources as their penetration is expected to increase significantly in the coming years as one of the government's objectives is to develop local generation, including from renewable energy sources. A 168 MW cap on the development of renewable energy capacity (mainly wind and solar PV plants), which was put in place in 2018, was updated in December 2021 for the period up to 2025, raising the maximum capacity to be supported by promotion mechanisms tentatively to 460 MW. The country plans to install an additional 400 MW.

The Moldovan power system is currently based on an inflexible domestic generation mix, and the country relies on Ukraine both for reserves and for balancing its generation. This reliance severely limits its ability to integrate large shares of VRE sources into the grid. As international experience demonstrates, a country's ability to integrate VRE depends on the flexibility of its power system – which is largely determined by its infrastructure, such as interconnectors, electricity storage and flexible power plants. It is equally important to have appropriate policies, including regulatory and market frameworks. Electricity market rules approved in 2020 create conditions for improved forecasting from large renewable energy plants, which would decrease imbalances in the system. In addition, a market framework with shorter scheduling intervals would allow scheduling to be closer to the real-time delivery of power and increase the accuracy of forecasts. Investment in flexible infrastructure in Moldova could include: storage, e.g. batteries and thermal storage; retrofitting and modernising of existing generators, e.g. regulation of power output from cogeneration plants; and increased interconnection and use of demand-side resources, e.g. smart-charging electric vehicles or time-of-use tariffs.

In the heating sector, Termoelectrica and CET-Nord JSC have secured loans from the World Bank and EBRD to improve operating efficiency and financial viability in the district heating systems in Chisinau and Balti, respectively. Energy efficiency measures, such as the modernisation of pumping stations and the rehabilitation of segments of the distribution network, have been implemented. Nevertheless, heat losses remain high, at around 19%, well above the level of 5 to 10% in more modern district heating systems of a similar size. There is a great need for further investments in the district heating infrastructure in Moldova, including new heat-generation plants and insulation of grids.

District heating is subject to regulation in setting tariffs and approval for investment projects. The tariff setting methodology, however, differs from the methodologies applied to electricity and gas tariffs. For district heating companies to be financially viable, tariffs should be set at a level that allows companies to recover costs related to improving the efficiency of operations and maintenance, and fuel and capital costs (including depreciation and financing costs). At the same time, protection of vulnerable customers should continue by targeted social policies.

Moldova faces a significant challenge to comply with the requirement to create strategic stocks of crude and/or petroleum products. As of early 2021, Moldova had limited oil stocks. The country drafted a Law on creating and maintaining a minimum level of oil product stocks in 2017, but its completion and adoption were still pending. There remain significant issues in terms of the appropriate mechanism to meet this legal obligation and the available facilities and compliance costs depending on the approach. This uncertainty and delay will only increase the potential negative impact (e.g. pressure on prices) if reserves are to be increased over a short period of time.

Energy, climate change and environment

As the energy sector is the key emitter of GHGs and of air pollutants, energy policies should be closely coordinated with both climate change and environmental policies. A working group has been established by the MIRD and the Ministry of Environment (ME) to prepare jointly the National Energy and Climate Change Action Plan. Coordination and information exchange between these two ministries should be further enhanced: for example, the energy demand and supply modelling prepared by the MIRD is helpful for

the ME's work on climate change projections, while the forecasts related to impacts of climate change on the Moldovan economy should inform the energy sector development strategies.

The government has created a multi-stakeholder Climate Change Coordination Mechanism to foster dialogue, coordination, collaboration and coherence among sectors. The National Climate Change Commission (NCCC) has been established to ensure cross-sectoral coordination of all climate-related components: adaptation, GHG emissions and mitigation. This is a very positive initiative. Since this Commission – as a formal body with a permanent secretariat and Technical Committees on specific thematic areas – has been established at a high decision-making level, it is ensured to get sufficient policy attention. The Commission was built upon the lessons learned from the operations of the previously established inter-ministerial bodies, such as the Committee on Sustainable Development and the Committee on Green Economy.

Following the adoption of the EU's "Clean Energy for all Europeans" package and the amendments in the relevant directives, Moldova needs to further adjust its legislation to the more ambitious EU framework. This includes preparing an integrated 10-year National Energy and Climate Plan (NECP) outlining how the country intends to meet the energy efficiency, renewable energy and other targets for 2030.

As regards energy efficiency (EE) and renewable energy (RE), Moldova has made commendable progress in adopting a legal and regulatory framework aligned with the relevant EU directives, in compliance with the country's commitments as an Energy Community Party. One praiseworthy example is the nearly complete transposing into national legislation of the EU *acquis* on eco-design and labelling of energy-related products. Moldova still needs to adopt several necessary by-laws to fully transpose the EU *acquis* related to energy efficiency and renewable energy. Most of the missing regulations have already been developed (with the support of the Energy Community Secretariat and other development partners), and the key challenge for the Government of Moldova will be their full implementation and enforcement. It is also important to establish national legally binding energy efficiency and renewable energy targets beyond 2020, which are absent in national legislation as of early 2021. Establishing legally binding targets for a relatively long period of time would give clear signals to market players.

Despite numerous strategies, action plans, programmes and an extensive body of legislation, progress in improving energy efficiency has been limited. Moldova needs to make additional efforts to ensure the effective implementation of energy efficiency strategies, policies and programmes. This can be done through better enforcement of legal and regulatory requirements, enhanced public awareness of energy efficiency benefits and related possible improvements, facilitated access to financing, support for developing an energy service companies (ESCO) market, and further legal and regulatory improvements particularly to facilitate decision-making and enable energy efficiency improvements in condominiums. The government should also consider how it can amend residential energy price subsidies and create additional incentives to provide proper price signals for energy efficiency improvement while avoiding exacerbating inequality and energy poverty.

According to the official methodology (Directive 2009/28/EC), renewable energy accounted for 25.1% of final energy consumption in 2020 compared to the binding 2020 target of a 17% share. However, this is mainly due to the traditional use of biomass for heating, which used to be underestimated until the revision of the data for the period

2010-2016. Moldova has successfully promoted the use of biomass in the heating sector over the last decade with the support of development partners. However, the available biomass – especially wood – is limited and the use of the different sources should be coordinated to be deployed in an efficient and sustainable manner. Adopting a comprehensive approach which would develop a clear strategy on biomass deployment based on a thorough study is therefore recommended. This study would investigate (among other things) best use of agricultural and municipal waste, wood and the option of an increased use of energy crops. The soil degradation resulting from the lack of soil regeneration and from potential depletion should be considered when implementing the strategy on the use of biomass residues. It is important to strive for a sustainable and balanced biomass deployment, thinking about all possible side effects.

According to the Law on the Promotion of the Use of Energy from Renewable Sources, which entered into force in 2018, RE-electricity can be supported by three legal instruments: net metering and feed-in tariffs (FITs) for smaller-scale installations, and auctions for larger plants. The net metering and FiT schemes have already been implemented resulting in growing electricity generation from renewable energy sources (RES). The government is now encouraged to finalise auction implementation details, and conduct initial RES auctions in accordance with best international practices.

The 10% mandatory target for RE in the transport sector is far from being met, as almost no action has taken place in this area. The government is encouraged to develop as soon as possible a clear strategy for the transport sector, supported by legal and regulatory instruments.

Implementation of Moldova's energy policy objectives will require deployment of new energy technologies. Moldova's research, development and demonstration (RD&D) system – with the presence of a strong scientific tradition, a network of industrial research institutes including the Academy of Sciences – provides an opportunity for the country to secure a certain share of the technology value chain, rather than import all of the necessary equipment and technological components. It is encouraging that energy efficiency and renewable energy were identified as one of Moldova's priorities in the EU Smart Specialisation Platform. However, the reduced state funding of research and development over the last several years is of concern. To enhance the relevance of energy technology R&D to the energy policy priorities, it is important to maintain adequate funding and to improve the cooperation of research institutions and scientists with public authorities. This can be done, for example, by establishing a joint scientific and technical council for setting up specific tasks on energy RD&D with subsequent project financing of the necessary developments.

The vulnerabilities of the energy sector to climate change, as well as related challenges and opportunities are recognised in the Moldovan official documents submitted to the UNFCCC. It is encouraging that the government is planning to update the Climate Change Adaptation Strategy that was approved in 2014. Further efforts could be made to ensure that the energy policy integrates the possible impacts of climate change on the development of energy supply and demand trends, such as increased summer demand due to air conditioning, possible decrease of biomass use and increase in solar and wind energy.

The government has also made substantial reforms in the area of environmental protection, which can influence energy sector operations. Following the adoption in 2014

of the Environmental Strategy for the years 2014-2023, institutional reforms have been implemented and several new laws and regulations have been enacted related to Environmental Impact Assessments and air quality, among other areas. More efforts could be given to the integration of environmental policies into sectoral policies, such as energy and transport.

Improving energy data use

The 2015 IEA review encouraged the Republic of Moldova to "continue to develop improved energy statistics and the collection of accurate data relative to consumption, renewable energy production and energy efficiency indicators." Since then, energy data collection has expanded to cover new relevant topics for data users. In parallel, public access to user-friendly energy information has improved.

The NBS is commended for its efforts to share energy statistics in a timely manner with international organisations, to present Moldova's energy balance in accordance with international standards and to translate international best practices into national documentation.

Moldova has started to develop energy efficiency indicators to track progress towards its energy policy goals. The relevant stakeholders are encouraged to continue cooperation to produce an expanded set of such indicators for all consuming sectors (residential, industry, services and transport) in order to monitor the impact of the EE actions taken by the Government To contribute to the work of other public entities and gain public support for energy efficiency measures, the data and analysis on energy efficiency should be communicated to the public.

Continued development of digital reporting is another praiseworthy accomplishment, which is expected to reduce the burden on respondents and simplify data exchange between public and private institutes.

Recommendations

The Government of Moldova should:

- Enhance the institutional capacity and the staffing of the state bodies responsible for energy policy development and implementation and improve coordination and cooperation between them.
- Further improve energy security through regional cooperation, regional market integration, diversification of routes/sources of supply in gas and electricity sectors and continue providing suitable conditions for developing local energy infrastructure and increasing energy efficiency.
- In updating energy strategy and setting up specific targets, enhance institutional capacity in energy data collection, modelling and forecasting, resource assessment, and system integration of renewable energy to allow informed decision-making.
- Continue the efforts – in cooperation with the energy regulator – to develop free, liberalised, competitive energy markets:

- Accelerate the implementation of the legislation and regulations to transpose the provisions of the Third Energy Package.
- Ensure transparent and fair market rules and minimise state interference in the market operations.

- Strengthen the independence, transparency and accountability of the Regulator (ANRE) to make sure it can adopt regulatory practices and methodologies that enable the much-needed private sector investments in the energy sector infrastructure without putting additional pressure on the state budget.
- Make sure that vulnerable energy customers are protected by efficient targeted social protection measures.
- Enhance the relationship between the energy policies and climate change, environmental and RD&D policies, and strengthen cooperation between the public and private stakeholders, civil society and academia, including through effective permanent working groups and policy dialogue.
- Reinforce the public-private dialogue on energy policy matters and develop a communication strategy for sector stakeholders and population on energy strategy and challenges for/ benefits of the ongoing reforms.
- Further develop national energy statistics to improve the data quality and to inform policy decisions:
  - Ensure that the development of the unified electronic data reporting portal objectively reduces the burden on respondents, respects the confidentiality of the data and allows for amending the forms based on current needs. Transferring the responsibility of the active portal to the National Bureau of Statistics (NBS) would allow for independent amendments and compliance with the principle of confidentiality.
  - Liaise with the EEA and NBS to ensure that appropriate data are available for energy planning and for the development of energy efficiency indicators (e.g. gross value added by manufacturing subsector, building stock and transport activity data).

References

Eurostat (2020), Shares (Renewables), https://ec.europa.eu/eurostat/web/energy/data/shares (accessed 30 May 2022)

IEA (2015), *Energy Policies Beyond IEA Countries: Caspian and Black Sea Regions*, International Energy Agency, Paris, https://www.iea.org/reports/energy-policies-beyond-iea-countries-eastern-europe-caucasus-and-central-asia-2015

RoM (Republic of Moldova) (2021), Official website of the Republic of Moldova, https://moldova.md/en (accessed14 May 2021).

2. General energy policy

Key data

(2020 provisional)

TES: 2.75 Mtoe (oil 34.1%, natural gas 28.1%, bioenergy 24.0%, electricity imports* 10.7%, coal 2.8%, wind 0.2%, hydro 0.1%, solar 0.01%), +9.5% since 2010

TES per capita: 1.00 toe/cap (World average 2019: 1.9 toe/cap)

TES per unit of GDP: 95 toe/USD million PPP (World average 2019: 114 toe/USD million PPP)

Energy production: :0.68 Mtoe (bioenergy 97.9%, oil 0.8%, wind 0.6%, hydro 0.6%, solar 0.1%, natural gas <0.01%), +30.3% since 2010

TFC: 2.61 Mtoe (oil 35.8%, bioenergy 24.6%, natural gas 16.9%, electricity 12.6%, district heat 7.3%, coal 3.0%), +13.8% since 2010

Exchange rate:100 Moldovan lei (MDL) = 5.77 USD; 5.06 EUR (2020)

* Includes electricity procured from MGRES.

Country overview

The Republic of Moldova (Moldova), situated in Eastern Europe neighbouring the north-eastern Balkans, had a usual resident population of 2.62 million people in 2020, a gross domestic product (GDP) of current [2020] USD 11.9 billion and a GDP per capita of current [2020] USD 4 547 (World Bank, 2021). The country covers 33 844 square kilometres (km^2) and is bordered by Ukraine on the north, east and south, while the Prut River on the west defines the boundary with Romania (Figure 2.1).

Moldova's capital is Chisinau, and its territory is organised administratively into 32 districts (made up of cities and villages), five municipalities (Chisinau, Balti, Tighina, Tiraspol, Comrat) and two regions with a special status. The breakaway region of Transnistria, a strip of land between the Dniester River and the eastern Moldovan border with Ukraine, is not recognised by United Nations (UN) states. The Moldovan government considers Transnistria to be a territorial administrative unit with a special status: part of the Republic of Moldova, but not controlled by its government (RoM, 2021). In this publication, the statistical data related to the energy sector refer to the Republic of Moldova without Transnistria.

Being one of the poorest countries in Europe, Moldova has made noteworthy achievements in reducing poverty and promoting inclusive growth since the early 2000s.

Over the past 20 years, Moldova's economy has grown at an annual average rate of 4.6%, driven by consumption and fuelled by remittances, which account for 10% of GDP, according to the World Bank. The impressive reduction in poverty from 28% in 2010 to 13% by 2018, however, stalled in 2019 and deteriorated further in 2020 following the COVID-19 pandemic.

The policy agendas of successive governments have been driven by aspirations for closer integration with Europe; many positive reforms have been initiated but face implementation challenges. Moldova's biggest economic challenges, according to the World Bank, include: the vulnerable political system, a polarised society, low productivity, demographic issues (large-scale emigration and low fertility rates), skills mismatches and a high vulnerability to climate-related events and external shocks (World Bank, 2021).

Figure 2.1 Map of Moldova

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Energy supply and demand

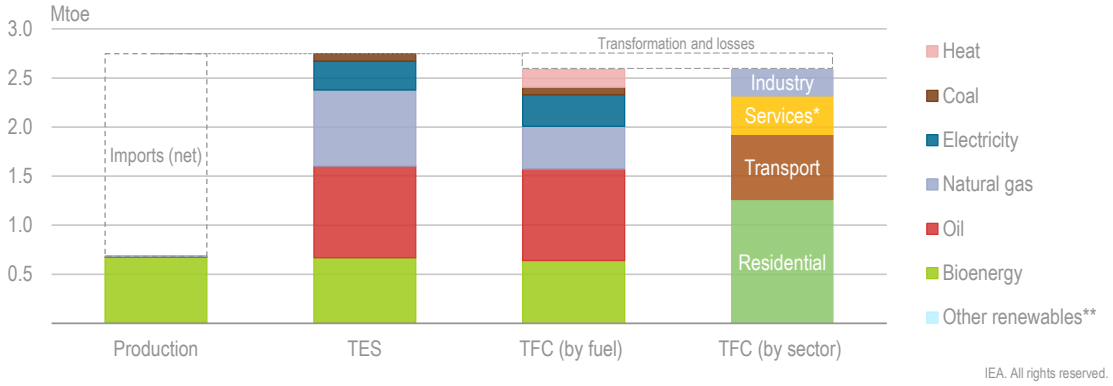
Being a country with no notable hydrocarbon reserves, domestic energy production is limited mostly to bioenergy, hydropower and variable renewables. As a result, Moldova's energy supply is dominated by imports (Figure 2.2) accounting for around 75% of the energy consumed in the country.

Oil, gas and bioenergy are the largest energy sources in total energy supply (TES)[1] and total final consumption (TFC). The energy transformation sector (most importantly electricity generation) is modest in Moldova. This explains the relatively small difference between TES and TFC. Virtually all fossil fuels consumed in the country – coal, oil products and natural gas – must be imported. Also, most of electricity is not generated locally.

TFC has grown 14% since 2010. The residential sector is the largest final consuming sector, responsible for half of the TFC. Households consume mostly solid biofuels for their needs (around 50% of total sectoral consumption in 2020).

The transport sector is the second-largest end use sector with a share of around 25%. While the data across different sectors prior to 2010 should be treated with care (as explained in Box 2.1), they suggest that the transport sector consumption has more than doubled since 2000. Consumption consists predominantly of oil products (98% of sectoral total in 2020). The service sector share hovers around 10% of the TFC. The industry sector is small in Moldova, consuming only 11% of the final energy.

Figure 2.2 Overview of the Moldovan energy system by fuel and sector, 2020



Moldova's energy production is notably lower than its energy consumption (primary and final), hence the country is a net importer of energy.

* Includes commercial and public services, agriculture, forestry and unspecified consumption.

** includes hydro, wind and solar PV; not visible at this scale.

Notes: Bunker fuels of around 0.02 Mtoe are not included in TES. Mtoe = million tonnes of oil equivalent.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

[1] TES corresponds to the total supply of energy in the country (production + imports – exports – international marine and aviation bunkers ± stock changes). This equals the energy that is consumed domestically, either in transformation (e.g. power generation and refining) or in final use. In contrast, total final consumption (TFC) corresponds to only the energy consumed by end-use sectors.

Bioenergy – mostly in the form of solid biofuels – is an important internal energy source in the country. The household energy consumption survey conducted in 2015-2016 revealed that the previously available data had grossly underestimated the use of biofuels (NBS, 2016). Box 2.1 explains how this survey affected the energy data time series, along with other particularities related to Moldova's energy data collected and reported by the IEA.

Box 2.1 Particularities of Moldova's Energy Data

The IEA collects energy statistics on supply and demand from national statistical offices worldwide to form a complete picture of regional and global energy trends. The National Bureau of Statistics (NBS) of the Republic of Moldova cooperates with the IEA and strives to provide accurate and timely energy statistics to the IEA.

The data for the Republic of Moldova in the *World Energy Statistics and Balances* database (IEA, 2022) include the IEA secretariat's estimates for Transnistria. For the purposes of this study these estimates are excluded. Electricity procured from the Moldavskaya GRES (or MGRES) power station situated in Transnistria is treated statistically as imports.

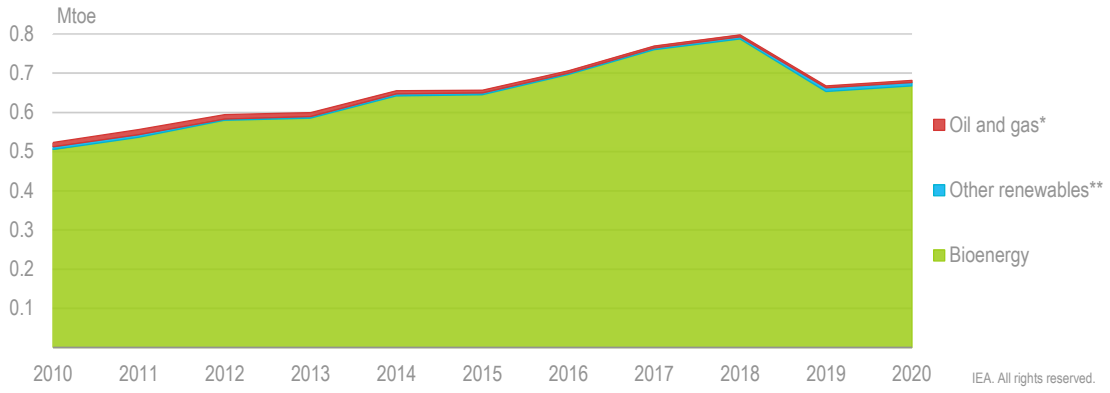
The household energy consumption survey conducted by the NBS from April 2015 to April 2016 revealed that the previously estimated biomass consumption by households was off by a factor of ten. This results in notable breaks in the time series which renders any trend analysis inaccurate if the data for the years prior to 2010 is used. Therefore, energy supply and consumption data in this report are displayed starting from year 2010.

Sources: IEA, 2022; NBS, 2016.

Energy production and self-sufficiency

Moldova's dependence on imports is clearly visible when domestic energy production is analysed. The only notable local energy source is bioenergy, accounting for 98% of domestic production (Figure 2.3). It consists mostly of solid biofuels, but biogas is also produced and used in electricity generation. The country produces small quantities of oil and gas. Solar and wind energy have started to be used but are yet to reach their potential. Overall energy self-sufficiency is around 25%.

Figure 2.3 Primary energy production by source, 2010-2020



Bioenergy is the only notable domestic energy source.

* Not visible at this scale.

** Includes hydro, wind and solar.

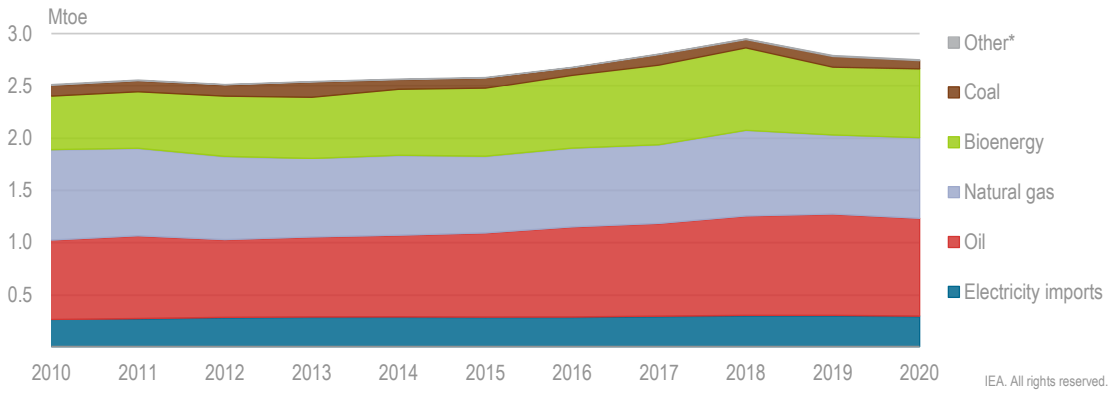
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Total energy supply

In 2020, the TES stood at 2.7 Mtoe. Oil, natural gas and bioenergy had fairly similar shares in the TES, amounting together to almost 90%. In 2020, oil accounted for 34% of TES, natural gas for 28% and bioenergy for 24%. Electricity imports[2] accounted for over 10% of the TES, a share that is among the highest in the world.

The share of fossil fuels decreased slightly from around 70% in 2010 to 65% in 2020. Renewable electricity generation is expected to increase in the future. By international comparison, Moldova's share of fossil fuels is well below the world average (65% vs. 81% of the TES in 2019 (Figure 2.4 and 2.5).

Figure 2.4 Total energy supply by source, 2010-2020



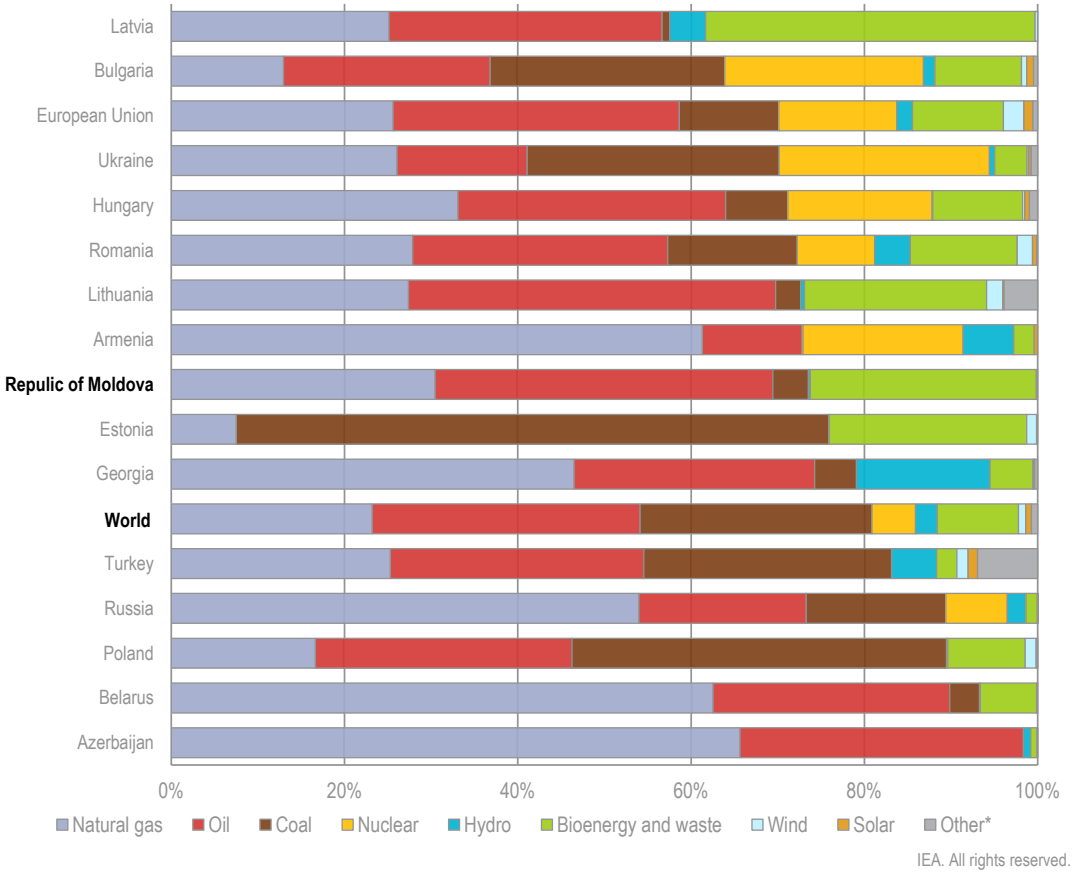
Moldova's TES increased almost 10% from 2010 to 2020.

* Includes hydro, wind and solar; not visible on this scale.

Source: IEA (2022). *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

[2] Including electricity procured from the Moldavskaya GRES power station in Transnistria.

Figure 2.5 Breakdown of TES in selected countries, 2019



Fossil fuels make up two-thirds of Moldova's TES.

* Includes geothermal and primary heat.

Note: Electricity trade not included.

Source: IEA (2022). *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Energy consumption

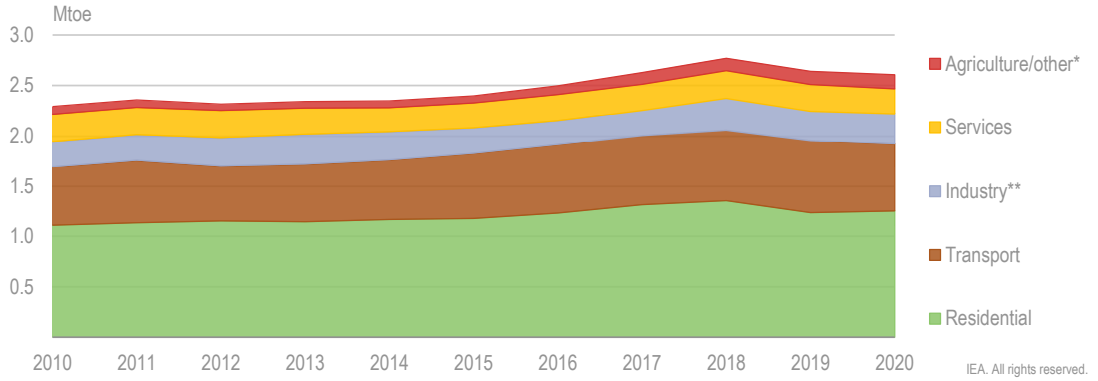
Moldova's TFC has grown modestly during the period for which comparable data are available and stood at 2.6 Mtoe in 2020 (+14% since 2010).

The residential sector is the largest consumer of energy (48% of TFC in 2020), and consumption varies with the outdoor temperature as heating accounts for the highest share in the sectoral energy demand (Figure 2.6). The transport sector accounted for 26% of the TFC in 2020. The consumption, mostly in the form of oil products, showed the strongest relative growth between 2010-2019, but fell notably in 2020 likely due to the Covid-19 pandemic.

Fossil fuels account for 56% of TFC in 2020 (Figure 2.7). Oil is the largest energy source with a 36% share in 2020. It dominates transport sector's energy consumption, but is also notably consumed by industries, service sectors and agriculture. Bioenergy is the second largest energy source (25%), and is used mostly in the residential sector.

Natural gas, electricity, district heat and coal cover the remaining 40% of the TFC. With the exception of the transport sector, they are consumed across all sectors of the economy. Currently the share of electricity in transport is low – below 1%.

Figure 2.6 Total final consumption by sector, 2010-2020



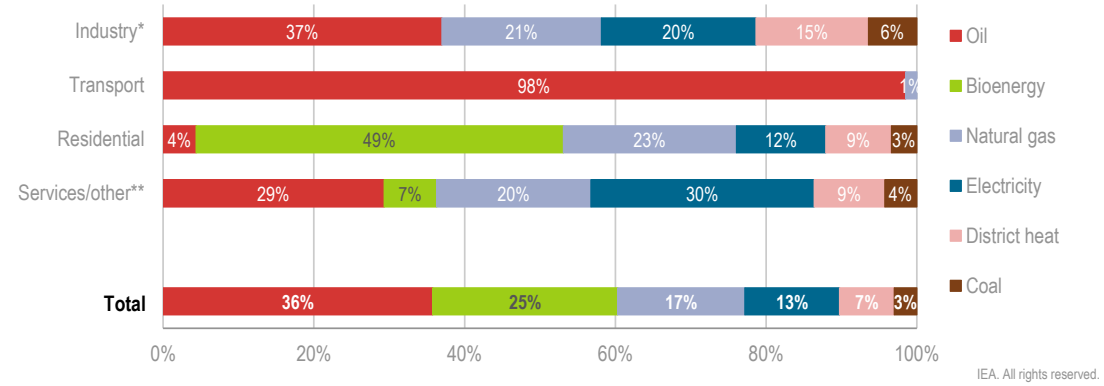
The household energy consumption survey in 2017 revealed that the residential sector is by far the largest energy consuming sector in the country.

** Includes agriculture and forestry and unspecified consumption.

** Includes non-energy consumption.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Figure 2.7 Total final consumption by source and sector, 2020



Oil and bioenergy cover 60% of Moldova's TFC.

* includes non-energy consumption.

** includes commercial and public services, agriculture and forestry, and unspecified consumption.

Note: For ease of readability, shares of less than 1% are not shown.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Energy sector governance

The Government of Moldova (GoM)'s responsibilities are split across various ministries and agencies, but it has a collective role in establishing the main priorities and objectives of the state policy in the energy sector. The government's mandate also includes approval of regulations that establish the energy sector foundations, including the security of supply

principles and well as mechanisms, support schemes and incentives that drive energy efficiency improvements and deployment of renewable energy sources.

The Ministry of Infrastructure and Regional Development (former Ministry of Economy and Infrastructure, MEI) (MIDR) is the central public authority responsible for the energy sector. The responsibilities of MIDR include elaboration and promotion of state policies, strategies, concepts and programmes, as well as legal documents in the energy sector; monitoring the implementation of state development and investment programmes; development of international energy relations, including acquisition of strategic energy resources, attracting investments, development of energy interconnections, and development of the energy market; management of state energy property; and supporting competition in the energy sector (GoM, 2017a).

The National Bureau of Statistics of Moldova (NBS) is the entity mandated to collect, process and distribute official energy statistics in Moldova, and three statisticians are dedicated part-time to this task. The main source of data is the energy survey (form 1-BE), and complementary data are drawn from various administrative sources, for example from ANRE on wind energy and solar photovoltaic (PV) electricity generation.

The National Energy Regulatory Agency (ANRE), established in 1997, is the state regulator for the energy sector in Moldova. Its main responsibilities include licensing, price/tariff setting, regulation and monitoring of the electricity, heating, gas and oil products markets, as well as consumer protection. ANRE promotes and ensures fair competition and efficient operation of energy markets, and contributes to energy security by approving and monitoring investment plans of system operators and by setting standards and requirements for distribution and transmission services and supply activities.

The Energy Law No.174/2017 gave more independence and powers to ANRE in compliance with the EU's Third Energy Package legislation (Sandulescu, 2020). By law, ANRE was set up as an institution legally distinct and functionally independent from any other public entity, and financed through extra-budgetary sources. ANRE is governed by five directors selected through a competitive process (with clear requirements for directors to ensure their competence and independence) and nominated by the Parliament for six years. The law also enhanced transparency of the regulatory process. However, it is reported that in practice ANRE is exposed to pressures, which challenge its independence (EnC, 2020).

The Energy Efficiency Agency (EEA) is the administrative authority with the mandate to support the implementation of policies in the areas of energy efficiency (EE) and renewable energy sources (RES), and to attract and allocate resources for financing specific EE and RES projects. It is a separate legal entity subordinated to the Ministry of Infrastructure and Regional Development. The EEA has existed since 2010 but was restructured by government decision in 2019 when it was absorbed by the former Energy Efficiency Fund (GoM, 2019a). The restructured EEA has a division responsible for implementation and monitoring of EE and RES policies and another division responsible for financing, implementation and monitoring of EE and RES projects – the mission that was formerly performed by the Energy Efficiency Fund. In addition, the Agency disseminates information on EE and RES, and contributes to the elaboration of local energy efficiency programmes, and plans and monitors their achievements (EEA, 2020).

The Competition Council – which succeeded the National Agency for Protection of Competition (2007-2012) – is an autonomous authority, subordinated to the Parliament. The Council ensures the enforcement and observance of legislation in the domains of competition, state aid and advertising, including in the energy sector. Its mandate is to ensure compliance with competition legislation by preventing anticompetitive practices, removing of competition infringements, and by promoting and improving the competition culture.

The Moldovan Investment Agency is a cooperation partner for domestic and foreign investors in development projects, including energy sector projects.

The Ministry of Finance is the central public administration body to develop and promote the state's public finance policy and to supervise public finances. The Ministry of Finance ensures the implementation of Public Finance Management policies and signs sovereign loans and guarantees for energy sector projects on behalf of Moldova's government.

The Ministry of Environment (ME) (GoM, 2017b) is responsible for developing environmental and natural resource management policies and strategies, as well as for implementing international environment treaties. It cooperates with MIRD and other institutions for the preparation of the National Energy and Climate Plan (NECP).

Energy policy directions

Key policy drivers

Moldova's energy policy is driven by several interrelated drivers including energy security and the high dependence on imports from limited sources, the obligations stemming from Moldova's aspirations for European integration and Moldova's international and internal commitments in the areas of climate change mitigation and environmental protection.

In 2010, the Republic of Moldova became a member of the Energy Community and in 2014, it signed an Association Agreement with the European Union. This implies a commitment to transpose the core EU *acquis communautaire* into national legislation. Box 2.2 lists key EU directives and regulations related to energy security, electricity, natural gas, energy efficiency, renewable energy and energy statistics that Moldova needs to transpose.

Box 2.2 EU Energy Sector *Acquis* Applicable to Energy Community Contracting Parties

By adopting the Energy Community Treaty, and like other Contracting Parties, Moldova has made legally binding commitments to adopt the core EU energy legislation included in the *acquis communautaire*. The *acquis* evolves constantly to reflect new challenges and priorities; therefore Articles 24 and 25 of the Treaty allow the adaptation of the *acquis* and implementation of possible amendments to enable Energy Community Contracting Parties to keep pace with EU legal developments. The EU key directives and regulations that Moldova needs to comply with include but are not limited to the following:

Electricity market

- Directive 2009/72/EC introduces common rules for the generation, transmission, distribution and supply of electricity, lays down universal service obligations and consumer rights, and clarifies competition requirements.
- Regulation 714/2009 sets rules for cross-border exchanges in electricity, thus enhancing competition within the internal market in electricity.

Natural gas market

- Directive 2009/73 /EC introduces common rules for the transmission, distribution, supply and storage of natural gas, liquefied natural gas (LNG), biogas and gas from biomass. It aims at unbundling energy production and supply from the network operation to eliminate possible conflict of interests between these activities.
- Directive 715/2009 lays down rules for natural gas transmission networks, gas storage and LNG facilities as in terms of access to infrastructure.

Security of supply

- Directive 2005/89/EC establishes measures aimed at safeguarding the security of electricity supply so as to ensure the proper functioning of the EU internal market for electricity, an adequate level of interconnection between Contracting Parties and an adequate level of generation capacity and balance between supply and demand.
- Directive 2004/67/EC establishes a common framework within which Contracting Parties can define general security-of-supply policies that are transparent, solidarity-based, non-discriminatory and consistent with the requirements of a single market in gas.
- Directive 2009/119/EC imposes an obligation on member states to maintain minimum stocks of crude oil or petroleum products

Energy efficiency and renewable energy

- Directive 2009/28/EC determines the Contracting Parties' binding national targets which are to be achieved through the use of renewable energy in the electricity, heating and cooling, and transport sectors by 2020.
- Directive 2012/27/EU on energy efficiency introduces binding energy efficiency targets and requirements to use energy more efficiently at all stages of the energy chain, from production to final consumption.
- Directive 2010/31/EU, known as the Energy Performance of Buildings Directive (EPBD), provides the legal framework for setting minimum energy performance requirements for new and existing buildings.

- Regulation (EU) 2017/1369 on energy labelling (replacing Directive 2010/30/EU) lays down a framework that applies to energy-related products placed on the market or put into service.

Climate change and environment

- Clean Energy for all Europeans Package.
- General Policy Guidelines (adopted in November 2018) on the 2030 targets for the Contracting Parties of the Energy Community.
- Recommendation 2018/01/MC-EnC on preparing integrated National Energy and Climate Plans (NECPs) by the Energy Community Contracting Parties (not legally binding).
- Directive 2001/80/EC on limiting emissions of certain pollutants into the air from large combustion plants.
- Directive (EU) 2016/802 of 11 May 2016 relating to a reduction in the sulphur content of certain liquid fuels.

Energy statistics

- Regulation (EC) 1099/2008 establishes a common framework for the production, transmission, evaluation and dissemination of comparable energy statistics in the Community.
- Regulation (EU) 2016/1952 of 26 October 2016 on European statistics on natural gas and electricity prices and repealing Directive 2008/92/EC.

Source: EnC 2021.

Regional energy cooperation with the European Union and with the Caspian and Black Sea countries “follows the framework of the Baku Initiative, which aims to facilitate the progressive integration of the region’s energy markets into the EU market, as well as the transportation of substantial quantities of Caspian oil and gas through to Europe. Moldova also participates in the Eastern Partnership, a joint initiative involving the European Union, its member states and the post-Soviet states of Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine; it provides a venue for discussions on trade, economic strategy and travel agreements, as well as an energy security platform. In addition, the European Neighbourhood Policy promotes bilateral cooperation between the European Union and Moldova in line with the Partnership and Co-operation Agreement, which includes energy co-operation” (IEA, 2018).

In 2016, Moldova signed the Paris Agreement on climate change and ratified the agreement in June 2017. In its Intended Nationally Determined Contribution (INDC) document, Moldova set an unconditional target of reducing national GHG emissions to 64-67% below the 1990 level by 2030. In March 2020, Moldova submitted its revised Nationally Determined Contribution (NDC) to the UNFCCC, increasing its ambition by committing to unconditionally reduce GHG emissions by 70% below its 1990 level by 2030 and by up to 88% if it receives technical, financial and technological support from the international community.

Strategic objectives

In 2013, Moldova adopted its National Energy Strategy (NES) for 2030. The NES, which is currently under revision, sets three main objectives:

1. Ensuring the security of energy supply;
2. Developing competitive markets and their regional and European integration; and
3. Ensuring sustainability of the energy sector and climate change mitigation.

The NES and several other strategic documents – such as the Low Emissions Development Strategy until 2030, the Environment Strategy for 2014-2023, the national energy efficiency and renewable energy Action Plans – set the key energy and climate targets to 2020 (summarised in Table 2.1). As an Energy Community party, Moldova will need to adopt new targets to 2030: a target for energy efficiency, a target for the contribution of renewable energy sources and a GHG emissions reduction target. These targets should be in line with the EU targets for 2030, represent an equal ambition for the Contracting Parties and take into account relevant socio-economic differences, technological developments and the Paris Agreement on Climate Change (EnC, 2021).

Table 2.1 Targets Set by Various Strategic Documents of the Republic of Moldova

№t	Objectives	Strategy Moldova -2020	Environment Strategy 2014-2023	Energy Strategy to 2030	National EE Programme 2011-2020	National Renewable Energy Action Plan 2013-2020	Low Emission Development Strategy until 2030
1.	Reduction of final energy consumption in all sectors of the national economy (compared to 2009)			9% by 2016, 20% by 2020	20% by 2020		
2.	Reduction of energy intensity	10% by 2020		10% by2020			
3.	Reduction of losses in T&D* electricity networks	13% by 2015, 11% by 2020		13% by 2015, 11% by 2020	7-10%, by 5-8% per year		
4.	Reduction of losses in natural gas T&D networks			20% by 2015, 39% by 2020			
5.	Reduction of losses in district heating networks			2% by 2015, 5% by 2020			
6.	Reducing energy consumption in construction	10% by 2020		10% by 2020			
7.	Share of energy from RES	10% by-2015, 20% by 2020	20% by2020	10% by 2015, 20% by 2020	20% by 2020	20% by 2020, 17% according	

№t	Objectives	Strategy Moldova -2020	Environment Strategy 2014-2023	Energy Strategy to 2030	National EE Programme 2011-2020	National Renewable Energy Action Plan 2013-2020	Low Emission Development Strategy until 2030
						to primary legislation	
8.	RES share in electricity	10% by 2020		10% by 2020		10% by 2020	
9.	RES share in transport		10% by 2020	4% by 2015, 10% by 2020	10% by 2020	10% by 2020	
10.	Share of renewed public buildings			10% by 2020			
11.	Reducing greenhouse gas emissions (1990)	25% by 2020	At least 20% by 2020	25% by 2020	At least 25% by 2020		At least 64% by 2030

* T&D: transmission and distribution.

Source: GoM (2019b). National Action Plan in the Area of Energy Efficiency for 2019-2021 (NEEAP).

Moldova has transposed the EU Third Energy Package in the primary legislation through Electricity Law 107/2016, Natural Gas Law 108/2016 and Energy Law 174/2017, which permit Third Party Access to networks and legalise market opening in both the electricity and gas markets.

One key direction of Moldova's energy policy is expanding interconnections in both electricity and natural gas sectors (Sandulescu, 2020). This is expected to achieve several policy objectives:

- increasing the security of supply by diversifying the energy supply sources and routes
- facilitating the development of competitive electricity and gas markets at the national level, and obtaining the best prices for consumers through enhanced wholesale competition
- creating the possibility of integrating the national electricity and gas markets into the EU internal energy market, and synchronising Moldova's electricity and natural gas networks with the European ones: the European Network of Transmission System Operators for Electricity (ENTSO-E) and Gas (ENTSO-G) (see Chapters 3 and 5).

Promotion of renewable energy sources through several mechanisms including auctions and improved energy efficiency are also expected to contribute to several policy objectives including energy security and sustainable development (see Chapters 8 and 9). In the oil sector, the government's objectives include enhancing of competition and the creation of strategic oil stocks (Chapter 4).

Energy statistics

Collection, validation and the dissemination of official energy statistics are the responsibility of the National Bureau of Statistics of the Republic of Moldova (NBS). Energy statistics in Moldova are in the public domain. An official national energy statistics

consulting group was formed through a cabinet decree in 2014 providing a platform for dialogue and information sharing between the NBS and the main data users. After the restructuring of the public authorities in 2017, the number of stakeholders has dropped.

Since 2010, the energy balance of the Republic of Moldova is presented in accordance with international standards (IEA, UN, Eurostat). The data are also shared in a timely manner with these international organisations. To improve the consumption data of the energy balance, the first household energy consumption survey was carried out in 2015-2016. The biomass consumption data were found to have been heavily underestimated. The next survey is planned for 2022, and the results are expected to reveal developments especially in rural household energy consumption.

As explained in Box 2.1, national official energy data and this in-depth review do not include districts from the left side of the Dniester river and the municipality of Bender (known as Transnistria). Electricity procured from the Moldavskaya GRES power station is reported under “from other sources”. The IEA statistical publications include estimates for the Transnistria area in Moldova energy data, therefore differences are observed between the IEA statistics and the official NBS energy data.

As a contracting party of the Energy Community since 2010, Moldova has had to conform to the relevant statistical regulations of the European Commission. To fulfil these obligations, the NBS submits annual energy questionnaires to Eurostat and to the International Energy Agency covering coal, electricity and heat, renewables, oil and natural gas. NBS collects monthly oil, gas, coal and electricity data and provides it to Eurostat and the Joint Organisations Data Initiative (JODI). Since 2018, semi-annual data on electricity and gas prices have been collected by the NBS.

The compilation of energy efficiency indicators is the responsibility of the EEA. The NBS provides data on energy consumption and liaises with the EEA to ensure coherence of other necessary input data. As of 2019, some indicators are available for the industrial and residential sectors, but the public authorities have expressed a clear need for an expanded set of energy efficiency indicators. If additional resources are available, it will be possible to cover additional sectors (e.g. transport and services) as well as increase the level of data disaggregation.

Main national users of the energy data include the Ministry of Infrastructure and Regional Development (MIDR) (responsible for the energy sector) and the Ministry of Environment (ME) (responsible for climate change-related activities and reporting to UNFCCC). The energy module of the national greenhouse gas inventory is mostly based on the official energy balance.

A data portal for unified electronic reporting is under development by the Ministry of Finance. The objective of the platform is to include all statistical and tax reporting forms to provide a user-friendly data entry point for the respondents. A harmonised electronic reporting system will enable the public authorities to shift from analogue to electronic data collection and analysis, which in turn will reduce the processing time and improve the data quality. Data in digital format is also expected to help in tailoring electronic data dissemination means to the users.

Currently the forms applied in national energy data collection are not implemented in the data portal. At the same time, there is no simple procedure for the NBS to amend the existing forms or add new ones. Furthermore, while a unified electronic reporting

mechanism is welcomed, the data confidentiality of the respondents should be respected. Free access to the statistical part of the developer portal and possibly other government bodies raises the question of abiding by the principle of confidentiality of data received from enterprises.

The draft legislation on oil stock-holding obligations is in preparation (see Chapter 4). The basis for the stock level calculation is done by ANRE based on data provided by the oil market operators instead of the NBS. At the time of drafting this report, it was unclear which entity will be responsible for monitoring the oil product stocks.

Assessment

Since the last IEA review of Moldova's energy policies (IEA, 2015), the Republic has made significant progress towards meeting the three key objectives, as mentioned above (Strategic Objectives section, p. 22) of the National Energy Strategy until 2030: 1) ensuring the security of energy supply; 2) developing competitive markets and their regional and European integration; and 3) ensuring sustainability of the energy sector and climate change mitigation.

In 2010, the Republic of Moldova became a full-fledged member of the Energy Community, which implies a commitment to transpose core EU energy legislation included therein. Since then, governmental efforts have been focused on aligning the national legal framework for energy with that of the EU. Moldova has successfully adopted several legislative acts which transpose the Third Energy Package at the level of primary legislation. Moldova is also on the right path to developing a sound institutional structure in the energy sector, informed by better statistical data. Efforts have also been made to adjust national legislation in the field of renewable energy and energy efficiency and to enhance regional cooperation.

Despite the progress in developing a strong legal framework, the Moldovan energy sector still faces major challenges which need to be addressed in a timely manner in order to improve energy security, accelerate the transition towards a more sustainable, clean and efficient energy system and support the development of free and competitive energy markets.

Implementation: an institutional challenge

As a matter of priority, the adoption of sound primary legislation should be followed by the adoption and effective implementation of secondary legislation and regulations. This process is hindered primarily by the lack of human and institutional capacity in the state institutions responsible for energy policy implementation. The number of staff seems insufficient to fulfil all the assigned responsibilities in a timely manner, and the salaries are reported to be too low to attract qualified specialists. In addition, insufficient coordination among the government institutions – and between the state bodies and other stakeholders – puts further stress on the limited human resources.

To facilitate and accelerate the implementation of the ongoing energy reforms, the government should ensure that the energy department of the Ministry of Infrastructure and Regional Development (MIDR), the Energy Efficiency Agency (EEA) and other key

institutions have sufficient capacities to fulfil the energy policy objectives. In addition, cooperation should be enhanced among the government agencies.

Proper communication and coordination between the public and private sectors are of vital importance in developing fair, optimal, simple and mutually agreed energy markets and an enabling environment. It is therefore necessary to develop a communication strategy to explain to energy stakeholders and the general population the key benefits and challenges associated with the ongoing reforms. The private sector and civil society should be involved in the development of the legal and regulatory framework, for example through the creation of working groups reporting to the highest levels of government and supported, where possible, by the donor/IFI community.

Since the energy regulator has a significant role in the further development of the energy sector in general, the independence, competence and accountability of the ANRE are crucial. It is therefore very important to ensure that the regulator can perform its functions without political pressure to effectively balance the needs to protect the end users, and attract investment to and ensure the financial sustainability of the energy sector. At the same time, the most vulnerable consumers should be supported by the targeted social protection measures.

Development of free, liberalised, competitive markets

Moldova will derive numerous benefits from the development of free, liberalised and competitive markets for electricity, gas and oil products: they would stimulate investments in generation facilities and infrastructure, provide reassurance to investors, suppliers, traders and consumers, contribute to overall increased energy security and decrease upward pressure on energy prices in the long run. To create such markets, the government and ANRE should accelerate the pace of implementing the legal and regulatory provisions in line with the Third Energy Package.

In line with the Package, it is necessary to finalise the unbundling and development of independent market operators in the electricity sector; ensure transparent and fair market rules; and minimise state interference in trading. With respect to electricity, providing access to neighbouring and regional markets, regional traders and suppliers will stimulate liquidity on the Moldovan market. It will be necessary to develop spot markets in order to allow market coupling with Romanian and Ukrainian Day-Ahead/Intra-day Markets. The development of balancing markets will create a favourable environment for the optimal operation of the energy system.

Over several years, Moldova has successfully removed cross subsidisation of electricity and gas tariffs for households although this has been politically difficult. It has also introduced targeted support schemes for the most vulnerable consumers. The Regulator and the government should be praised for this major achievement. There is still room for further improvements and potential for innovative approaches to the distribution of benefits within the energy taxation system and for phasing out tax distortions.

Energy security, regional market integration and diversification

Moldova is highly dependent on imports for most of its energy supplies – about 75% of energy demand is covered through the imports of electricity, gas and oil products. The sources of electricity and gas imports are not diversified and crucially depend on gas supply from Russia and from the Moldavskaya GRES which operates beyond the control of the Moldovan government. The development of alternative routes and sources of energy supply as well as own generation is of vital importance. Absence of alternatives gives the monopolistic supplier potential to leverage strong economic/political pressure, which may be used to limit new entrants into the market.

The security of supply can be enhanced through diversification of routes/sources of supply in the gas and electricity sectors, development of local energy production, development of cross border/regional infrastructure and harmonisation of cross-border trading rules and regulations with Romania and Ukraine, with further integration and market coupling goals for the short/long term future. Moldova's integration in the regional market and diversification process will make relations with the left bank (Transnistria) more sustainable and mutually beneficial.

Improving energy data use

The 2015 IEA review encouraged the Republic of Moldova to "continue to develop improved energy statistics and the collection of accurate data relative to consumption, renewable energy production and energy efficiency indicators. Statistics should comply with international standards and provide a comprehensive energy database that would allow for systematic monitoring and for increasing transparency to the industry and potential investors". Since then, energy data collection has expanded to cover new relevant topics for data users. In parallel, public access to user-friendly energy information has improved.

The NBS is commended for its efforts to share energy statistics in a timely manner with the relevant international organisations (IEA, UN, Eurostat), present Moldova's energy balance in accordance with international standards and to translate international best practices and guidelines into national documentation and metadata.

The development of some energy efficiency indicators for the industry and residential sectors is a positive step for achieving Moldova's energy policy goals. However, there is a clear need for an expanded set of energy efficiency indicators for all consuming sectors (residential, industry, services, transport) in order to monitor the impact of the EE actions taken by the Government. To support the energy efficiency policies, the relevant stakeholders (EEA, NBS and MIDR) should coordinate even more closely and compile a list of the missing key indicators and an action plan to fill in the data gaps. To contribute to the work of other public entities and gain public support for energy efficiency measures, the data on and analysis of energy efficiency should be made publicly available.

Continued development of digital reporting is another praiseworthy accomplishment, which is expected to reduce the burden on respondents and simplify data exchange between public and private institutes.

Recommendations

The Government of Moldova should:

- Enhance the institutional capacity and the staffing of the state bodies responsible for energy policy development and implementation and improve coordination and cooperation between them.
- Further improve energy security through regional cooperation, regional market integration, diversification of routes/sources of supply in the gas and electricity sectors and continue providing suitable conditions for developing local energy infrastructure and increasing energy efficiency.
- In updating the National Energy Strategy and setting up specific targets, enhance institutional capacity in energy data collection, modelling and forecasting, resource assessment, and system integration of renewable energy to allow informed decision-making.
- Continue the efforts – in cooperation with the energy regulator (ANRE) – to develop free, liberalised, competitive energy markets**:**
  - Accelerate the implementation of the legislation and regulations to transpose the provisions of the Third Energy Package.
  - Ensure transparent and fair market rules and minimise state interference in the market operations.
- Strengthen the independence, transparency and accountability of ANRE to make sure it can adopt regulatory practices and methodologies that enable the much-needed private-sector investments in the energy sector infrastructure without putting additional pressure on the state budget.
- Make sure that vulnerable energy customers are protected by efficient targeted social protection measures.
- Strengthen cooperation between the public and private stakeholders, civil society and academia, including through effective permanent working groups and policy dialogue.
- Reinforce the public-private dialogue on energy policy matters and develop a communication strategy for sector stakeholders and population on energy strategy and challenges/benefits of the ongoing reforms.
- To further develop national energy statistics to improve the data quality and to inform policy decisions
  - Ensure that the development of the unified electronic data reporting portal objectively reduces the burden on respondents, respects the confidentiality of the data and allows for amending the forms based on current needs. Transferring the responsibility of the active portal to the National Bureau of Statistics (NBS) would allow for independent amendments and compliance with the principle of confidentiality.
  - Liaise with the Energy Efficiency Agency (EEA) and NBS to ensure that appropriate data are available for energy planning and for the development of energy efficiency indicators (e.g. gross value added by manufacturing subsector, building stock, transport activity data).

References

ANRE (Agenţia Naţională pentru Reglementare în Energetică/ National Agency for Energy Regulation) (2020), Annual Activity Report 2019, ANRE, Chisinau.

EEA (Energy Efficiency Agency) (2020), Institutional Set-up of the Energy Efficiency Agency, Core Functions and Responsibilities, Energy Efficiency Agency, Chisinau, presentation to IEA, 6 February 2020.

EnC (Energy Community) (2021), *Energy Community Acquis,* website, https://www.energy-community.org/legal/acquis.html, (accessed 17 May 2021).

EnC (2020), *Moldova Annual Implementation Report,* Energy Community Secretariat, 1 November 2020.

GoM (Government of Moldova) (2019a), *Government Decision No 45 of* 30-01-2019 *on the Organisation and Functioning of the Energy Efficiency Agency,* http://www.legis.md/cautare/getResults?doc_id=117667&lang=ru

GoM (2019b), *National Action Plan in the Area of Energy Efficiency for 2019-2021* (NEEAP), Government Decision 698/2019 of 27 December 2019.

GoM (2017a), *Government Decision No 690 of 30 August 2017 on the Organisation and Functioning of the Ministry of Economy and Infrastructure***,** *[in Russian]* http://www.legis.md/cautare/getResults?doc_id=119193&lang=ru

GoM (2017b), *Government Decision No 695 of 30.08.2017 on the Organisation and Functioning of the Ministry of Agriculture, Regional Development and Environment, [in Russian]* http://www.legis.md/cautare/getResults?doc_id=119185&lang=ru

IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics/data-product/world-energy-statistics-and-balances (accessed 10 March 2022).

IEA (2018), *Moldova: Country Overview*, IEAforEU4Energy, Paris, https://www.eu4energy.iea.org/countries/moldova

IEA (2015), *Energy Policies Beyond IEA Countries: Caspian and Black Sea Regions*, International Energy Agency, Paris.

IRENA (2019), *Renewables Readiness Assessment: Republic of Moldova*, International Renewable Energy Agency, Abu Dhabi.

MIRD (Ministry of Infrastructure and Regional Development) (2020a), *Fourth Annual Report under the Energy Efficiency Directive*, Chisinau, July 2020.

MIRD (2020b) *Promotion of the Use of Renewable Energy in the Republic of Moldova*, MIRD presentation to IEA, February 2020, updated October 2020.

MIRD (2020c), *Promotion of the Efficient Use of Energy in the Republic of Moldova*, Chisinau, presentation to IEA, February 2020.

MIRD (2019), *Security of Supply Statement*, Order of the Ministry of Infrastructure and Regional Development No. 363 of 31 December 2019.

NBS (National Bureau of Statistics of the Republic of Moldova) (2016), *Energy Consumption in Households: Results of the Survey on Energy Consumption*, NBS, Chisinau, https://statistica.gov.md/pageview.php?l=en&id=5413&idc=350

Parliament of the Republic of Moldova (2016), *Law No 10 of 26.02.2016 on the Support of Use of Energy from Renewable Sources*, published in Monitorul Oficial Nr. 69-77 on 25 March 2016.

RoM (Republic of Moldova) (2021), Official website of the Republic of Moldova, https://moldova.md/en (accessed 14 May 2021).

RoM, Ministry of Justice, https://www.legis.md/ (database), (accessed 15-30 April 2021).

Sandulescu, Alexandru (2020), Developments in the Energy Sector of the Republic of Moldova, EU High Level Adviser, presentation to the IEA, Chisinau, 6th February 2020

World Bank (2021), *Moldova: Overview* (website), https://www.worldbank.org/en/country/moldova/overview (accessed 17 May 2021).

3. Natural gas

Key data:

(2020 provisional):

Domestic production: Negligible (< 1 mcm)

Net imports: 1.1 bcm, -11.1% decrease since 2010

Share of natural gas: 28% of TES, 87% of electricity generation, 17% of TFC

Gas consumption by sector**:** 1.1 bcm (power and heat generation 40.3%, residential 37.3%, services 9.8%%, industry 8.1%, distribution losses 2.7%, transport 1.3%, agriculture 0.4%)

Exchange Rate: 100 Moldovan lei (MDL) = 5.77 USD; 5.06 EUR (2020)

Overview

Natural gas is of crucial importance for Moldova. Accounting for around 30% of total energy supply, it is the second largest source of energy after oil products. Natural gas plays a major role in electricity and heat generation as well as in direct supply to final consumers. With negligible domestic gas production and no significant hydrocarbon reserves, Moldova depends almost fully on imports. Having no gas storage and no facilities to handle liquefied natural gas (LNG), Moldova depends fully on external sources also for balancing seasonal variations of demand. Historically the natural gas has been imported solely from the Russian Federation. However, by the end of 2021, imports from Romania were made possible allowing a higher degree of diversity in supply. Moldova's natural gas system is split between the right bank Moldova and Transnistria, where the system is not controlled by Moldovan authorities and where major gas-fired power generation takes place for the right bank.

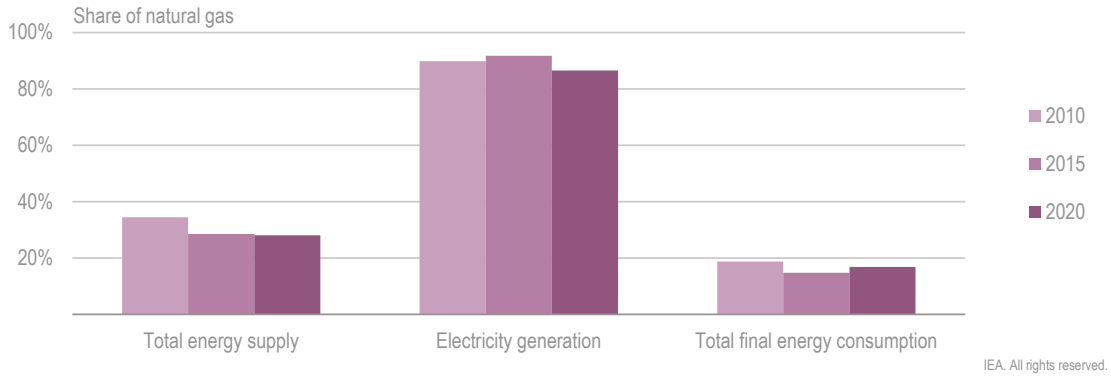
Supply and demand trends

The share of natural gas in Moldova's total energy supply (TES) was 28% in 2020, down from over one-third in 2010 (34%) (Figure 3.1).[1] Almost 90% of the electricity is generated from natural gas. This also explains the seemingly low share in final consumption (17%) as gas is transformed into electricity for final use.

[1] Together with Transnistria region where most of the gas is used for power generation, Moldova's demand was 3.0 bcm in 2020.

Total gas consumption decreased over 10% in a decade (-10.8% since 2010). Reduction in gas-based electricity generation is even higher (-20%), but has been offset by an increase in gas demand in the residential and industry sectors.

Figure 3.1 Share of natural gas in Moldova's energy system, 2010-2020



The role of natural gas in Moldova's economy is larger than its share in final consumption as most electricity and heat consumed in the country is generated via natural gas.

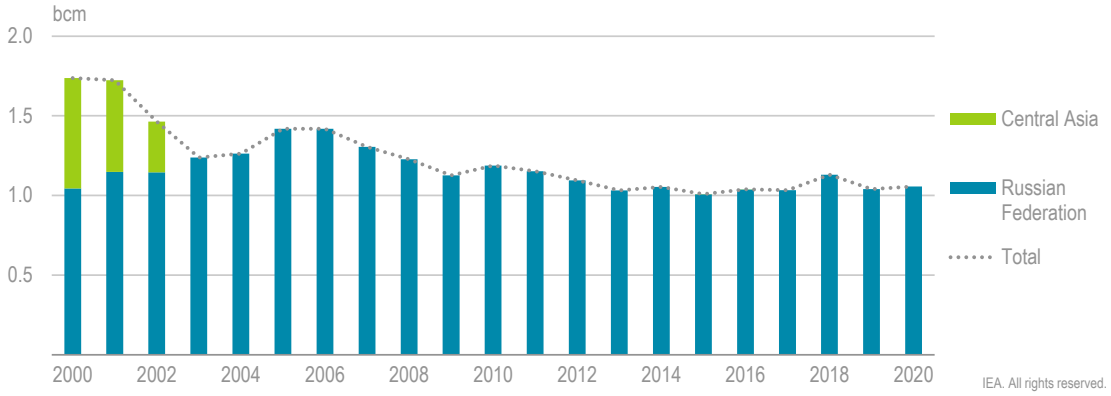
Notes:2020 data are provisional, Domestic production is negligible and not shown.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Imports

In 2020 the gas imports of the right bank Moldova amounted to 1.1 bcm supplied from the Russian Federation. Gas imports and consumption declined from the early 2000s through to the 2008 economic crisis, but since the early 2010s have remained essentially flat (-11% since 2010) (Figure 3.2). All natural gas was supplied through Russia's state-owned energy corporation, Gazprom.

Figure 3.2 Moldova's natural gas imports by country of origin, 2000-2020



Moldova's natural gas is supplied from Russia.

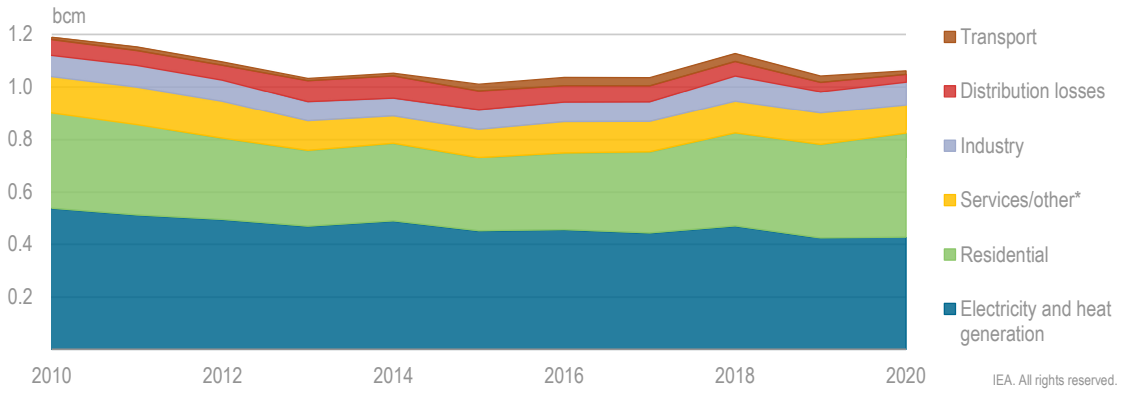
Notes: 2020 data are provisional. bcm = billion cubic metres.

Sources: National Bureau of Statistics of the Republic of Moldova; IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Electricity and heat generation account for the largest share of natural gas consumption in Moldova at 40% as most domestic electricity and heat are generated in natural gas-fired heat and power plants (Figure 3.3). The residential sector is the second-largest gas consuming sector with a 37% share in 2020. Since 2010, residential consumption has increased only modestly (+9%) while some recent increases may be attributed to the increasing number of households switching to individual gas heating from centralised heat supply due to gasification.

The remainder of the natural gas is consumed in services (10% share in 2020; -22% since 2010) and industry (8%; +8% since 2010). Preliminary data suggest that distribution losses accounted for 3% of the total demand in 2020 whereas the 10-year average is 6%. Transport consumption is modest (<2%), but showed rapid growth in the mid-2010s, though it has since declined. Still in 2020, consumption in transport was 44% above the 2010 level.

Figure 3.3 Natural gas consumption by sector, 2010-2020



Electricity and heat generation and residential consumption form the main share of domestic gas demand.

* Includes commercial and public services, agriculture and forestry.

Notes: 2020 data are provisional. bcm = billion cubic metres.

Sources: National Bureau of Statistics of the Republic of Moldova (NBS); IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Due to the low share of industrial consumption, gas demand has a profound seasonal pattern: winter consumption exceeds by more than six times the use of gas in the summer months.

Gas Sector Structure

Moldova's gas sector is largely monopolised: the majority of functions – imports, wholesale and retail supply, cross-border and national transmission, distribution and retail – is performed by the Moldovagaz joint-stock company (JSC) and its subsidiaries. Shareholders of Moldovagaz are Gazprom PJSC (50%), the Public Property Agency of the Republic of Moldova (35.33%), the administration of the Transnistrian region (13.44%) and other shareholders (1.23%). Moldovagaz owns 100% of the shares in the affiliated transmission and distribution companies. Moldovagaz JSC is the main importer and supplier of natural gas (under a Public Service Obligation [PSO] regime), and is also appointed as the Supplier of Last Resort for those consumers who may lose their gas suppliers in the market.

Moldovatransgaz LLC (limited liability company), a subsidiary of Moldovagaz JSC, operates most of the transmission networks and has been also appointed as the balancing entity in the gas market. The legal and functional unbundling of Moldovatransgaz from Moldovagaz has been implemented, while the ownership unbundling is (according to ANRE) still under consideration. In August of 2021 the certification of Moldovatransgaz was rejected by ANRE on the grounds of deficiencies in ownership unbundling, third party access and absence of contractual backhaul (ECS, 2021). Moldovagaz plans to fully unbundle the transmission system operator Moldovatransgaz and achieve its certification by the Energy Community by the end of 2021. The unbundling plan has been developed with the support of the Energy Community Secretariat, with the provision of Independent Transmission Operator (ITO). The plan also calls for Moldovagaz to separate its import and trading operations from final supply to consumers.

Vestmoldtransgaz LLC, a licensed transmission system operator (TSO) owned by EUROTRANSGAZ LLC (75% owned by ”TRANSGAZ” of Romania and 25% by the EBRD), is an operator of the Ungheni-Chisinau pipeline. It is fully unbundled from gas commodity-related activities. Vestmoldtransgaz was certified as a TSO under the Third Energy Package in September 2021 and delivered the limited volumes of gas in October 2021.

The regional distribution companies – including the biggest, Chisinau-gas LLC – have been unbundled and conduct only distribution services, while supply is provided by only Moldovagaz JSC which acts as a public supplier and maintains about 99% of market share and supplies all consumers at regulated prices.

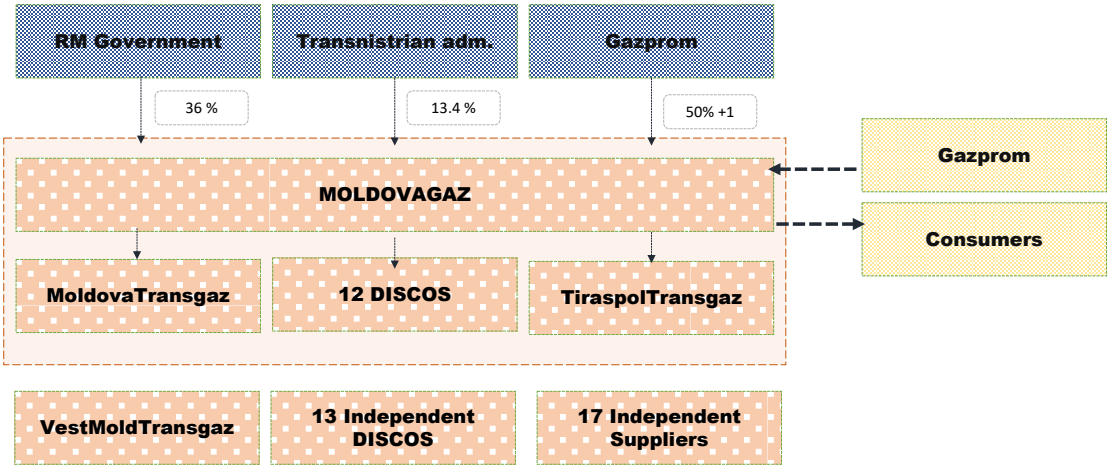
In 2020, there were twelve major regional distribution system operators (DSOs), all subsidiaries of Moldovagaz JSC. Other smaller independent DSOs distributed in total less than 5% of the natural gas used in Moldova.

Tiraspoltransgaz LLC, another affiliate of Moldovagaz JSC is the transmission network operator and supplier in Transnistria. Gas distribution in the region is handled through five distribution system operators. Moldovagaz is accumulating large debts to Gazprom for the gas provided to Tiraspoltransgaz (Box 3.1).

Box 3.1 Non-commercial Practice in Moldovagaz

The gas provided to Tiraspoltransgaz has not been paid for since the early 2000s. The resulting debt accumulation to Gazprom makes Moldovagaz financially unsustainable as its accounts can be legitimately seized at any moment. As of the end of 2019, Gazprom showed on its books USD 7 billion debt of Moldovagaz (Gazprom 2020). Although the debt does not accrue to the Moldovan government or the Moldovan right bank consumers, the unsustainable business model harms Moldovagaz' credibility as a trusted, financially healthy market participant. In its turn, Moldovagaz was a creditor to heat producers Termoelectrica and CET-Nord. The solution was found after the government transferred the debt of Termoelectrica to state-owned Energocom and pledged to repay the debt to Moldovagaz demanded by Gazprom as a condition for continued supply in the winter of 2021-2022.

Figure 3.4 Moldova's gas sector before unbundling



*DISCOS here mean Distribution system operators/ distribution companies – not suppliers
Source: European Union High Level Advisors' Mission 2019-2021.

Energocom JSC, a state-owned electricity importer and domestic electricity supplier, also has a licence to supply natural gas. However, its main objective was to serve as a backup for gas imports in case of termination of Gazprom supply in the winter of 2019-2020. There is also a small number of emerging small suppliers.

As of September 2021, there were in total 25 licensed natural gas suppliers and 25 distributors operating in Moldova (ANRE, 2021b).

Infrastructure

Moldova has a well-developed system of transmission and distribution gas networks that covers the whole territory of the country.

Moldova's natural gas transmission networks include gas pipelines with the pressure above 1.2 megapascals (MPa), compression stations, delivery and measurement points and other facilities. In 2020 the gas transmission networks in operation included:

- 817 km of main/transit pipelines, of which 656.3 km [2] are located on the right bank of the Dniester River and 160.4 km on the left bank (Transnistria)
- 1 106 km of gas service connection pipelines, of which 903.5 km are located on the right bank of the Dniester and 202.9 km on the left bank
- 96 gas delivery stations, of which 81 delivery stations are located in the right bank Moldova and 15 delivery stations in Transnistria
- Five compression stations, of which three are located on the right bank of the Dniester
- Two gas metering stations: at Căușeni, with a capacity of 80 mcm/d, and Ungheni, with a capacity of 3.75 mcm/d.

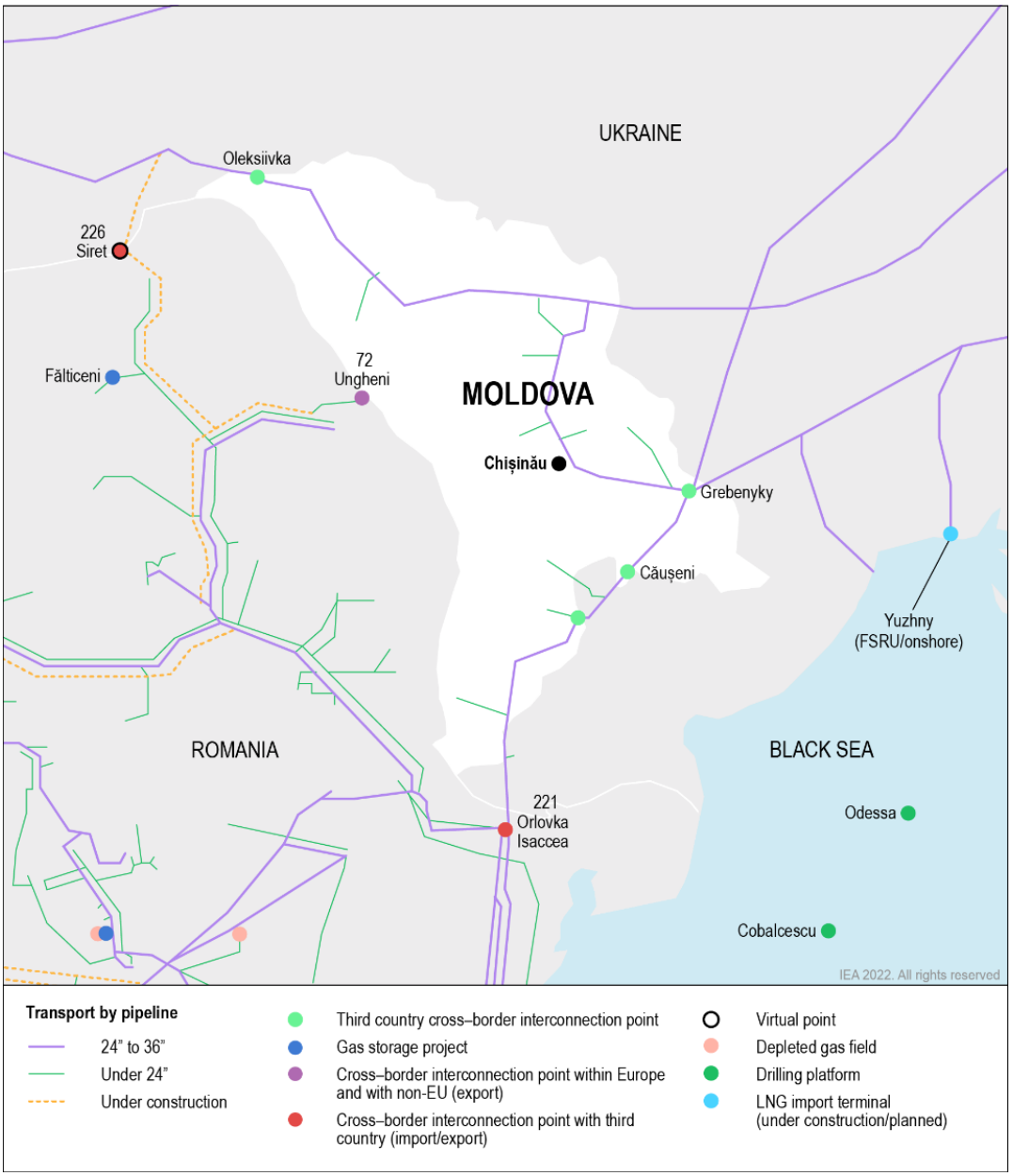
Gas distribution networks have a total length of about 25 000 km and supply more than 760 000 residential and non-residential consumers (Figure 3.5). In 2020, all districts of

[2] Moldovatransgaz (2021a), Company Presentation, https://moldovatransgaz.md/en/about/presentation.

Moldova had access to natural gas, and the access to natural gas distribution networks on the right bank of the Dniester River was above 63%.

The three main (north-south) transit pipelines in Moldova have a throughput capacity of 34.6 bcm/y and the total length of 343 km, of which 247 km are managed by Moldovatransgaz and 96 km respectively by Tiraspoltransgaz. Another transmission interconnection with a capacity of 9.1 bcm/y passes through northern Moldova and connects two parts of the Ukrainian network as well as gas storage facilities at Bohorodchany, Ukraine.

Figure 3.5 The gas transmission network of Moldova



Source : Adapted from the ENTSO-G: https://www.entsog.eu/sites/default/files/2018-09/ENTSOG_CAP_2017_A0_1189x841_FULL_064.pdf

Moldova has no LNG or gas storage facilities.

An important recent addition to Moldova's pipeline system is the completion in August 2020 of the Ungheni-Chisinau 120 km connection line (600 mm diameter). This pipeline can connect Moldova with Romania and hence the EU markets. To allow sufficient gas flows to Moldova during the cold season, Romania, with the support of other EU partners, is building on its territory the Onesti – Gheraesti – Letcani gas pipeline and two compression stations in Onesti and Gheraesti. Completion of this project will allow 1.5 bcm/y to be provided to Moldova with sufficient pressure and throughput. Gas flows over the Iasi-Ungheni-Chisinau pipeline started in October 2021. However, the daily throughput of the pipeline is still insufficient to switch completely to this new source.

Gas supply security

Having no known reserves and negligible production of natural gas[3] Moldova has depended fully on a single source, Gazprom, which has supplied gas to Moldova through Ukraine and the breakaway region of Transnistria. Along with its own consumption of 1.1 bcm, the right bank of Moldova also depends on gas supply to Transnistria, which consumes about 2 bcm/y and uses its major share to produce electricity at the Cuciurgan Thermal Power Plant (Moldavskaya GRES). MGRES supplies about 80% of the electricity used on the right bank of Moldova which is therefore vitally dependent on the security of the gas supply to Transnistria.

In addition to its own consumption of natural gas, Moldova has played an important role in the transit of natural gas from the Russian Federation through the Balkan pipelines towards Romania, Bulgaria and further to Turkey, Greece and Macedonia (Figure 3.6). The supply and transit contracts between Moldovagaz and Gazprom have been renewed annually at the end of each year since 2012 creating a risky situation for winter supplies.[4] The most recent agreement was achieved between Gazprom and Moldovagaz on 29 October 2021, for the gas supply over five years starting from 1 November. The agreed price for November was USD 450 per thousand cubic metres, to be indexed in line with price changes at European gas hubs. The agreement was achieved after preliminary negotiations on repayment of the debt of state-owned heat suppliers to Moldovagaz and agreement on auditing the debt claimed by Gazprom for the gas supplied to Moldova, for its further repayment.[5] In 2018 the utilisation of cross-border pipelines through Moldova had been about 45–55%, with 20 bcm/y transited through the Southern route and 1.3 – 2 bcm/y through the Northern route. However, the gas transit over Moldova has drastically dropped to 5% of previous volumes, to about 1 bcm/y.

The complex dependence on gas supplies and transit from Gazprom, combined with its ownership control of the whole gas system, creates an overly high dependence and the associated security risks. It also complicates the establishment of an internal competitive

[3] The rights for exploration and production of hydrocarbons were conceded to „Frontera Resources International" LLC, but as of 2020, no results of exploration works were made public (Oil & Gas Regulation, 2020).
[4] In the winter 2019-2020, EBRD was prepared to finance Moldova's Energocom for emergency procurement of gas on EU markets in case the supply from Gazprom over Ukraine was interrupted (EBRD, 2019).
[5] Kobzeva, Oksana and Alexander Tanas (2021), "Russia's Gazprom and Moldova sign 5-year gas deal", Reuters 29 Oct 2021, https://www.reuters.com/business/energy/russias-gazprom-moldova-sign-5-year-gas-deal-2021-10-29/

market and the creation of independent regional gas policy. However, the recent changes in regional and internal gas infrastructure and internal market reforms may lead to a new reality where the security of gas supply can be significantly improved.

Indeed, the commissioning of the TurkStream pipeline and commencing of reverse flows over the Trans-Balkan pipeline system have radically changed the gas transit and supply picture in the region. The countries of Southeast Europe which were previously supplied through transit over Ukraine and Moldova were switched to supply from TurkStream and the reverse flow of the Trans-Balkan pipelines. At the end of 2019 the Balkan corridor was prepared to transport in reverse regime up to 15 million m^3 per day, from Bulgaria through Romania and Ukraine to the Republic of Moldova. It is expected that the Republic of Moldova will be able to transit 17 mcm/day of natural gas to and from Ukraine, with annual transit capacity of 3 bcm, along the Trans-Balkan pipeline.[6] Completion of the Iasi-Ungheni-Chisinau pipeline and the strengthening of the Romanian internal network for the supply to Moldova create an important alternative supply route that can significantly improve Moldova's security of supply.

Thus, Moldova, which was until recently fed exclusively from Ukraine and Transnistria, will have access to a number of supply options. These include: traditional supply of Russian gas through Ukraine, procurement of Russian gas supplied through TurkStream and Trans-Balkan reverse flow (TBRF) at the border between Romania and Ukraine (GMS Isaccea/GMS Orlivca), procurement of gas from EU markets to be supplied through Ukraine or Romania and, potentially, access to LNG markets, especially after the anticipated completion of the Alexandroupolis LNG terminal and Bulgaria-Greece interconnector.[7] Romania's plans to ramp up domestic gas production,[8] in particular from offshore fields, may provide additional opportunity for further diversification.

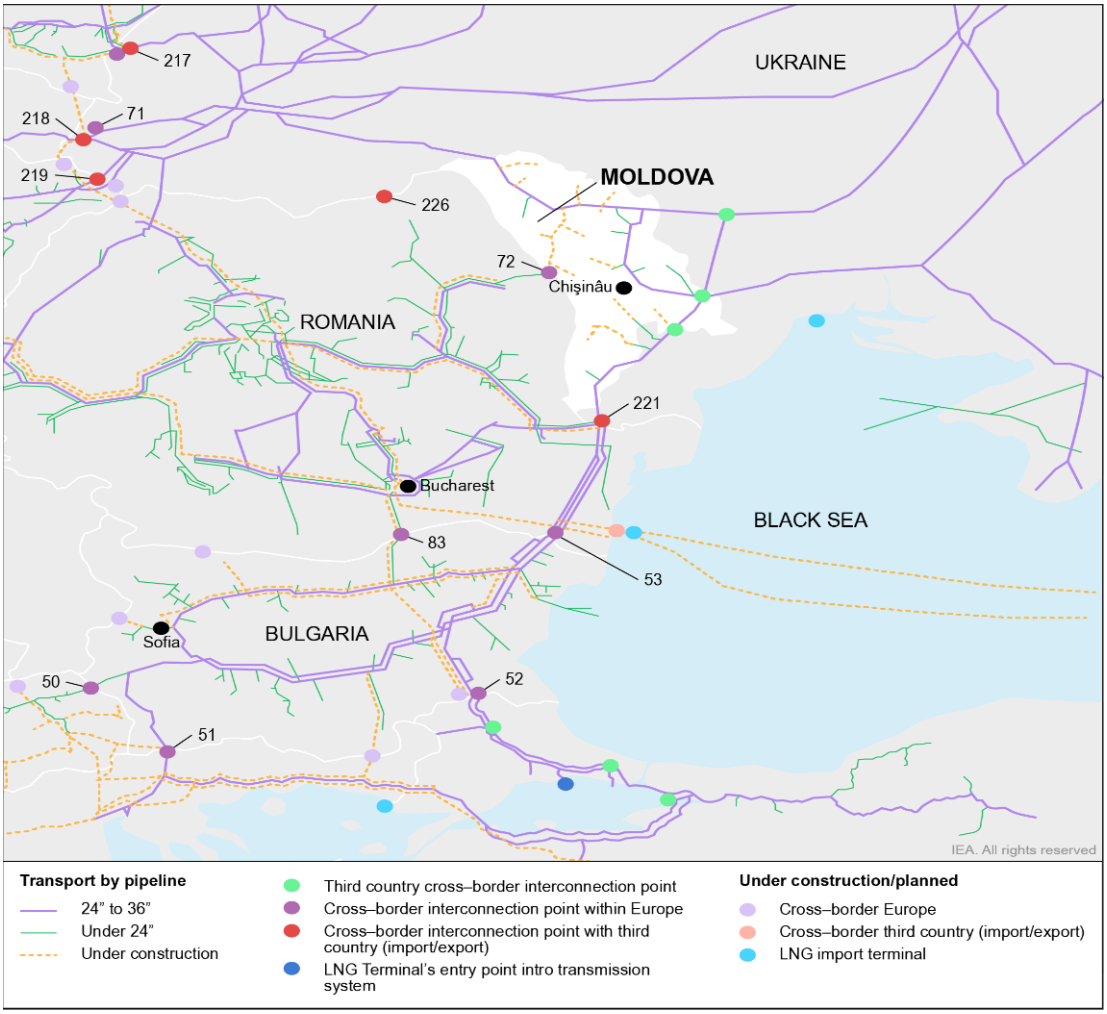
However, the dependence on monopolistic supply and ownership from Gazprom, though more balanced, cannot be fully discarded as the capacity of the Romania interconnection – 1.5 bcm/y – is still insufficient for covering the winter consumption daily peaks of the right bank of the Dniester River and the dependence on gas supply from Gazprom to Transnistria is not diversified.

[6] Moldovatransgaz (2020a), "'Moldovatransgaz' LLC joined the 'Regional Booking Platform' – RBP", https://moldovatransgaz.md/en/news/44

[7] The test supplies from the Greek Revithoussa LNG terminal over RTBF to Ukraine were conducted in 2020, http://www.eru.com.ua/en/press_centr/news/eru-trading-creates-a-new-vertical-of-gas-supplies-greece-romania-ukraine/

[8] https://ubn.news/seeking-to-diversify-gas-supplies-ukrainian-planners-hailed-last-julys-test-shipment-by-eru-trading-of-gas-from-revithoussa-greeces-lng-terminal-on-the-aegean-sea-through-romania/

Figure 3.6 Regional gas transmission systems



Source: Adapted from the ENTSO-G: https://www.entsog.eu/sites/default/files/2018-09/ENTSOG_CAP_2017_A0_1189x841_FULL_064.pdf

Moldova can further enhance the above opportunities for strengthening its supply security and its role in the region through regulatory harmonisation, cross-border connectivity and operation for gas transit and trade, as well as market reform to limit monopoly power in the internal market.

Along with the long-term security of supply, Moldova is also advancing on short-term emergency preparedness. To increase system flexibility and resilience, Moldova began storing gas in Ukraine in October 2020 – so far only a modest 100 mcm.

The government has approved the Regulation on Emergency Situations and the Gas Emergency Action Plan in April 2019 (GoM 2019). Gas Market Emergency Action Plans are developed by Moldovagaz in accordance with the requirements of EU Directive 2004/67/EC concerning measures to safeguard the security of natural gas supply.

Regulation and policies

Institutions

The Government of Moldova is the primary governing and policy-making body for the energy sector including natural gas. These functions are implemented by the Ministry of Infrastructure and Regional Development. The Ministry defines priorities and state policies, develops long-term strategies and approves state development programmes of the natural gas infrastructure, including interconnectors and storage facilities. The responsibilities of the Ministry also include assurance of the security of supply of natural gas, exploration and development of own reserves; appointing the Public Service Obligation (PSO) providers, state assistance to vulnerable consumers, international relations, environmental protection and safety, research and innovation in the gas sector, approval of emergency action plans and other secondary legislation.

The National Energy Regulatory Agency (ANRE) is an independent public authority which supports the introduction of market mechanisms in the energy sector and regulates the sector while protecting the interests of customers and investors. ANRE promotes market competition and efficiency, authorises and oversees the licensees, sets standards for distribution and transmission and supply activities, approves regulated tariffs, and supervises customers' rights and protection.

Strategies and action plans

The *Energy Strategy of the Republic of Moldova until 2030* (GoM, 2013) reflects the country's priorities in balancing its external dependence with internal resources, calls for increased connectivity with the EU and reflects the country's obligations to reach the national targets and international obligations for EU association. The Strategy defines the objectives of natural gas policy as: Harmonisation of national legislation with the EU *acquis*; market liberalisation and the ensuring of free access to the natural gas market; development of a competitive gas market; and strengthening energy security and supply diversification. However, the document adopted in 2013 needs an update and is being revised.

The transmission system operator develops the Ten Year Development Plans and submits them for ANRE's approval. These plans include measures to ensure the reliability of the natural gas system and the security of natural gas supply. The plans of Moldovatransgaz and Vestmoldtransgaz for 2020-2029 have been approved by ANRE. Similarly, distribution operators develop three-year plans to be approved by the regulator.

Gas Prices and Tariffs

As of 2020, the retail market was highly regulated where ANRE defined the regulated supply prices (under the PSO) to almost all customers, as well as transmission and distribution network tariffs.

In October 2020 ANRE approved the regulated supply prices[9] existing as of September 2021. The prices for residential customers are set at 4 298 MDL/1 000 m^3 (around USD 250/1 000 m^3) excluding VAT, while the wholesale regulated gas price at the entry of the transmission system is 2 613 MDL/1 000 m^3 (about USD 150/1 000 m^3), excluding VAT. Following the reduction in wholesale gas prices, the customer prices were decreased 6.8%-12.2% compared to the regulated prices, approved in 2018. The estimated average (for all customers) regulated supply price in 2020 was USD 237/1 000 m^3 excluding VAT (ANRE, 2021b).

ANRE's public service obligation decision envisages a seven-year period of supply at regulated prices. ANRE also sets the prices for the supplier of last resort, which is Moldovagaz. Customers who lose their suppliers on the market may revert to Moldovagaz as a supplier of last resort to purchase the gas at the regulated price.

The network tariffs are defined at the entry and exit points of the transmission system, as well as at high, medium- and low-pressure levels of the distribution systems. In November 2020, ANRE approved a new tariff methodology for distribution system operators. The regulated distribution tariffs are differentiated by the pressure levels and DSOs.

Rerouting of Russian gas supplies to Southeast Europe through TurkStream has resulted in a sharp drop of transit volumes through Moldova. In order to compensate the operational costs of Moldovatransgaz's network, ANRE increased the transmission tariff to USD 11.4/1 000 m^3 which further discouraged the private shippers, while Gazprom is allegedly getting an exception and pays only USD3/1 000 m^3 (Atlantic Council, 2020). The expected increase in transit volumes (ICIS, 2020) may bring this tariff down and encourage a further increase in transit.

Legislation

Moldova, being a member of the Energy Community, develops its primary and secondary legislation in line with Energy Community *acquis*, to transpose and implement the EU Third Energy Package and with the outlook for full implementation of the EU energy legislation. For implementation of this policy, Moldova adopted the Law on Gas No. 108/27.05.2016 (GoM, 2016) in 2016, transposing EU Directive 2009/73/EC on the internal natural gas market, and Regulation (EC) 715/2009, on conditions for access to the natural gas transmission networks. The law determines the organisation, regulation and operation of the natural gas sector to assure the availability, reliability and continuity of supply; adequacy of natural gas networks, including cross-border connections; market development, its open entry and competitiveness, security of supply, provision of public service, consumer rights protection, and environmental compliance. The adoption of the Law on Gas gives the final consumers in the Republic of Moldova the right to choose and to change natural gas suppliers. However, to realise these rights and open the gas market, a range of mechanisms and conditions needs to be enacted.

Moldova has adopted a substantial package of secondary legislation in order to transpose the requirements of the EU directives. The approval of the Natural Gas Network Code (Gas Network Code, 2019) and Gas Market rules (Gas Market Rules, 2019) in 2019 (ANRE, 2019a, 2019b, 2020a) was a step towards the establishment of a competitive

[9] ANRE 2021a, Tarifele și prețurile reglementate în vigoare la gazele naturale [Tariffs and regulated prices currently in force for natural gas], https://www.anre.md/gaze-naturale-3-205

market in the gas sector. The Gas Network Code ensures a transparent access to the natural gas transmission networks, including the cross-border transactions and provides procedures for cooperation and data exchange with system operators in neighbouring countries. The Natural Gas Market Rules define the conditions of the natural gas market organisation and functioning, as well as the rights and obligations of market participants.

The package of adopted secondary legislation includes: The Regulation on access to the natural gas transmission networks and congestion management; The Regulation on the quality of natural gas transmission and distribution services; The Regulation on natural gas supply; The Regulation on connection to the natural gas networks and on providing natural gas transmission and distribution services; and The Methodology for calculation, approval and application of tariffs for natural gas transmission services. Moldova has adopted the full set of security of supply rules, even beyond the current Energy Community *acquis*.

The implementation of Gas Network Codes is progressing: ANRE has adopted a list of entry/exit points, with provisional tariffs for natural gas transmission services in place. The Law on Natural Gas was amended in December 2020 to allow bi-directional gas flows to and from Ukraine through a backhaul procedure starting from January 2021; Regulation (EU) no. 312/2014 was transposed into the Network Code to establish the balancing responsibilities in the market.[10] Moldovatransgaz has been appointed as a Balancing Entity.

The legislative process in the gas sector continues to be active and along with the adoption of the secondary legislation, the government is planning to revise the main Law on Natural Gas and eliminate the flaws identified over the course of the several years of its operation.

Regional Cooperation

With the development of trans-border interconnections, the increased cooperation of TSOs and the interest of private companies in regional markets, Moldova is acquiring new opportunities for supply diversification and strengthening of its transit function, with associated economic and security benefits. Moldova can encourage the improvements through facilitating access to its transmission system, enacting the network codes and supportive transit regulations, developing the internal market and working closer with its neighbours. In recent years there have been a number of significant advances in these directions.

In 2020, Moldovatransgaz joined the Regional Booking Platform (RBP) developed by the Hungarian national TSO, FGSZ (Moldovatransgaz, 2020a). Moldova plans to switch the measurement of gas in its transport system to energy units. It is expected that the capacity allocations will be performed in line with the Network Code on Capacity Allocation (CAM), that will allow the fair and non-discriminatory access to all system users, through an electronic platform, certified by ENTSO-G. Gas Network Codes have been transposed enabling the reverse flow (backhaul). In total this creates a positive trend for increased interoperability and regional market integration in cooperation with the TSOs of Romania and Ukraine.

[10] Moldovatransgaz (2020b), https://moldovatransgaz.md/en/news/41

In July 2021, Moldovatransgaz joined the Memorandum of Understanding on trans-regional cooperation for the development of an integrated gas market for South-East and East Europe (SEEGAS).

Moldovatransgaz announced its intention to make virtual reverse capacity of 17mcm/d available on the main transit route. In December 2019, Moldovatransgaz concluded an interconnection agreement with Ukraine's Gas TSO (GTSOU) in line with the Network Code on Interoperability and Data Exchange Rules. The agreement covers the interconnections at Grebenyky, Căușeni, Oleksiivka and Ananyiv, and provides a virtual point for delivery to Moldovan consumers near the border.

In spite of high transit tariffs there is an interest from private companies in Ukraine and Romania that may increase the transit volumes from 1 bcm in 2020 to 3 bcm in 2021 with associated reductions in transportation costs. Moldovatransgaz LLC signed contracts on natural gas transmission system services with 14 international traders,[11] who have tested the shipment of gas in various directions over Moldova's transmission network. In August 2020, GTSOU carried out a south-north transmission test requested by a private company to enable delivery of gas from Revithoussa LNG terminal in Greece via the Balkan pipeline through Bulgaria and Romania to Ukraine. The technical viability of this route has been demonstrated although commercial viability is still unclear. The above developments indicate the sound policy basis for regional cooperation and integration with regional markets to make Moldova an important transit hub for the region.

Assessment

Achievements

Over the last several years Moldova has made commendable progress in diversifying the natural gas supply routes and adopting the EU legislation for its gas market liberalisation. With the new cross-border and internal transmission infrastructure, increased market liquidity in neighbouring countries and the reshaping of regional energy flows, Moldova is obtaining access to a number of new opportunities for leveraging the complex external dependence on natural gas supplies and ownership of critical energy assets. By further active restructuring of the sector, liberalising the internal market and harmonising with the EU legislation, Moldova is making good progress towards achieving the higher interconnectivity and interoperability necessary for utilising these opportunities.

Moldova has made notable achievements in improving the regulatory framework and security standing of the gas sector:

- By connecting through to Romania by the Iasi-Ungheni-Chisinau pipeline, Moldova has created the possibility of alternative gas supply. The modification of the gas network, enabling reverse flows from the Trans-Balkan system, actual testing of deliveries to Ukraine and the use of its gas storage capacities have created additional possibilities for supply diversification, including potential access to LNG supplies from Greece. Together with traditional supplies of Russian gas through Ukraine, the possibility of purchasing gas from EU markets creates a set of options that can be developed to significantly improve the energy security of the country.

[11] Moldovatransgaz (2020b), https://moldovatransgaz.md/en/news/66

- By adopting a package of primary and secondary legislation, Moldova has progressed in reforming the gas sector in the direction of a competitive market and integration with the EU market system.
- In order to achieve the desired higher degree of market liberalisation, Moldova has developed a plan for unbundling of Moldovatransgaz LLC, subsidiary of Moldovagaz JSC. Supported by the Energy Community Secretariat, the government is working on amendments to the Gas Law and other legislative acts to enable full reforms of the market and to rectify the provisions related to public supplies and reverse flow.
- Moldova has adopted all EU Gas Network Codes and Moldovatransgaz has joined the Regional Booking Platform (RBP). ANRE has adopted a list of entry/exit points, with provisional tariffs for natural gas transmission services; Moldovatransgaz concluded an interconnection agreement with the Ukraine TSO in line with the Network Code on Interoperability and Data Exchange Rules. Moldova joined the regional cooperation initiative, SEEGAS.
- Moldova has developed sound Security of Supply Rules and emergency action plans in compliance with relevant EU regulations.

These developments create a positive expectation of improved energy security and market operation. However, a number of challenges remain.

Remaining Challenges

Despite the impressive progress, there are substantial remaining challenges to be addressed:

- Moldova is still supplied almost exclusively by Gazprom through the traditional route via Ukraine. The Iasi-Ungheni-Chisinau pipeline remains essentially idle (S&P Global Platts, 2020) and the TBRF has not yet materialised in any significant flow to and across Moldova. The opportunities for trading and physical flows from the south to the north towards Ukraine as well as the potential of gas flows from Romania to Moldova still remain essentially untapped.
- The transit volumes remain low. Transportation tariffs remain high and their application is allegedly non-uniform, providing a 70% discount to Gazprom (Atlantic Council, 2020). Transit procedures involving combined cross-border tariffs, and three sets of entry and exit fees at Grebenyky, Căușeni and Isaccea-Orlivka, discourage European traders. The allocation of transmission capacities through an open auction process in accordance with the Network Code on Capacity Allocation mechanisms (CAM) is not implemented yet.
- The retail market is illiquid and foreclosed with almost all customers supplied under PSO by Moldovagaz. The unlimited and unrestricted PSO regime precludes the market opening and causes inefficient use of public resources. The number of independent suppliers is growing but their market share remains insignificant.
- The unbundling and certification of Moldovatransgaz is still not completed; third party access,[12] implementation of capacity allocation, backhaul (contractual reverse flow), harmonisation of network tariffs and establishment of virtual trading point and balancing rules are still pending (ECS, 2021).
- Debt accumulation for the gas provided to Transnistria continues to make Moldovagaz – a major supplier and public service provider – financially unsustainable. Moreover, through Moldovagaz, Gazprom's financial grip extends to heating provider companies.

[12] Moldovatransgaz has signed a transmission service contract only with its owner Moldovagaz and has not yet started to allocate capacity at any capacity booking platform.

Further progress in the gas sector depends strongly on Moldova's practical implementation of the adopted regulations; full application of the EU Third Energy Package; opening of the internal market; implementation of transparent and equitable transit regulations; and active engagement with neighbouring countries to encourage improved regional cooperation, trade and exchange.

Recommendations

The Government of Moldova should:

- Develop further the emerging opportunities for diversification of supply routes to achieve a higher degree of connectivity and interoperability with regional and EU gas markets. The options provided by the new interconnection with Romania, reverse flow through the Trans-Balkan pipeline and access to the EU markets via Ukraine should be developed to supplement and provide an alternative to the traditional route of importing gas from Gazprom.
- Continue the cooperation with the gas TSOs of Ukraine, Romania and other countries bilaterally and through the SEEGAS initiative to achieve the proper network conditions and full interoperability for the commercial gas flows over the TBRF and Iasi-Chisinau pipeline.
- Cooperate with ANRE and sector entities to:
- Revisit the transit tariffs, simplify the procedures and fees at multiple border crossings and assure their transparent uniform application. Uniformly apply network codes for all interconnections including full entry-exit tariff systems with virtual trading points, capacity allocation through auctioning, mechanisms for balancing and backhaul operations. Adopt and implement the Regulation on Wholesale Market Integrity and Transparency REMIT.
- Complete the liberalisation of the wholesale and retail gas markets through the full adoption and implementation of the regulatory framework in compliance with the EU Third Energy Package.
- Complete the unbundling and certification of Moldovatransgaz and gradually open the wholesale and retail gas markets to increase the market share of independent traders starting from large consumers. Use the process of unbundling to establish the gas trade according to market principles.
- Refine the application of the public service obligation regime, to focus it on target groups of residential consumers. In parallel, develop the mechanisms for protection of vulnerable customers.
- Work with Gazprom to resolve the issue of debt accumulation by Moldovagaz to separate it from unpaid supplies to Transnistria and thus achieve the financial sustainability of this major importer, public service provider and Supplier of Last Resort.

References:

ANRE (Agentia Națională pentru Reglementare in Energetica /National Agency for Energy Regulation) (2021a), *Tarifele și Prețurile Reglementate în Vigoare la Gazele Naturale [Tariffs and regulated prices currently in force for natural gas*], https://www.anre.md/gaze-naturale-3-205

ANRE, (2021b), *ANRE Annual Activity Report 2020,*https://www.anre.md/raport-de-activitate-3-10

ANRE (2020a), *ANRE Annual Activity Report 2019,* https://www.anre.md/storage/upload/administration/reports/495/Annual%20Activity%20Report%202019.pdf

ANRE (2020b), *Distribution Tariff Methodology,* https://www.legis.md/cautare/getResults?doc_id=124358&lang=ru

ANRE (2020c),Tariffs*,* https://www.moldovagaz.md/rus/potrebiteli/tseny

ANRE (2019a) Resolution on the Approval of Gas Market Rules, https://www.chisinaugaz.md/files/files/shares/Legi/Hot534ro.pdf

ANRE (2019b), Resolution on the Approval of the Code of Natural Gas Networks,https://www.legis.md/cautare/getResults?doc_id=120009&lang=ro

Atlantic Council (2020), https://www.atlanticcouncil.org/blogs/ukrainealert/time-for-europe-to-rethink-the-balkan-pipeline/

Dovgal V., P. Martin (2020a), “Moldova plans to implement EU gas laws”. https://www.argusmedia.com/news/2154874-moldova-plans-to-implement-eu-gas-laws

Dovgal,V., P.Martin (2020b), “Romania to apply EU gas network codes at non-EU borders”, https://www.argusmedia.com/en/news/2164138-romania-to-apply-eu-gas-network-codes-at-noneu-borders

(EBRD, 2019) https://www.ebrd.com/news/2019/ebrd-helps-moldova-secure-winter-gas-supplies.html

(ECS (Energy Community Secretariat), 2021), https://energy-community.org/implementation/Moldova.html

(Gas Market Rules, 2019) https://www.chisinaugaz.md/files/files/shares/Legi/Hot534ro.pdf

(Gas Network Code, 2019) https://www.chisinaugaz.md/files/files/shares/Legi/Hot420ro.pdf

(Gazprom, 2020) https://www.gazprom.com/f/posts/72/802627/gazprom-financial-report-2019-en.pdf

GoM (2019), *Gas Emergency Regulation and Action Plan* 2019 https://www.legis.md/cautare/getResults?doc_id=113991&lang=ro

GoM (2017), *Law on Energy No.174/2017*, https://www.legis.md/cautare/getResults?doc_id=110368&lang=ro [in Romanian; also available in Russian at this site].

GoM (Government of Moldova) (2016),*Law on Natural Gas No. 108/27.05.2016,* https://www.legis.md/cautare/getResults?doc_id=105945&lang=ro [In Romanian; the Russian is available at http://www.legis.md/cautare/getResults?doc_id=105945&lang=ru].

GoM (2013), *Energy Strategy of the Republic of Moldova until 2030*, https://www.serviciilocale.md/public/files/Energy_Strategy_2030_Final.pdf [available in Romanian at https://www.legis.md/cautare/getResults?doc_id=68103&lang=ro, with a Russian translation also provided].

Guzun, A. (Schoenherr) (2020), "Moldova", *Oil and Gas Regulation 2020*, Global Legal Group Ltd, London https://www.schoenherr.eu/media/ls4gt201/og20_chapter_20_-_moldova.pdf

IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics/data-product/world-energy-statistics-and-balances (accessed 1st February 2022)

(ICIS, 2020) https://www.icis.com/explore/resources/news/2020/12/04/10583003/moldova-expecting-transit-increase-gas-sector-overhaul-in-2021

Kobzeva, Oksana and Alexander Tanas (2021), "Russia's Gazprom and Moldova sign 5-year gas deal", Reuters 29 Oct 2021, https://www.reuters.com/business/energy/russias-gazprom-moldova-sign-5-year-gas-deal-2021-10-29/

Moldovagaz (2021), *Activity Report 2019-2020*, https://www.moldovagaz.md/pic/uploaded/docs/Activitatea-anului-gazier-2019-2020.pdf

Moldovatransgaz (2021a), Company *Presentation*, http s://moldovatransgaz.md/en/about/presentation.

Moldovatransgaz (2021b), "One more international trader tested transportation of natural gas through the Trans-balkan pipeline", https://moldovatransgaz.md/en/news/66

Moldovatransgaz (2020a), "Moldovatransgaz LLC joined the 'Regional Booking Platform' – RBP", https://moldovatransgaz.md/en/news/44

Moldovatransgaz (2020b), "Natural gas network code has been supplemented with stipulations regarding gas flow balancing, based on EU Directive 312/2014", https://moldovatransgaz.md/en/news/41

S&P Global Platts (2020), https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/081920-feature-moldova-set-for-gas-diversity-as-romania-links-launch-imminent

Sandulescu, Alexandru (2020), Developments in the Energy Sector of the Republic of Moldova, EU High Level Adviser, presentation to the IEA, Chisinau, 6th February 2020

4. Oil

Key data

(2020 provisional)

Crude oil production: negligible (0.11 kb/d, -51% since 2010)

Oil product net imports: 0.95 Mt (20.1 kb/d) (imports 0.96 Mt, exports 0.01 Mt)

Share of oil*: 0.8% of domestic energy production, 34.1% of TES, 0.1% of electricity generation, 35.8% of TFC

Consumption by sector: 0.94 Mt (transport 70.7%, industry 11.8%, agriculture/forestry 11.8%, residential 5.3%, other** 0.5%)

Exchange rate: 100 Moldovan leu (MDL) = 5.77 USD; 5.06 EUR (2020)

* TES does not include oil used for international bunkering.

** Includes services, power and heat generation and distribution losses.

Overview

The Republic of Moldova is almost fully dependent on imports (more than 99%) of oil products, with a slight production (2010-2020 average was 0.16 kb/d) of crude oil. There is virtually no domestic refining capacity, with the exception of a micro refinery for local oil production. Therefore, most of the imported oil products come from refineries in the neighbouring countries. Romania is by far the largest supplier of diesel and motor gasoline, while liquefied petroleum gas (LPG) is sourced from Kazakhstan, the Russian Federation and Romania (Figure 4.1).

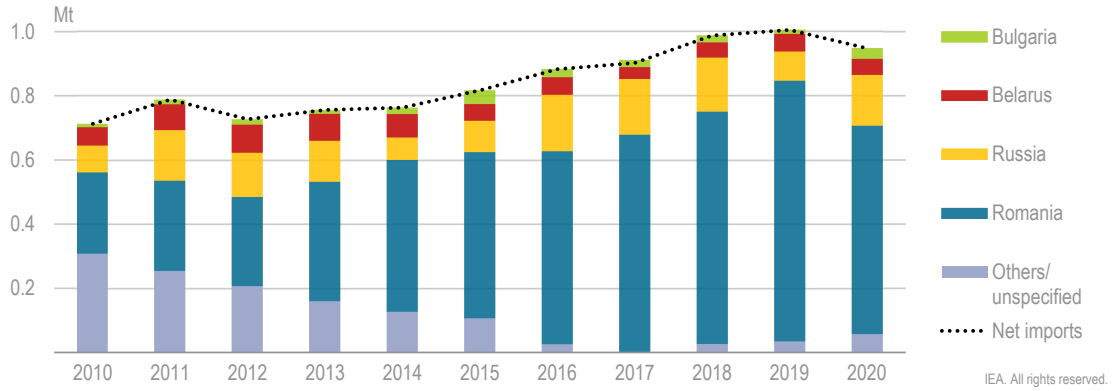
Therefore, from the perspective of the global market, the Moldovan market represents only the retail chain and the prices of oil products (gasoline, diesel, LPG) are volatile, primarily due to fluctuations on the international markets.

At the end of 2016, Frontera Resources (a US company) and Moldovan authorities signed a 50-year concession agreement for the exploration and development of hydrocarbon resources in southern Moldova. The contract grants Frontera the exclusive right to explore and develop oilfields within an area of 12 000 km^2, focused around the Dobrogea Basin. The aim of this concession is to increase and diversify Moldova's energy sources and reduce the country's dependence on energy imports.

Supply and demand

The imports of oil products into the Republic of Moldova in 2020 amounted to 0.95 Mt, of which most was diesel (63%). Gasoline accounted for 17% and LPG accounted for 7%.

Figure 4.1 Moldova's oil product imports by country, 2010-2020



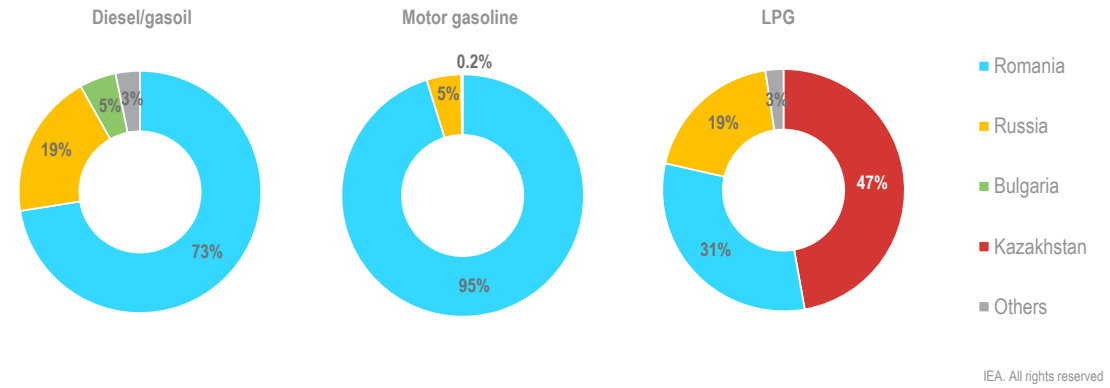
The share of oil product imports from Romania has almost doubled since 2010.

Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Romania is the main supplier of oil product imports (61% of total imports between 2010 and 2020), accounting for more than 95% of motor gasoline and almost 72% of diesel imports in 2020 (Figure 4.2). This trend is explained by the presence of the Romanian oil companies on the Moldovan domestic market that have their own refineries in the neighbouring countries and the short distance that allows import by road at relatively low costs. Other main oil supplier countries are the Russian Federation (15% of the total imports in the last decade) and Belarus (7%).

LPG imports come mainly from three countries: Kazakhstan (47% of LPG imports in 2020), Romania (31%) and the Russian Federation (19%). Kazakhstan's role as the main supplier is explained by the fact that the selling price of liquefied gas imported from Kazakhstan is lower than in other regions.

Figure 4.2 The structure of petroleum product imports by countries of origin, 2020

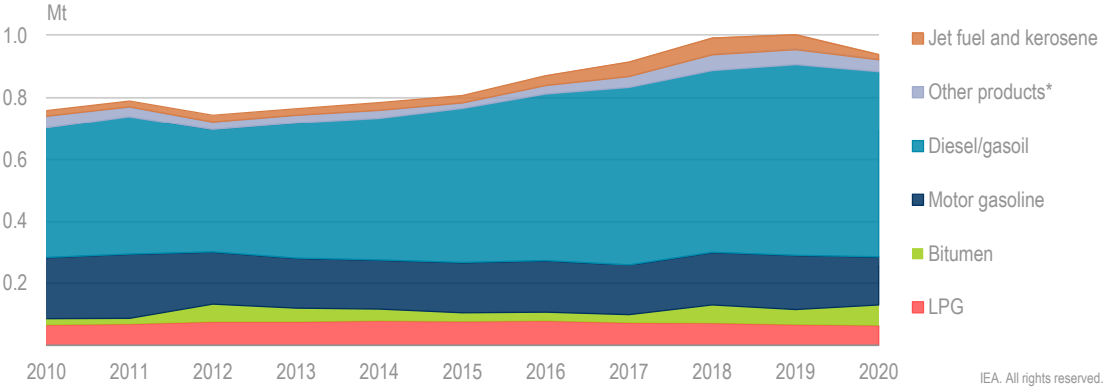


Romania and Russia are the main suppliers for diesel and motor gasoline, Kazakhstan for LPG.

Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Preliminary data published by the National Bank of Moldova (NBM, 2021) suggest that oil demand decreased noticeably in 2020 relative to the previous year. Moldova reduced the import of diesel fuel in value terms by 36.4%, from USD 399.6 million (in 2019) to USD 254.0 million (in 2020) and gasoline by 35.7%, from USD 108.4 million to USD 69.7 million (Figure 4.3). These decreases were due to both a decrease in procurement prices, and a decrease in the physical volume of imports. Comparatively, natural gas imports declined by 34.4%, from USD 247.2 million to USD 162 million,

Figure 4.3 Moldova's oil consumption by product, 2010-2020



Diesel makes up the vast majority of motor fuel use in Moldova.

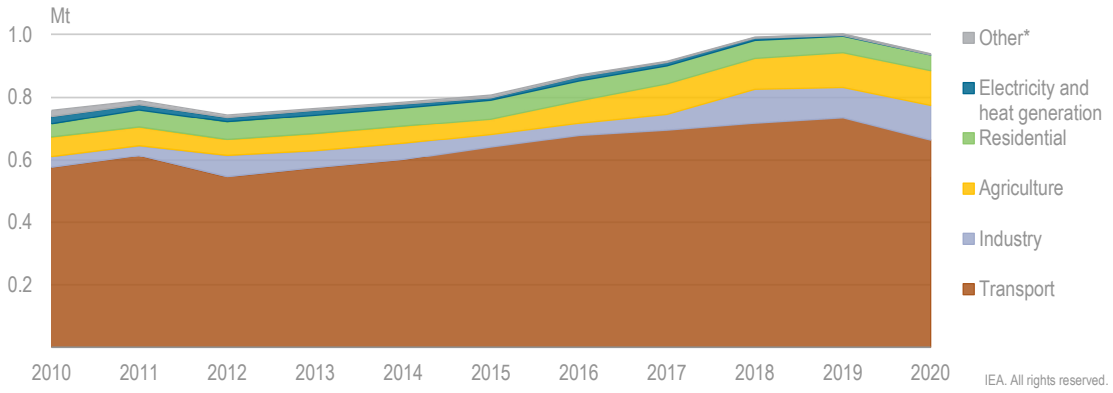
* Includes crude oil, white spirit, lubricants, paraffin waxes, petroleum coke, residual fuels and non-specified oil products.

Note: Total consumption includes refinery fuels and aviation bunkers, and excludes international marine bunkers.

Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

The majority of oil is consumed by the transport sector (71% in 2020), mostly in the form of motor gasoline and diesel. Agriculture and industry both accounted for around 12% of consumption, with the former mainly consuming diesel, whereas industry demand mostly consisted of bitumen and petroleum coke. Residential consumption of oil is limited (5%) and use for electricity and heat generation is negligible.

Figure 4.4 Moldova's oil consumption by sector, 2010-2020



For the last decade, the transport sector has driven oil demand in Moldova.

* Includes services, distribution losses, energy sector own use and unspecified consumption; not visible on this scale.

Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Oil market structure

The Republic of Moldova is a member of the Energy Community and is therefore committed to implementing the core EU legislation in oil and gas.

The main public institutions in the oil sector are:

- The Ministry of Infrastructure and Regional Development (MIRD) - the central body in the energy sector, in charge of developing and implementing energy policy in the Republic, including in the oil sector.
- The National Agency for Energy Regulation (ANRE) - the single authority for regulating the energy sector equipped with country-wide regulatory competences, including the oil and gas sector.

ANRE is by law set up as an institution legally distinct and functionally independent from any other public entity. Its main responsibilities in the oil sector include licences, monitoring and controlling the licensees' activities, price regulation, etc.

The oil products market is open to competition, with about two hundred licensees in the import and retail trade (see Table 4.2). However, the competition is *de facto* limited: large regional companies (Lukoil, Petrom, Rompetrol), which incorporate the entire value chain and have the flexibility in profits reallocation dominate the domestic market of oil products.

Table 4.1 Number of licence holders in the oil products market

Type of licence	31 December 2019	31 December 2020
Import and wholesale of gasoline and diesel	23	22
Import and wholesale of liquefied gas	11	13
Retail sale of gasoline and diesel at filling stations	90	90
Retail sale of liquefied gas at filling stations	76	77
Total	200	202

Source: *ANRE Licensing Register* (ANRE, 2021).

Oil prices and taxes

For Moldova, Platts FOB MED quotations for gasoline and diesel are the most relevant, and serve as reference prices for import contracts for petroleum products on the Moldovan market. The crude oil price (Brent) is less relevant, as there are no capacities to process crude oil in derivatives (refineries).

Until the end of 2015, according to the Law on the Petroleum Products Market (RoM, 2001), activity on this market was regulated by ANRE by:

- licensing of activity
- capping the profit margin for the petroleum products trading activity at 10%, a figure derived by the methodology for calculating and applying the prices for petroleum products, approved by ANRE in 2007. Within this limit, prices for petroleum products had to be applied independently by market operators.

However, according to amendments to the Petroleum Products Market Law (Law No. 461, 2001) passed in 2015 and which entered into force on 31 March 2016, ANRE was required to apply another methodology for petroleum product prices based on international quotations (using Platts and Argus price quotations). The regulation prohibits commercialisation of petroleum products at a price that exceeds the price ceiling set and published by ANRE. Every two weeks ANRE set the price ceiling for petroleum products according to the Platts FOB MED quotations, the tax component and the specific trade margin, regulated for each type of product.

Since 15 March 2019, the new methodology returns the price setting of fuel by the operators themselves, taking into account their costs and an annual rate of return of up to 10%. Changes in the methodology were made in connection with the adoption of the relevant amendments to the Petroleum Products Market Law in 2019 (Article 4 of Law 461) by the Parliament, due to the big discrepancies on the market. According to ANRE, for the year 2019, the average rate of return applied by licensees for the sale of petroleum products and liquefied gas in the formation of retail prices was 4.23%, while the average effective return was 1.51%.

Nevertheless, on 9 April 2021, the Moldovan parliament adopted new amendments to the Petroleum Products Market Law, providing for the establishment of new general rules for the calculation and application of prices for basic petroleum products to ensure the fairest prices for gasoline and diesel fuel, taking into account the existing fluctuations on international and regional exchanges (Platts). It is planned that prices will be calculated for 1 litre, separately for each type of product and imported batch. The suggested frequency of recalculation is 14 days. Within a month from the date of publication of the adopted law (middle of June), ANRE will develop and approve a new methodology for calculating and applying prices for petroleum products.

The taxation system of the Republic of Moldova includes general state taxes (VAT, excise tax, corporate and personal income taxes, custom tax and road tax) and local taxes (natural resources taxes, property tax, land tax, etc.) (Table 4.2). The energy sector is not subject to any specific taxation.

Consumption of gasoline and diesel, as well as LPG, is subject to excise tax.

Table 4.2 Excise taxes applied to the petroleum products

	Gasoline		Diesel		LPG	
	MDL*/ tonne	USD/ tonne	MDL*/ tonne	USD/ tonne	MDL*/ tonne	USD/ tonne
2018	2 092	125	4 961	295	3 124	186
2019	2 280	130	5 414	308	3 406	194
2020	2 508	145	5 960	344	3 580	207

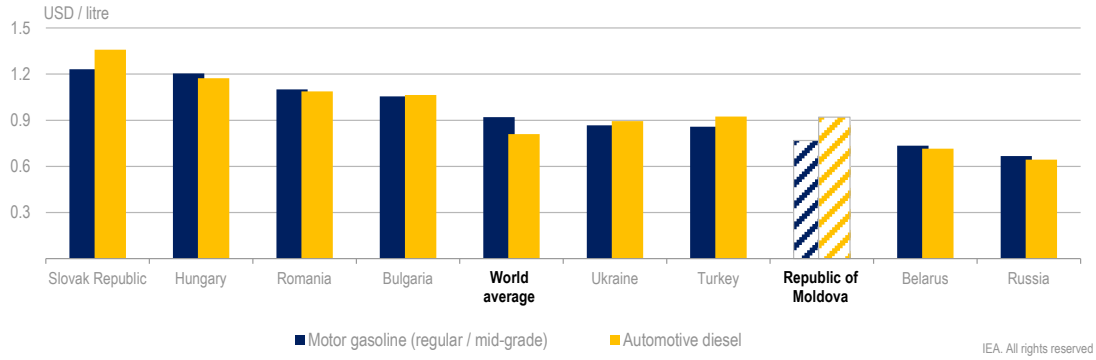
*MDL=Moldovan leu (100 Moldovan lei (MDL) = 5.77 USD; 5.06 EUR (2020)).

Source: RoM, 1997; updated 2020.

The Moldovan Tax Code sets a reduced VAT rate (8%) for the delivery of LPG and natural gas, no (0%) VAT for the delivery of electricity and heat to households, for which the standard VAT rate is set to 20%.

However, the price level for petroleum products in the Republic (excluding VAT and excise tax) is higher or at least at the same level when compared to other European countries, including those that are deeply dependent on imports (Figure 4.5). These countries' prices include other components in the form of specific taxes and duties: oil tax, emergency stock tax, energy tax, carbon tax, local and regional government tax, etc., not applicable in the Republic of Moldova.

Figure 4.5 Transport fuel price comparison for selected countries, 2020



Source: IEA (2022b), *World Energy Prices* (database), https://www.iea.org/data-and-statistics/dataproducts?filter=prices

Emergency response policy

As part of the EU Association Agreement and Moldova's membership in the Energy Community, the country must fulfil the requirements of the *acquis* on oil (Directive 2009/119/EC) by 1 January 2023 (Box 4.1). This imposes an obligation on Member States to maintain minimum (90 days import or 61 days of consumption, whichever is greater) stocks of crude and/or petroleum products.

At present, Moldova has no emergency oil stocks, as required by this Oil Stocks Directive, but only operational stocks. The stocks of petroleum products at the end of the year 2019 ensured the internal consumption for a period of 31 days for gasoline, 17 days for diesel and 28 days for LPG.

The country drafted a Law on creating and maintaining a minimum level of oil product stocks in 2017. The Law's adoption is pending, but submission to the Government and Parliament for adoption is planned by the end of 2021. The transposition of this Directive into the national legislation will put additional pressure on the petroleum products price.

Moldova's total storage capacity for petroleum products is over 150 000 m^3, including state and industry storage, while excluding the army's storage. In addition, the Giurgiulesti terminal has eight tanks for petroleum product storage with a total capacity of 63 600 m^3 at its disposal.

Box 4.1 Stockholding in IEA countries

The various stockholding regimes of IEA member countries reflect differences in oil market structure, geography and national emergency response policy. Three general approaches exist to ensure that overall stock levels meet minimum requirements: government stocks, agency stocks and industry stocks. Some countries use only one category of these, whereas most countries use a combination.

Government-owned stocks are typically financed through the central government budget and are held exclusively for emergency purposes. **Agency stocks** are also considered public stocks when a stockholding arrangement involves establishing a separate agency to maintain all or part of the stock obligation. The agency can be administered by the government or led and/or owned by industry. Public stocks offer the advantage of providing a clear indication of oil available solely for emergency purposes.

Industry stocks include both stocks held to comply with national stockholding rules and for commercial purposes.[1] For emergency stockholding, a government generally requires certain companies (e.g. importers, refiners, product suppliers and wholesalers) to hold a minimum amount of stocks. The required amount is set in proportion to the company's oil import share or its share of sales in the domestic market. One general attraction of a mixed system, in which both public and industry stocks are held, is that it can improve overall visibility of emergency stocks while maintaining an operational link with oil companies. In some cases, however, it can be problematic to distinguish between companies' operational and obligatory stocks, and thus difficult to monitor the stockholding obligation and the availability of these stocks in a crisis. By contrast, it is easier to monitor stocks that are completely segregated from operational stocks.

Another approach is to hold emergency stocks in tanks within commercial tank farms, where the location and volume of emergency stocks can be identified at any moment and made available during a crisis. This approach may offer the dual benefits of making the stocks visible and easy to check, and also readily available to be injected into the operational system quickly in times of emergency.

Source: IEA (2019), *Energy Security in ASEAN+6.*

Quality regulation

In order to create the necessary framework for the implementation of some provisions of the EU Directive 98/70/EC on the quality of gasoline and diesel, the Law on the Petroleum Products Market was amended on 26 July 2018. Thus, according to the new legal framework:

- The Agency for Consumer Protection and Market Surveillance carries out quality control of petroleum products.

[1] IEA emergency stockholding methodology. EU Council Directive No. 2009/119/EC does not count commercial stocks as contributing towards meeting the 90-day net import stockholding requirement.

- The Ministry of Infrastructure and Regional Development elaborates public policies and normative acts regarding the process of monitoring the quality of petroleum products.
- The monitoring of the quality of the petroleum products is carried out through accredited and recognised inspection bodies within a monitoring system approved by the Government.

Consequently, the normative framework was completed by establishing the mandatory technical specifications for motor gasoline and diesel based on health and environmental considerations, carried out according to the analytical methods provided in the European standards, as well as the introduction of a mechanism to monitor the quality of the fuels. However, gas oil used for non-road mobile machinery is not covered.

In 2019, the Ministry established a working group to ensure the preparation and publication of national data on monitoring the quality of gasoline and diesel. The first report was expected to be elaborated by the end of August 2021.

Assessment

As Moldova has almost no oil production or refining capacity, this chapter focuses on the downstream sector, including imports, wholesale and retail market of oil products (gasoline, diesel and LPG). These products face import excise and VAT at 20% (8% for LPG as for all gas products). This amounts to up to 5% of Government taxation revenue.

The market is relatively concentrated for import and wholesale. In general, however, it can be seen as still competitive, with the majority of product import and wholesale markets concentrated with around five companies holding circa 80% of market share. The outlier is the import of gasoline which is concentrated with only three companies with the majority of market share (where it may be necessary to facilitate an increase in competition). Stakeholders (companies) suggested that there is an oversupply in the retail sector which is significantly impacting potential returns. This would suggest that there is a strong potential for a functioning competitive market, but the regulator (ANRE) continues to apply price regulation to the market, instead of the market receiving oversight from a competition authority. The regulator moved (in 2019) from a variable price cap to a percentage margin for companies. However, the recently introduced amendments to the Law on the Petroleum Products Market (April 2021) provide for a new change in the procedure for setting fuel prices. Therefore, the wide public continues to perceive the oil product prices as regulated ones.

Market participants suggest that the combination of tight price regulation and excessive retail competition make the market potentially unattractive for international companies. They may find it preferable to have stronger regulation on licensing which could also include health and safety standards, and a removal of price regulations to be replaced by competition management. It may be necessary to provide support to improve the capacity of the competition council and provide appropriate communications to demonstrate the national and international competitiveness of the market to the citizens.

Moldova faces a significant challenge in complying with the requirement to create strategic stocks of crude and/or petroleum products. As of early 2021, Moldova had limited oil stocks. The country drafted a Law on creating and maintaining a minimum level of oil

product stocks in 2017, but this law's completion is still pending. The draft Law foresees its entry into force in the first quarter of 2022.

There remain significant issues in terms of the appropriate mechanism to meet this directive and the available facilities and compliance costs depending on the approach. This uncertainty and delay will only increase the potential negative impact (e.g. pressure on prices) if it is found necessary to increase reserves in a short period of time.

Moldova is also looking to the future within the oil products sector, by starting to undertake pilots and programmes for biogas, compressed natural gas and electric vehicles alongside policies for the blending of biofuels in the imported fuels. These activities could help to improve security of supply and reduce the climate and environmental impacts (e.g. pollution), but also increase reliance on gas. There is a need for greater clarity of the policy framework and its potential impact in supporting or limiting these developments, and in the future the tax revenue from oil products could be replaced. Future technical areas may include blending of biofuels, electric vehicles, compressed natural gas and biogas.

Recommendations

The Government of Moldova should:

- ☐ Increase the speed of the transition towards a fully liberalised oil products market. Encourage the regulator to remove price regulation, whilst improving licensing regulation.
- ☐ Decide as soon as possible – in a consultative and transparent way – on the approach to delivery and monitoring of the strategic oil stockholding.
- ☐ Fully consider the wider implications of future technological developments that may provide alternatives to oil products.

References

ANRE (2021), Licensing Register [in Moldovan/Romanian].

ANRE (National Agency for Energy Regulation) (2020), Report on the Result of Monitoring the Oil Products Market of the Republic of Moldova for 2019, http://anre.md/rapoarte-de-monitorizare-3-102

ANRE (2016), Methodology of Formation and Application of Prices to Petroleum Products, Decision No.102, Approved on 31.03.2016

ECS (Energy Community Secretariat) (2020), Annual Implementation Report 2020 (https://www.energy-community.org/implementation/IR2020.html);it

IEA (2019), Energy Security in ASEAN+6, https://www.iea.org/reports/energy-security-in-asean6

IEA (2022a), World Energy Statistics and Balances (database), https://www.iea.org/data-and-statistics

IEA (2022b), World Energy Prices (database), https://www.iea.org/data-and-statistics.IEA (International Energy Agency) (2019), *Energy Security in ASEAN+6,* https://www.iea.org/reports/energy-security-in-asean6

NBM (National Bank of Moldova) (2021), *Balance of Payments for 2020* (https://www.bnm.md/files/02_BP_2020_q4.pdf).

RoM (Republic of Moldova) (2001),, *Law on the Petroleum Products Market of the Republic of Moldova, Law No. 461/2001, Approved on 30.07.2001* [in Romanian], https://www.legis.md/cautare/getResults?doc_id=111446&lang=ro [also available in Russian at this site].

RoM (Republic of Moldova) (1997; updated 2020), *Tax Code*, https://sfs.md/uploads/files/Docs/tax-code/Tax_Code_of_the_Republic_of_Moldova3.pdf; www.legis.md/cautare/getResults?doc_id=117668 [in Moldovan/Romanian; Russian version also available at the site]

5. Electricity

Key data

(2020 provisional)

Electricity generation: 0.98 TWh (natural gas 86.6%, wind 5.2%, hydro 4.8%, bioenergy 3.0%, solar 0.4%, oil 0.1%); -7.6% since 2010

Electricity net imports*: 3.42 TWh (imports 3.42 TWh, no exports)

Electricity import dependency: 80% of total electricity supply

Installed capacity: 490 MW

Electricity consumption: 3.85 TWh (residential 44.9%, services 32.6%, industry 18.3%, transport 1.1%, other 3.1%), +10.4% since 2010

Exchange rate: 100 Moldovan lei (MDL) = 5.77 USD; 5.06 EUR (2020)

*Includes quantities procured from the Moldavskaya GRES [power plant].

Overview

Moldova's total electricity generation capacity[1] is limited, 490 megawatts (MW) in 2020, and local electricity production accounted for 20% of the supply. As of early 2022, Moldova was synchronously interconnected with Ukraine's Integrated Power System (IPS) and, in turn, Russia's Unified Power System (UPS). In addition, Moldova also has an interconnection with Romania. On February 24, Ukraine and Moldova successfully disconnected from UPS to run in island mode. On March 16, Moldova, along with Ukraine, were able to connect their power systems via emergency synchronisation to that of ENTSO-E. However, full synchronisation, which would allow for commercial electricity, has not yet occurred. Technical work remains underway, but Moldova is significantly closer to achieving its long-held objective to fully integrate into the EU electricity market. Today, Moldova's wholesale electricity market is based on bilateral contracts, and most electricity supply is procured from the Moldavskaya GRES (or MGRES) power station situated in Transnistria, or imported from Ukraine. Driven by the EU membership aspirations, Moldova implements electricity sector reforms aligned with the EU energy *acquis*, which includes

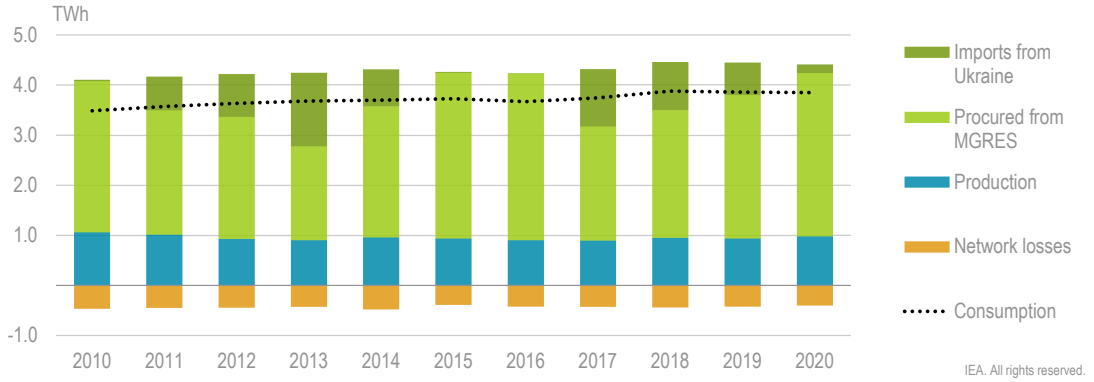
[1] In this publication, Moldova's electricity sector does not include the Transnistrian region (the left bank of the Dniester river), where the Moldovan authorities do not monitor the electricity sector. The Moldavskaya GRES (MGRES) is the only participant from the Transnistrian region that has applied for and obtained a licence for electricity production from ANRE (Moldelectrica (2021a), Surse de Energie/ Energy Sources, https://www.moldelectrica.md/ro/electricity/energy_sources).

unbundling, enhancing competition and security of electricity supply, regional integration and facilitating integration of renewable energy into the power system.

Supply and demand

Local electricity production can meet only a fifth of the demand. Imports of electricity have hovered around 80% over past 10 years (Figure 5.2). The rest is procured from the Moldavskaya GRES [state district power plant], or MGRES) power station – 3.25 TWh in 2020 - situated on the right bank of the Dniester River and owned by the Russian company Inter RAO, or imported from Ukraine (0.17 TWh). Electricity consumption has grown only modestly in recent years (1.0% AAGR 2010-2020) and is expected to remain at about this rate in the period to 2030 (Ministry of Infrastructure and Regional Development, 2020) Network losses are on the decline, being 10.0% of the supply in 2020 (-15.6% since 2010) (Figure 5.1).

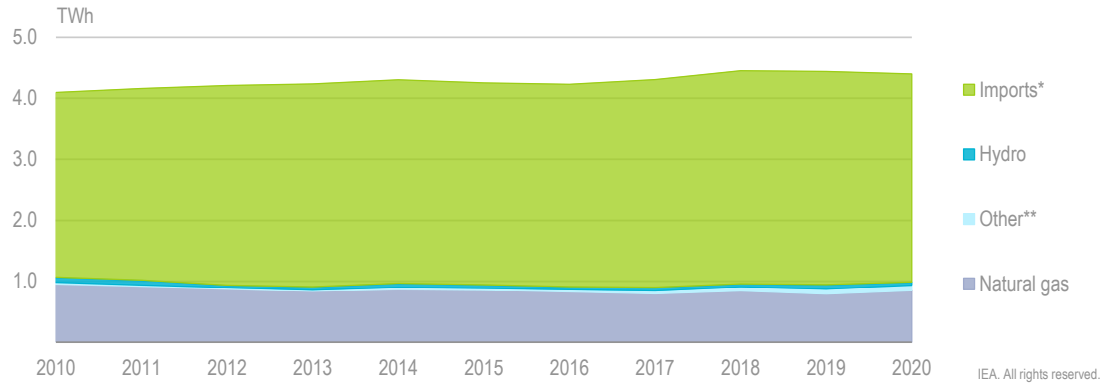
Figure 5.1 Moldova's electricity supply, 2010-2020



Around 80% of the electricity supply consists of imports (including electricity procured from MGRES).

Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Figure 5.2 Electricity supply by source, 2010-2020



The bulk of electricity consumed in Moldova comes from imports.

* Includes quantities procured from MGRES. ** Includes wind, biogases, oil and solar PV.

Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Imports and procurement from MGRES

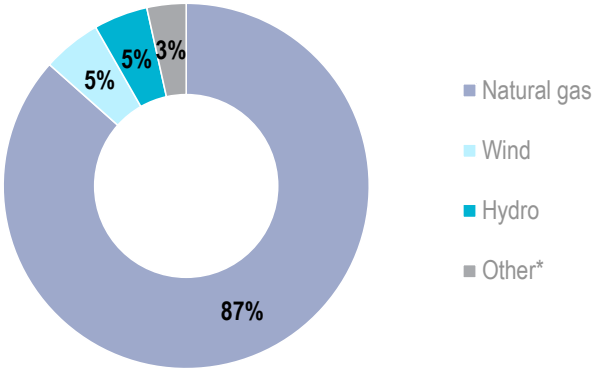
Moldova has electricity interconnections with Romania (400 kV and 110 kV) and Ukraine (330 kV and 110kV). Since the 1990s, it has procured most of its electricity supply from the MGRES and the additional demand has been covered by imports from Ukraine. The situation has its roots in the Soviet period when the electricity systems of the neighbouring republics were integrated, and the large Moldavskaya GRES power station served a large area including the current-day Moldova. In 2020, the country procured 3.25 TWh from MGRES and imported 0.16 TWh from Ukraine, with virtually no exports of electricity. Moldova is among the few countries of the world where more electricity is imported than produced locally.

Generation

Moldova's gross electricity generation was 0.98 Terawatt-hours in 2020 (-8% since 2010). It is generated primarily by natural gas-fired power plants (87% in 2020, 10-year average share in generation was 90%). The remainder has traditionally been generated mostly by hydro power plants (HPPs), (4.8% in 2020, 10-year average share was 6%). However, in 2020, for the first time more electricity was generated from wind (5.2%) than hydro due to capacity additions (See Table 5.1). Gropa's research (2018) indicates that the system could absorb around 1 GW of renewables. The increased use of solar PV and wind technologies, however, would present a big challenge, as Moldova completely depends on Ukraine for generation balancing. The government decided to approve caps for renewable capacities development (RoM, 2018), in order to avoid paying high costs for RE or for balancing. In the same context, it should be mentioned that the capacity that the state is ready to support, 168 MW, is enough to reach the target share of 10% of the electricity demand satisfied by locally produced renewable electricity by 2020 out of the planned target of 460 MW by 2025 (GoM (Government of Moldova) (2020)).

The remainder of the electricity is generated via biogas, oil and solar PV (Figure 5.3). The rapid growth of wind generation cannot yet offset the reduced electricity output from natural gas-fired plants. However, this may change in the future with the plans of adding a 55-MW combined-cycle gas turbine (CCGT) plant and about 400 MW from renewable energy plants (2022-2025). Financing for and development of these planned projects will require substantial investment.

Figure 5.3 Electricity generation by source, 2020



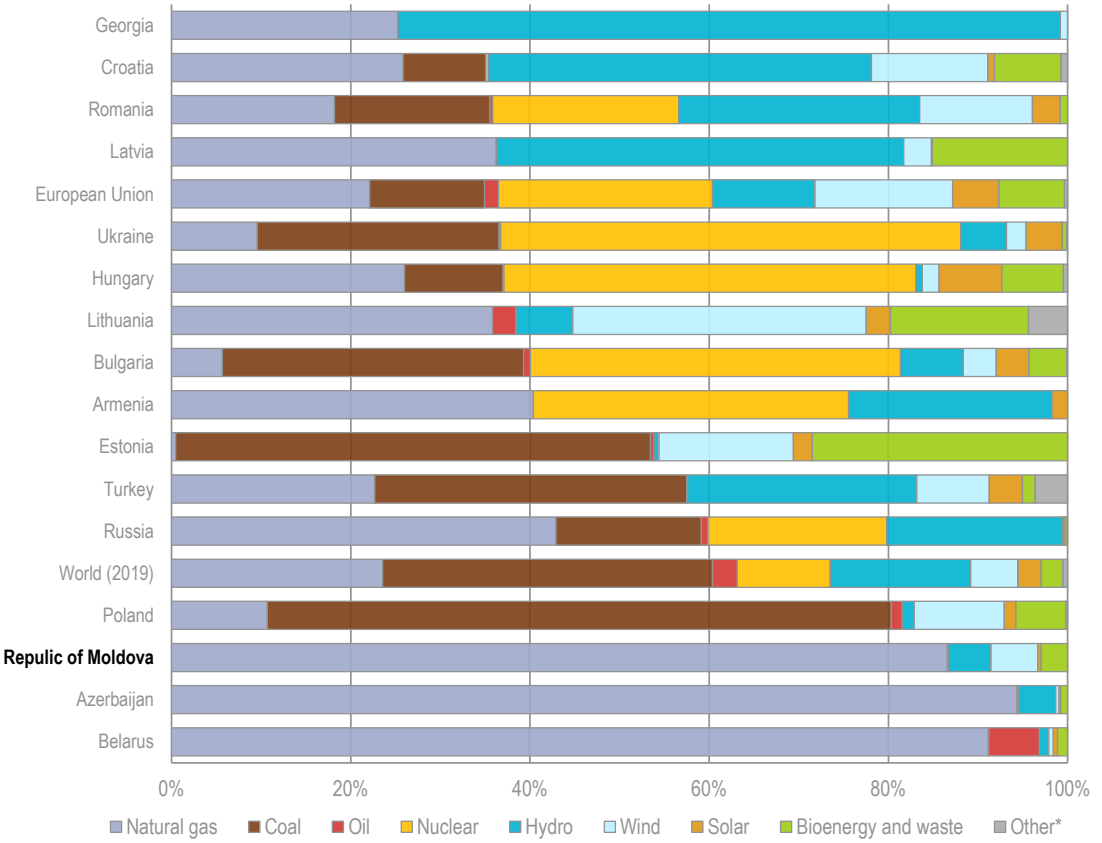
Moldova's electricity mix is dominated by natural gas.

* Includes biogases, oil and solar PV.

Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Due to the country's heavy reliance on natural gas for its electricity generation, the share of fossil fuels in the electricity mix is high, almost 90% (Figure 5.3). This is above the world average fossil fuel share of two-thirds of electricity generation (Figure 5.4).

Figure 5.4 Electricity generation by source in selected countries, 2020



Around 90% of Moldova's electricity generation is based on natural gas.

* Includes solar photovoltaic (PV), solar thermal, wave and ocean power, and other power generation (e.g. from fuel cells).

Source: IEA (2021), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Moldova's installed generation capacity stood at 490 megawatts (MW) in 2020 (Table 5.1). Almost 90% of this is from combustible fuels. In recent years, some natural gas capacity has effectively gone off-line due to ageing infrastructure. The major plants operate in steam cycle using condensers.

Hydro potential is almost completely tapped, but wind capacity is expected to increase in the future.

Table 5.1 Installed electricity-generating capacity, (MW)

Energy source	2000	2005	2010	2017	2018	2019	2020
Hydro	16	16	16	16	16	16	16
Solar PV	-	-	-	2	3	5	4
Wind	-	-	-	9	34	35	41
Combustible fuels	-	-	433	450	425	430	428
Oil	-	-	12	69	68	73	70
Gas	-	-	421	375	352	352	352
Bioenergy and waste	-	-	-	6	6	6	7
Total capacity	16	16	449	477	478	486	490

Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

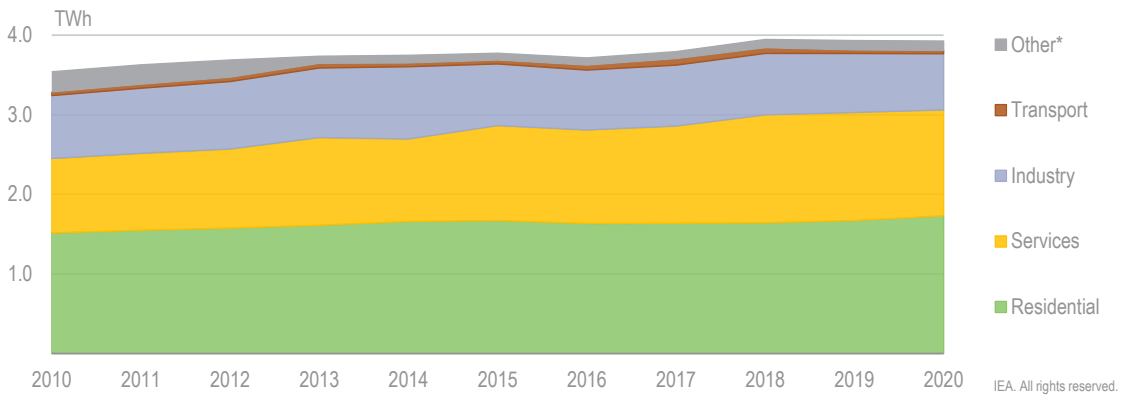
Electricity demand

Total electricity consumption was 3.8 TWh in 2020 (+10% since 2010) (Figure 5.5). The residential sector is the main consumer with a 45% share of the total (1.7 TWh) in 2020. Residential consumption grew by 14% between 2010 and 2020. For comparison, global residential demand grew over 20% since 2010.

Services are the second largest consumers of electricity (1.3 TWh in 2020) amounting to 33% of the total and also responsible for the largest absolute growth since 2010 (0.4 TWh or +29% since 2010), driven by the sector-intense development over the last decade.

The industrial sector consumed only 18% of the total in 2020, declining 11% since 2010. The remainder is consumed by agriculture, transport and energy industries.

Figure 5.5 Electricity consumption by sector, 2010-2020



The residential sector is the largest consumer of electricity.

* Includes unspecified consumption in the energy industries and agriculture.

Note: TWh = terawatt-hour.

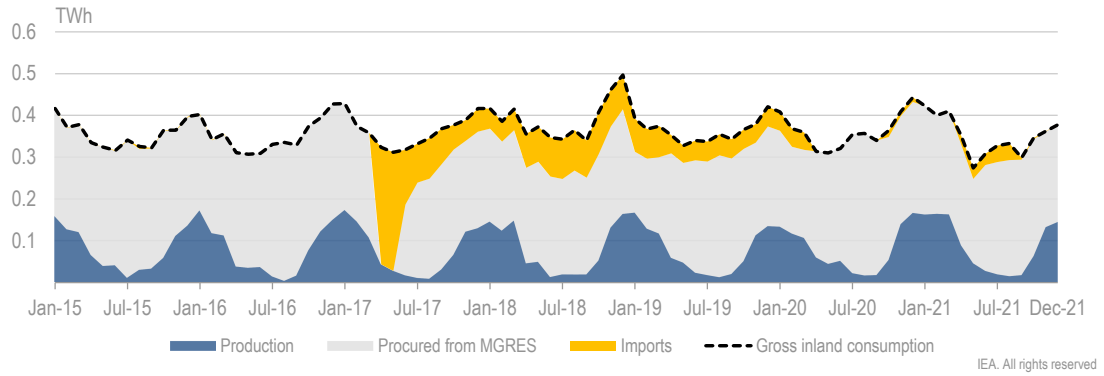
Source: IEA (2022a), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

As virtually all electricity generation in Moldova is generated from natural gas, the generation pattern is mainly driven by the demand increase during the heating season with its peak in January (Figure 5.6).

In the cold season, the typical load variation of the Moldovan power system (the right bank of the Dniester River only) ranges between a minimal base load of 330-370 MW and a maximum peak load of 700-760 MW, while in the summer season it ranges from a minimum of 260 MW to a maximum of 610 MW. The maximum load for both banks of the Dniester can reach up to 1 100 MW (Moldelectrica, 2018).

Due to the insufficient generation capacity and the structure of the power system (heat-demand driven CHP plants and small-scale hydropower plants with vulnerable hydrology), Moldova has no plants that can fully provide primary, secondary and tertiary capacity reserves. It must therefore rely on Ukraine for frequency control as well. MGRES could provide some additional reserves, but such an agreement had not been concluded as of 2021.

Figure 5.6 Moldova's monthly electricity supply, January 2015-December 2021



Domestic electricity production shows a strong seasonal pattern peaking in January.

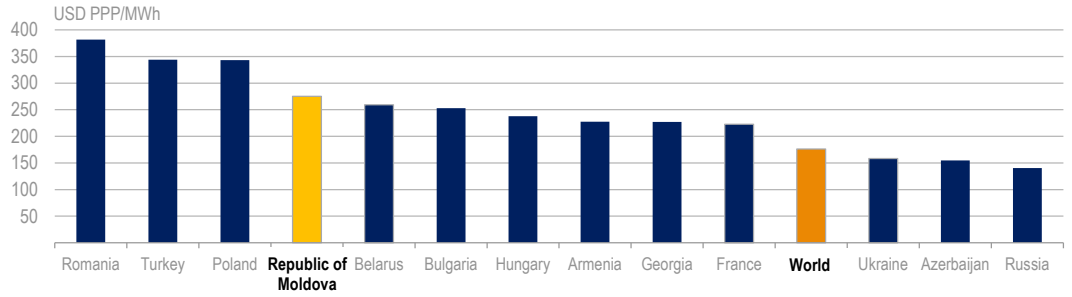
Notes: TWh = terawatt-hour.

Source: National Bureau of Statistics of the Republic of Moldova (2022), Stocks, inputs and electricity consumption, monthly, 2015-2021 (database), http://statbank.statistica.md/PxWeb/pxweb/en/40%20Statistica%20economica/40%20Statistica%20economica__15%20ENE__serii%20lunare/ENE010100.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774)

Electricity prices

An international price comparison, particularly with the countries in the region (Figure 5.7), shows that the residential electricity price in Moldova is 28% lower than it is in Romania. By contrast, it is almost 70% higher than in Ukraine.

Figure 5.7 Residential electricity prices in selected countries, 2020



The residential electricity price is notably different compared to its neighbours: lower compared to Romania but significantly higher than in Ukraine.

PPP = purchasing power parity.

Source: IEA (2022b), *World Energy Prices* (database), https://www.iea.org/data-and-statistics

Institutional framework

Key institutions

The line ministry responsible for the energy sector is the Ministry of Infrastructure and Regional Development, which, according to the Law on Energy, is primarily in charge of energy sector policies and legal framework development, in addition to the energy sector itself (electricity, gas, oil, district heating, etc.). The EU Third Energy Package requirements are fully transposed into Moldova's energy legislation.

The Law on Electricity (adopted May 2016) created the general legal basis for the management and regulation of the electric utility sector, ensuring its effective functioning and monitoring. The Government of Moldova is primarily in charge of electricity sector policies and legal framework development. The Law provides for the division of the electric power industry according to licensed types of activity: production, market management, transmission, distribution and sale of electricity. The law also ensures that all final customers are eligible to buy electricity from any generator or supplier, but as of November 2021 no customer has exercised the right to switch providers.

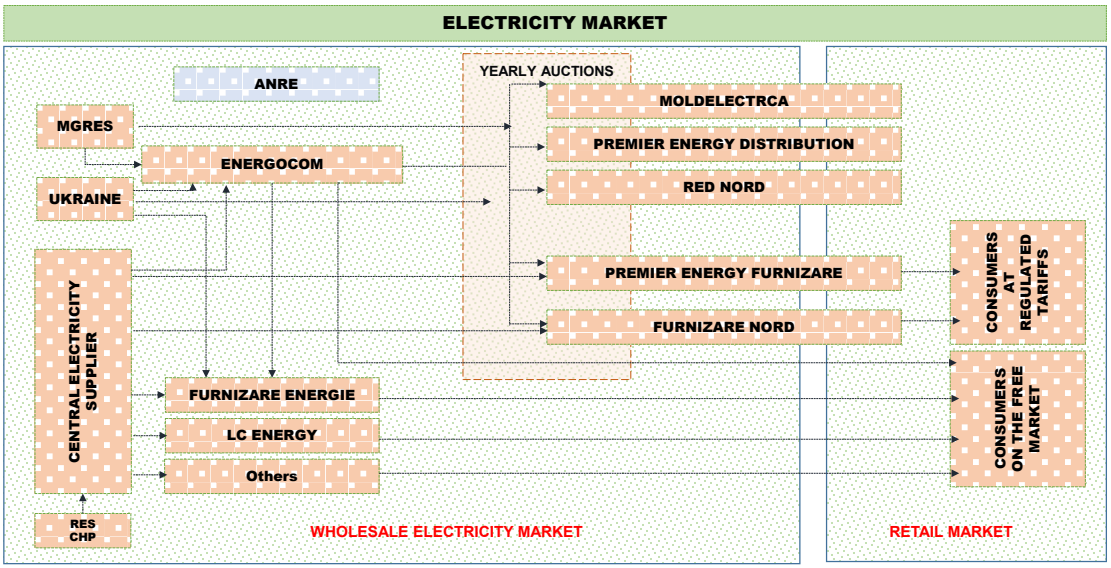
The National Agency for Energy Regulation of the Republic of Moldova (ANRE) is an independent public authority that supports introduction of market mechanisms in the energy sector and regulates the sector while protecting the interests of customers and investors. For the electricity sector, ANRE supervises compliance legislation, promotes and ensures fair competition and efficient operation of energy markets, issues licences for activities on the energy market, monitors the investment plans of system operators, approves standards and requirements for the transmission system operator (TSO) and distribution system operators (DSOs), and approves regulated tariffs and costs of power system maintenance and planed investments for TSO and DSO.

The Competition Council is the authority which ensures that provisions of the Law on Competition are implemented properly in the electricity sector.

Sector structure

Key players

Figure 5.8 Moldova's electricity market



Source: European Union High Level Advisers' Mission 2019-2021.

There are multiple public and private actors in the electricity sector in Moldova (Figure 5.8). These include domestic electricity production companies which include larger CHP plants (**Termoelectrica, CHP-Nord**), **Costesti** hydropower plant and several smaller private companies that include CHPs in the sugar industry and small renewable electricity plants. In addition, the largest generation company of relevance to the Moldovan electricity system is **Moldavskaya GRES (MGRES)**, a subsidiary of the Inter RAO UES, located in the breakaway region of Transnistria.

As demonstrated in the section on Supply and Demand, electricity supply in Moldova is dominated by gas-fired generation, including CHPs, and electricity procured from MGRES. **Moldovagaz JSC**, a vertically integrated company and monopoly supplier of Russian gas that controls the entire chain of the gas business: import, transit, transmission, wholesale supply, distribution and retail supply. **Moldovatransgaz LLC** is the operator of the gas transmission system of the Republic of Moldova that performs a set of organisational and technical measures for the maintenance and operation of main gas pipelines and their facilities (see Chapter 3 for more details).

SE Moldelectrica is the state-owned single power TSO of Moldova, which specialises in centralising the transport services and operative dispatching of the electricity system. SE Moldelectrica manages the internal transmission network on the right bank of the Dniester River.

Electricity distribution in Moldova is comprised of two DSOs. **RED Nord** is 100% state-owned while **Premier Energy Distribution** is privately owned. The latter covers about 70% of the territory of Moldova (excluding the territory on the left bank of the Dniester River).

The main suppliers are:

- Premier Energy (former Gas Natural Fenosa Furnizare Energie) LLC Foreign Capital Company which was created as a result of the separation of the activities of SCS Premier Energy Distribution JSC FCC (former RED Union Fenosa JSC), in accordance with the Law on Electricity (EU Directive 2003/54 / EC);

- Furnizarea Energiei Electrice Nord JSC founded as a result of the separation of distribution and supply activities of RED Nord and RED Nord-West.

Both companies sell electricity at regulated prices and act as suppliers of last resort. There are also a number of electricity suppliers which sell electricity at non-regulated prices through the wholesale electricity market.

Energocom JSC, is the designated Central Electricity Supplier. According to the provisions of the Law on Electricity, the Law on Promoting the Use of Energy from Renewable Sources and the Law on Thermal Energy and Promotion of Cogeneration, Energocom is also a single buyer for renewable electricity and electricity produced by cogeneration plants. Energocom JSC is a state-owned electricity supplier and trader on the wholesale market, which, until 2021 managed electricity import contracts with Ukraine and MGRES. It also covers imbalances for eligible producers of renewable electricity. While another 27 suppliers are currently licensed by ANRE, a large part of these suppliers are not active on the electricity market. The competitive electricity market share in 2019 was 7.4% and 9.7% in 2020 (EnC, 2021).

Electricity grid and interconnections

Moldova's electricity grid was predominantly built in the times of the Soviet Union, making it relatively old and inefficient. Until late-February 2022, it was synchronously interconnected with Ukraine's Integrated Power System (IPS) and, in turn, Russia's Unified Power System (UPS) in the northern and south-eastern parts of the grid. While Moldova is also interconnected with Romania, it cannot operate synchronously with Romania's electricity system, which is part of ENTSO-E and has stricter regulations for the technical operation of its network. Hence, with ENTSO-E it is limited to operation in island mode, allowing only very small amounts of trade.

Synchronous interconnection occurred on 16th of March 2022, but was an unforeseen event, triggered by the war in Ukraine. Commercial exchanges are not yet allowed, but technical work is ongoing to allow for full trade, potentially as early as mid-2022. Synchronous work in the ENTSO-E system via Romania in normal mode would require significant effort in terms of the rehabilitation and modernisation of generators, lines and substations, which currently fall short of ENTSO-E technical requirements. Some rehabilitation of the network is ongoing, supported mainly by international financial institutions.

The State Enterprise Moldelectrica is a specialised enterprise that provides centralised operational dispatch control of the Moldovan energy system. The TSO has two main groups of tasks:

- transmission of electrical energy
- unified operational and technological management of the Moldovan energy system.

The electrical equipment kept in operation by TSO SE Moldelectrica consists of:

- 183 electrical transformer substations (SS) 10 - 400 kV;
- 4 704.41 km of electrical overhead lines (OHL) 35 – 400 kV;
- Power transformers and autotransformers with total power of 5 071.8 mega volt ampere (MVA).

In order to ensure regulation of the activities of electricity transmission and distribution companies, and protection of the interests of consumers and producers of electricity, ANRE adopted Regulation 168/2019 for connecting to electrical networks and transmission services and distribution of electricity, which provide details of terms of access to distribution networks, as well as connection provisions.

Tariffs for accessing distribution networks are regulated and approved by ANRE (decisions 40/2021 and 41/2021 on regulated tariffs and prices on electricity) (Table 5.3).

Table 5.2 Distribution tariffs

Electricity distribution	Premier Energy Distribution	RED Nord
	bani/kWh*	
Networks: 35;110 kV	2	-
Networks: 6;10 kV	13	28
Networks: 0,4 kV	39	89

* 1 Moldovan leu = 100 bani

Source: ANRE (2021a). Tarife pentru serviciul de distribuţie/Distribution Tariffs, https://www.anre.md/tarife-pentru-serviciul-de-distributie-3-69

Losses in the electricity distribution networks during 2001-2010 dropped from over 29% to 13%, after the distribution network operators were bounded to invest in their networks and improve their performance under the regulations approved by ANRE. Over the next decade distribution losses continued to be reduced and were 7.6% in 2020. In 2020, distribution losses decreased by 0.5 percentage points below the level of 2019 (ANRE (2021b), Rapoarte de Monitorizare/ Monitoring Reports)

Prior to the synchronous interconnection with ENTSO-E, for which certain requirements had to be met (Box 5.1), Moldova aimed to connect asynchronously with Romania via back-to-back converters, with a memorandum of understanding (MoU) concluded between the two countries in 2015 on five key projects for interconnecting both the electricity and gas systems. This includes three projects for asynchronous connection of the electricity networks in the north, central and southern parts of Moldova. The asynchronous electricity in the southern part (Isaccea – Vulcanesti – Chisinau) has been started, involving the construction of a new 400 kV power line from Vulcanesti to Chisinau and a back-to-back substation of 600 MW in Vulcanesti. Financing is through an EU grant of 40 million Euros and loans from the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and World Bank. From mid-March 2022, Moldova was

able to connect to ENTSO-E in synchronous mode through the Ukrainian power system.

Upcoming projects will further strengthen the connection between Romania and Moldova power systems.

The electricity network in Moldova is comprised of 400 kilovolt (kV), 330 kV, 110 kV, 35 kV, 6–10 kV and 0.4 kV lines. Moldelectrica manages the internal electricity transmission network of 4 700 kilometres (km) of lines on the right bank of the Dniester River and also dispatches 1 746 km of Dnestrenergo transmission lines in the Transnistrian region (Moldelectrica, 2021b). The electricity distribution network is composed of 56 850 km of distribution lines, supplying 1.3 million consumers.

In addition to the new interconnections, generators, lines and substations will need to be rehabilitated and modernised. Some rehabilitation of the network is ongoing, supported mainly by international financial institutions: the EBRD, EIB, and the EU Neighbourhood Investment Facility (NIF).

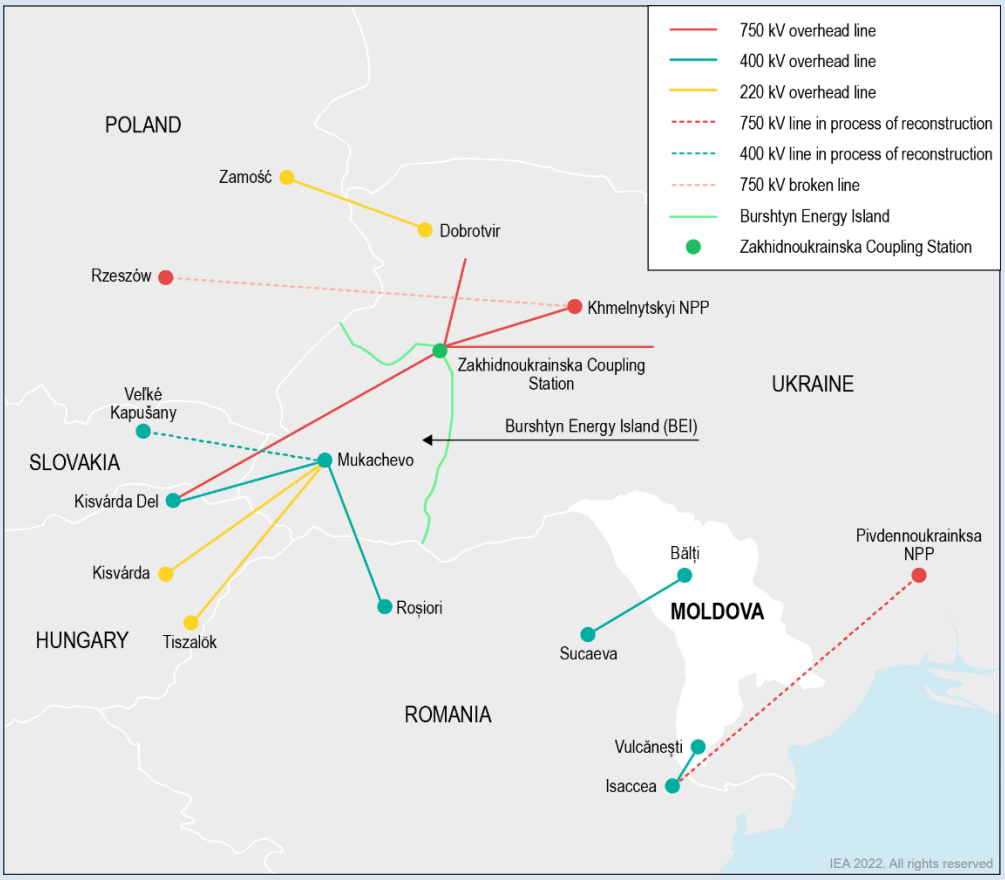
Box 5.1 Moldova and ENTSO-E

"The ten-year network development plan (TYNDP) that ENTSO-E publishes every two years presents how to develop the power grid in the next 10 to 20 years. The TYNDP is the outcome of a two-year process, starting with the development of scenarios or visions of how the European power system might look in 2030 and 2040. Over 200 experts Europe-wide carried out regional exploration studies, pan-European analyses and assessed projects to reinforce the grid submitted through a European-wide call for candidature.

Regulation (EC) 714/2009 tasks ENTSO-E with developing a non-binding Community-wide 10-year network development plan, aimed at providing a vision of the extra-high voltage grid in 10-15 years' time, and Regulation (EU) 347/2013 makes the TYNDP the sole basis for the selection of Projects of Common Interest (PCIs)" (ENTSO-E, 2019).

"In 2017 the Ukrainian Transmission System Operator (TSO) Ukrenergo signed a Connection Agreement with the Moldovan TSO Moldelectrica and ENTSO-E, called "Agreement on the Conditions for Future Interconnection of Power System of Ukraine with Power System of Continental Europe with Ukraine's Ukrenergo and Moldova's Moldelectrica" (Energy Community Secretariat, 2021). The agreement contains a list of legal, regulatory, market and technical requirements to enable accession to the synchronous European grid within a set timeframe of six years" (Zachmann and Feldhaus, 2020, pp. 140-141).

Synchronous interconnection by ENTSO-Ukrenergo-Moldelectrica



Map source: Berlin Economics (2020)

Source: ENTSO-E (2016), Recommendations relating to the coordination of technical cooperation between Union and Third Country TSOs.

Electricity market

The wholesale electricity market, in its current shape without a spot market, is based on a number of bilateral contracts between transport and distribution companies (that purchase electricity to cover network losses), generators and power suppliers (traders). Currently there is a lack of wholesale competition: imports from Ukraine or the MGRES plant situated in Transnistria together accounted for 80% of the electricity supply in 2020. These imports from are concluded on an annual basis through a tendering procedure. The Law on Electricity (Law No. 107 of 27 May 2016) is expected to ensure the liberalisation of the electricity market, as discussed in the next section.

As the MIRD's 2017 Security of Supply statement (p. 17) points out: "Electricity suppliers and eligible customers are bound to buy all electricity produced by CHPs, hydropower plants and RES PP [power plants] on [the] mainland [i.e. the right bank of the Dniester river] which de facto represents all electricity produced on [the] mainland at present. In this respect, [the] Law on Electricity provided creation of a Central Electricity Supplier (CES) that must purchase all electricity produced by CHP, HPP and RES PP[s] and sell it to all suppliers and eligible customers, according to the market share." By the Government

Decision no. 885/2017 and 986/2020, JSC Energocom was designated as a central electricity supplier during the validity period of its licence for the supply of electricity. Then, once the new electricity market rules come into force, participants are required to use the bilateral and day-ahead market to balance contractual obligations and efficiently operate in the electricity market.

The design for the operation of the new wholesale electricity market and detailed wholesale electricity market rules were approved in August 2020 and entered into force 2 October 2021. Starting from 1 January 2015, final consumers became eligible to purchase electricity from any producer, or supplier, including from abroad.

Sector reforms

Electricity sector policy is driven by Moldova's intention to integrate into the European Union and its internal energy market. The legal and regulatory framework in Moldova has been developed with the objective of harmonisation with the European framework and the *acquis communautaire*. To comply with the Third Energy Package and other EU requirements, the key policy priorities for the Moldovan government include: improving security of supply; electricity sector unbundling (i.e. supply and generation are separated from the operation of transmission networks); enhancing competition; and improving regional integration and building interconnections, and facilitating integration of variable renewable energy (VRE).

The Law on Electricity No. 107/2016, transposing the Directive 2009/72/EC concerns common rules for the internal electricity market, including:

- defining the competencies of the governmental authorities and the objectives, duties, powers and rights of the ANRE
- defining the tasks and responsibilities of the producers, transmission system operators, distribution system operators and of the electricity suppliers
- defining the concept of public service obligation and the basic rules for imposing such obligations, which may refer to security, including security of supply, regularity, quality and the price of supplies, as well as to environmental protection, including energy efficiency and energy from renewable sources
- separation, appointment, certification and independence of the transmission and distribution system operator
- developing networks and competencies in order to make investment decisions
- defining the concept of consumer protection and first of all, of vulnerable consumers in terms of energy poverty
- defining market organisation, market liberalisation and third party access to the transmission and distribution systems.

In addition to the primary legislation, a number of secondary normative acts have been approved by ANRE, in particular regarding such issues as licensing, market rules, investments, tariffs, customer protection, access and connection to the electricity network, energy contracting, supplying and billing and guarantees of origin for energy produced from renewable sources.

As a result of the adoption of the Law on Electricity and the Law on Promoting the Use of Energy from Renewable Sources, some normative acts of ANRE have been modified in accordance with the primary legislation and other new acts have been developed and implemented in order to ensure a proper implementation of these laws.

The Third Energy Package unbundling models cannot be implemented under the current legislative framework in Moldova. The Moldovan authorities are in the process of transposing the independent system operator model into the Law on Electricity.

On 7 August 2020, the energy regulator, ANRE, approved the wholesale electricity market rules, developed with the support of the Energy Community Secretariat. The rules entered into force in October 2021. The wholesale market rules replaced the Transparency Regulation and include a procedure that became operational in January 2021 for the procurement of electricity. However, as of January 2022 there is no mechanism for distributing the imbalances between the balancing responsible parties. Such a mechanism is expected to be developed during 2022.

Competition is not likely to improve before Moldova couples its electricity market either with Ukraine or the European market (see implementation status in Table 5.4) through the interconnection with Romania. With the signature and ratification of the loan agreements, the Government of Moldova took important steps to advance the project on interconnection with the Romanian electricity system using back-to-back stations. The project is envisaged to be operational by 2024.

In order to strengthen the operational capacity of the Moldovan power-sector regulator, the Energy Community recommended the following:

- regulation of the institutional performance management of ANRE
- improvement of the performance of ANRE's subdivisions and employees. This regulation sets well-defined objectives, on an annual basis, and performance indicators for achieving the objectives. Clear and transparent procedures regarding the process of selection and hiring staff were established
- creation of the Council of Experts of ANRE. This Council, created in 2019, consults with the Administration Council of ANRE. According to ANRE's Decision no. 142/2019, the Regulation on establishing the Council of Experts of ANRE and its attributions was approved. The Council of Experts has 14 members, including four representatives from academia, four representatives from civil society, three representatives from the media and three representatives from professional associations from regulated sectors or other non-commercial organisations;
- instituting a code of ethics and professional conduct for ANRE. The Energy Community recommended that ANRE obligate its employees to remain independent

from regulated companies and political influence. In 2019, the Administration Council approved the Code of professional ethics and conduct of ANRE (Decision no. 29/2019 of 06.03.2019).

Importantly, this final recommendation regulates the procedures for the drafting of acts by ANRE and regulates the procedures for interacting with civil society. It also has an impact on the procedures of submitting and examining the applications of licensees regarding regulated prices and tariffs. The regulation regarding this (approved by Decision no.286/2018, 17.10.2018) goes even further. This regulation increases transparency in the process of examining and approving prices and regulated tariffs.

Table 5.3 Moldova's implementation status with regard to Energy Community requirements for the electricity market

Electricity Indicators	Implementation Status	Descriptions
Unbundling	55%	The lack of unbundling of electricity transmission is subject to an infringement case. Unbundling of the distribution system operators is compliant.
Access to the system	48%	Tariffs are approved and published. The Connection Network Codes have been implemented since January 2020. The Transparency Regulation is transposed by the wholesale electricity market rules, which are not yet in force
Wholesale market	38%	The entry into force of the wholesale electricity market rules, initially envisaged for 2 October 2021, was postponed until 1 January 2022. The transposition and implementation of REMIT depends on amendments to the Laws on Electricity and Energy
Retail Market	58%	Though all customers are formally eligible, they still have access to regulated service supply until 2026. Despite that, market opening reached 9.7% in 2020 compared with 7.4% in 2019.
Regional integration	15%	The Moldovan and Ukrainian transmission system operators have made progress towards joint allocation of cross-border capacities and settlement of unintentional deviations. The delays in adoption of the wholesale electricity market rules in Moldova impede further progress.

Source: Energy Community, 2021.

Security of supply

As the foundation of its Energy Strategy 2030, Moldova laid down its intention to integrate into the European Union and its internal energy market (Energy Strategy to 2030, 2012). Meeting Energy Community requirements over the past decade has progressed. The strategy approaches the period 2020-2030, however, differently, considering that Moldova will need to invest in more expensive and less domestically-available energy technologies,

such as renewable energy sources. More pressing is the reality that electricity transport relies on network development and on competition and diversification, the benefits of which can be provided only through participation in a larger energy market. This will also require updating physical facilities for work in normal mode with synchronous interconnection with the European ENTSO-E system.

A risk to electricity security in Moldova is the rather limited level of technical reliability and, consequently, of the availability of the existing power stations and CHPs, because all are at least 30 years old. The age of the facilities negatively impacts both their technical performance (i.e. availability of capacity, efficiency of fuel conversion, dependence on thermal load and problems associated with tariff approval) and their economic performance, posing significant risk to electricity supply security.

Since the last in-depth review of Moldova in 2015, the major changes relevant to the electricity sector have been:

- transposition of the EU's Third Energy Package (including provisions stemming from the Directive 2009/72/CE, Directive 2005/89/CE and Regulation 714/2009)
- strengthening the national power transmission infrastructure and thus increasing security of supply through commencing construction of the 400 kV Isaccea-Vulcanesti-Chisinau overhead line (OHVL) and a related back-to-back station (BtB) and assessing the feasibility of constructing the 400 kV OHVL Balti-Suceava and related BtB station
- strengthening the power transmission and reliability of the internal power transmission grid, which is operated by the transmission system operator, Moldelectrica
- the Regulation of Exceptional Situations on the Electricity Market and the Action Plan for exceptional situations on the electricity market (Government Decision No. 149/2019) was approved in 2019. The Regulation established measures necessary to ensure the correct and continuous operation of the competitive internal electricity market and the implementation of non-discriminatory, transparent and specific procedures to guarantee the security of electricity supply in the event of such situations.

As an EU Association country, Moldova is expected to transpose a number of the EU acquis into national legislation in accordance with provisions of the Energy Community Treaty.

Table 5.4 List of EU electricity sector acquis that Moldova must transpose

- Directive 2009/72/EC concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC
- Regulation (EC) 714/2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) 1228/2003
- Regulation (EU) 838/2010 on laying down guidelines relating to the inter-transmission system operator compensation mechanism and a common regulatory approach to transmission charging
- Regulation (EU) 543/2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) 714/2009
- Regulation (EU) 2016/1388 establishing a network code on demand connection

- Regulation (EU) 2016/631 establishing a network code on requirements for grid connection of generators
- Regulation (EU) 2016/1447 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules
- Regulation (EU) 1227/2011 on wholesale energy market integrity and transparency

Table 5.5 shows investments in electricity infrastructure that were approved by Moldova's national regulator from 2019 to 2021.

Table 5.5 Electricity infrastructure investments

	Sector	Investments, million lei		
		2019	2020	2021
1.	Transmission infrastructure /TSO/	275 848	196 037	555 493
2.	Distribution infrastructure /DSOs/	577 061	602 736	618 276
3.	Electricity suppliers	1 384	3 526	1 786
	TOTAL	854 293	802 299	1 175 555

Source: Government of Moldova, ANRE reports.

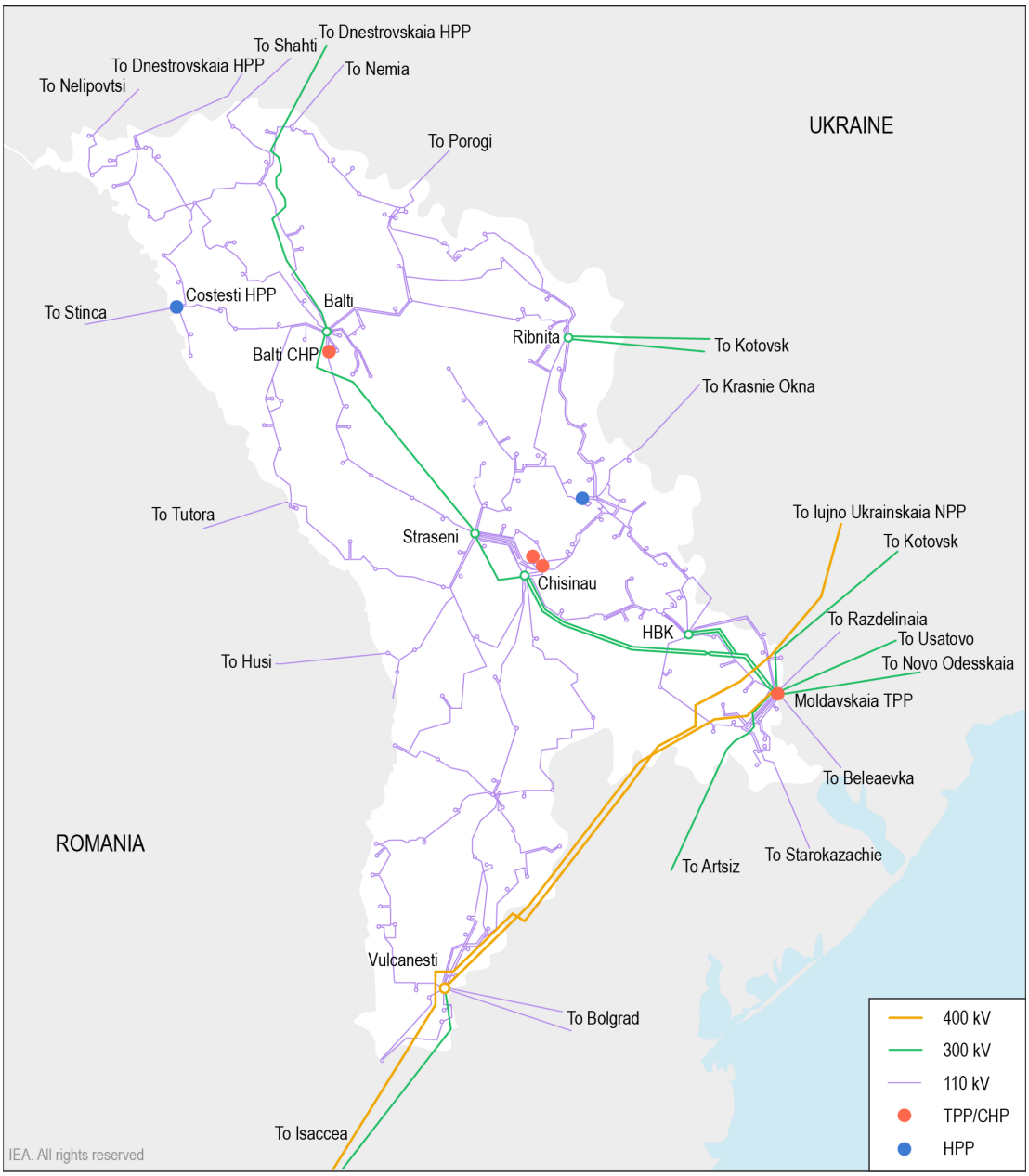
The rehabilitation of the Moldelectrica electricity transmission networks was completed in 2021 with a completion percentage of 61% in early 2020. The project includes the design and rehabilitation of a number of substations and transmission lines, and is expected to lead to greater security of the transmission network and improvements in energy efficiency. The rehabilitation project is co-financed by the EBRD and EIB. The loans are guaranteed by the Government of Moldova.

Another project being implemented is aimed at strengthening bi-directional transmission connections between the IPS/UPS and ENTSO-E systems. This project is being supported by the EBRD and EIB, with additional funding from the EC Neighbourhood Investment Platform and the World Bank. Its expected completion date is 2024. Figure 5.9 depicts the current transmission network in Moldova. It shows the country's reliance on Ukraine and MGRES. It also clearly illustrates that the 110-V networks linking its grid with Romania are insufficient to forwarding its aspirations to joining ENTSO-E.

Moldova's Energy Strategy 2030 envisages the country becoming an electric-power transit country. Interconnection projects with the EU internal power market, through new power lines and the enhancement of internal networks, are considered essential both for supply security and for social welfare. The Moldovan and Ukrainian governments are synchronising their energy plans related to the interconnection of their national power systems with the ENTSO-E grid. In June 2017, the transmission system operators of both countries signed a Memorandum of Understanding with ENTSO-E confirming their plans (IRENA, 2019) Two major projects are currently being implemented by the Republic of Moldova: the Project concerning the synchronous interconnection of the electricity systems of the Republic of Moldova and Ukraine with the ENTSO-E electricity system and the Project concerning the asynchronous interconnection of the electricity system of the Republic of Moldova with the electricity system of Romania by means of construction of

the Vulcanesti back-to-back station and the Vulcanesti-Chisinau 400 kV OHVL. This project received grants from the European and Central Asia Capacity Development Trust Fund (Moldelectrica, 2017).

Figure 5.9 High voltage transmission grid in Moldova



Source: Moldelectrica (2017), *Plan de Dezvoltare a Reţelelor Electrice de Transport în perioada anilor 2018-2027* [Development plan for the electrical transmission networks in the period 2018-2027].

System integration of renewables

The Law on Promoting the Use of Energy from Renewable Sources No. 10/2016, transposing Directive 2009/28/EC of 23 April 2009 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources is important in solving the problems related to electricity generated from RE sources (E-RES), which can also have an impact on the security of the electricity supply (see Chapter 9 for more details).

The integration of electricity generation from renewable energy sources is challenging in Moldova. The system operator issued technical conditions for connecting renewable energy projects with the total capacity 1 GW but there is an open question how much variable RE generation Moldova's power system can integrate (Gropa, 2018).

Existing conditions in Moldova will require that the TSO be given the ability to dispatch (e.g. control active and reactive power generated, connect/disconnect, control real-time voltage, manual or automatic) and monitor (through electrical and character data collection technology in real time) new power sources. This would include both renewable and conventional sources in order to ensure security of the operation of the national electricity system and compliance with contractual agreements.

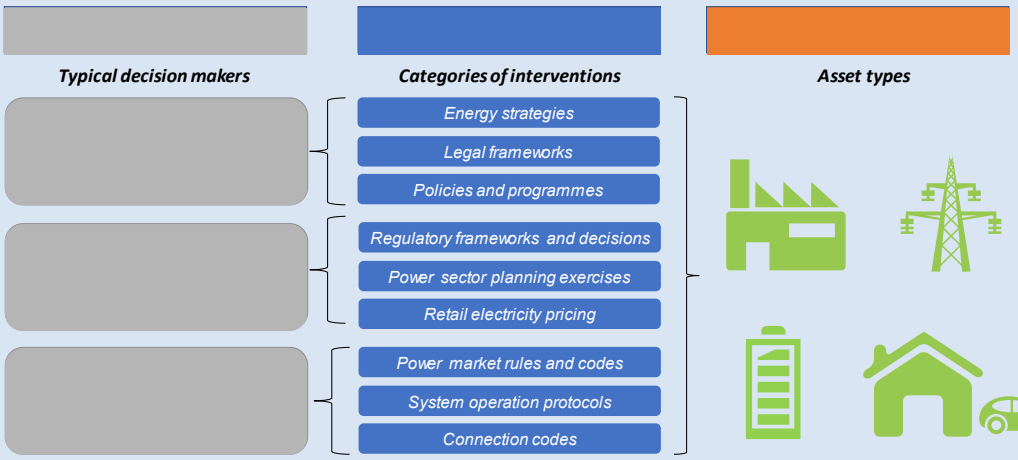
New mechanisms of the balancing market introduced in Moldova since October 2021 make it possible to effectively integrate renewable energy variables into the energy system. However, it is necessary to constantly monitor and control market participants in order to prevent possible manipulations (as was the case in Ukraine). It is also important to be ready to promptly amend new market rules in order to respond to changes arising from price imbalances or to organise the monopoly position of individual entities.

Box 5.2 Power system flexibility

"The flexibility of a power system is the ability of a power system to reliably and cost-effectively manage the variability and uncertainty of demand and supply across all relevant timescales, from ensuring instantaneous stability of the power system to supporting long-term security of supply.

While flexible resources, such as storage, demand-side resources, power plants and gird infrastructure are providers of flexibility, these require appropriate policy, market and regulatory instruments, as well as financial resources, to access the potential of flexibility from these resources. In this regard, a range of operational, policy and investment-based options is available to render modern systems more flexible, thereby facilitating energy that is sustainable, more reliable, more resilient and more affordable. These options can be grouped into several categories of interventions at various levels of decision making, as depicted in the blue boxes below". (quoted from IEA, 2019b)

Layers of power system flexibility



A range of approaches and interventions to enhance power system flexibility is available at different levels of decision making.

Source: IEA (2019c), *System Integration of Variable Renewables in Moldova: A Roadmap*, https://iea.blob.core.windows.net/assets/2f272890-0b12-42fa-9959-269ec576302a/SystemIntegrationofRenewablesinMoldova_Aroadmap.pdf

Assessment

Moldova has successfully transposed the Third Energy Package into its legislation related to the electricity sector, but much work is still needed to implement and enforce this legislation. It is encouraging that ANRE has approved market rules for the procurement of electricity on forward, day-ahead, intra-day and balancing markets and [for] ancillary service procurement and imbalance settlement (EnC, 2020a).

The country has also made progress in pursuing its objective to improve energy security by enhancing regional cooperation. Lessons have been learnt from other countries in the region, such as neighbouring Romania, which have liberalised and synchronised their markets with ENTSO-E, but intermediate steps will be necessary to ensure an eventual transition to the new markets, especially as the markets establish liquidity. It will be important that incentives are in place that allow for investment in flexible technologies and aid the development of a power system that aligns with Moldova's long-term energy strategy.

Energy security

Moldova's electricity supply is hugely dependent on procured electricity from the Transnistria region (MGRES) and imports from Ukraine. To reduce this dependency, one key government policy objective is to develop local generation, including from renewable energy sources. The Law on Renewable Energy, adopted in 2016 and enforced since March 2018, lays out the support mechanism for the development of renewable energy sources in Moldova (see Chapter 9). The approved 168 MW cap for development of renewable energy capacity (mainly of wind and solar PV plants) was put in place by

Government Decree 689/2018, based on the limitations of the balancing of generation procured from Ukraine. It was in 2021 for the period up to 2025, raising the renewable energy generation cap tentatively by 400 MW.

The system operator issued technical conditions for connecting renewable energy projects, with the total capacity limited to 1 GW. These constraints may demonstrate a lack of coordination and different modelling used to plan the power system development with variable renewable energy sources. The share of VRE can be realised when the overall flexibility of the power system is improved.

In addition, investment decisions in the power sector, whether in local renewable energy plants, conventional generation or flexibility sources, will certainly compete with existing suppliers, including Ukraine and MGRES, which together accounted for about 80% of electricity supply in 2020.

The absence of a formula for setting transparent and competitive prices diminishes the attractiveness of investment in the energy sector and limits the development of alternative sources of power generation, including own generation. At the same time, there is still a high risk of the termination of gas transit through Ukraine, which will lead to either the reduction or termination of gas-fired electricity production from MGRES.

Modelling

The government established a cap on renewable energy supply based on modelling of the off-peak load during winter months, when the combination of must-run CHP units - under the assumption of a worst-case scenario where all units run at maximum capacity - and low, overnight load projects insufficient domestic demand. These very conservative assumptions, however, may not correlate with renewable energy output. Solar power, for example, contributes very little to electricity supply in winter months, and geographically-dispersed wind production may even cease during periods of very low temperatures and high heating demand.

Modelling capacity in Moldova is being strengthened through a forecasting project, using the TIMES[2] model, for 2030 and 2050. The Ministry of Infrastructure and Regional Development will use the results of the project to assess and allocate support for renewable energy sources. An improved modelling capability could aid the development of viable RES targets and lead to the development of an optimal generation mix and adequate network planning. To achieve these objectives, the identification of appropriate modelling tools to perform, among others, production cost modelling, load flow analysis and dynamic stability studies would be required. Robust data collection of power systems, including historical weather profiles for wind and solar and correlated temperature data to approximate heat demand, would also be necessary.

The absence of both a sufficient workforce staff and an ability to retain existing staff is also a major challenge. Thus, government efforts should be focused on maintaining the

[2] The TIMES (the Integrated MARKAL-EFOM System) model generator was developed as part of the IEA-ETSAP (Energy Technology Systems Analysis Program), an international community which uses long term energy scenarios to conduct in-depth energy and environmental analyses. The TIMES model generator combines two different, but complementary, systematic approaches to modelling energy: a technical engineering approach and an economic approach.

institutional capacity to both carry out and improve modelling capabilities and the consideration of employing staff with academic and/or research institute partners.

Regional integration

Moldova's long-term objective has long been to gain access to the EU electricity market by interconnecting its national electricity network with Romania's network. From mid-March 2022 Moldova was able to connect to ENTSO-E in emergency synchronous mode through the Ukrainian power system, and work remains ongoing to establish full synchronous connection. In addition, the government of Moldova, with the support of the EBRD, EIB, World Bank and EC, is pursuing interconnections with Romania through an initial back-to-back converter in Vulcanesti in southern Moldova and a 400 kV line between Vulcanesti and Chisinau. Further interconnection points are also being explored. These interconnections will both strengthen electricity security through diversification of import partners and reduce Moldova's reliance on imports from Ukraine and the Transnistria region.

Flexibility of the power system

The Moldovan power system is based on an inflexible domestic generation mix, with cogeneration plants in the cities of Balti and Chisinau representing the main sources of electricity generation. Electricity output from these plants is, however, driven by heating and hot water demand. Apart from only 72.9 MW renewable energy capacities, the balance of electricity demand in Moldova is supplied from Ukraine and the Transnistrian region, which together account for 81% of electricity demand. Moldova relies on Ukraine both for reserves and balancing its generation. This reliance severely limits its ability to integrate variable renewable energy sources into the grid. As a result, the majority, if not all, of the flexibility in the Moldovan power system relies on the Ukrainian power system.

The flexibility of a power system is largely determined by its infrastructure, such as interconnectors, electricity storage and flexible power plants. It is equally important to have appropriate policies, including regulatory and market frameworks. Energy market rules approved on 7 August 2020, for example, ensure that all entities that are responsible for balancing due to deviations from their intra-daily schedules (e.g. hour-ahead) should incentivise improved forecasting from renewable energy plants and retailers. This would decrease forecasting errors and imbalances in the system. In addition, a market framework with shorter scheduling intervals would allow scheduling to be closer to the real-time delivery of power and increase the accuracy of forecasts.

Investment in flexible infrastructure in Moldova could include: storage, e.g. batteries and thermal storage; retrofitting and modernising of existing generators, e.g. regulation of power output from cogeneration plants; and increased interconnection and the use of demand-side resources, e.g. smart charging EVs or time-of-use tariffs.

Recommendations

The Government of Moldova should:

- ☐ Pursue the implementation and achieve steady operation of new wholesale, retail and balancing markets that allow and incentivise the investment in, and operation of an efficient, reliable and flexible power system.

- Invest in institutional capacity in modelling to allow informed decision making on the network planning, calculating the optimal generation mix, setting RES targets and identification of balancing requirements.
- Increase flexibility of the power system to accommodate VRE and promote electricity security in Moldova through pursuing greater interconnection and incentivising flexibility from domestic sources.
- Analyse scenarios and develop strategies to ensure secure electricity supply in the case that MGRES discontinues power generation, including promoting and stimulating the development of local generation facilities, power storage systems and diversification of routes/sources of electricity imports.

References

ANRE (2021a). Tarife pentru Serviciul de Distribuţie/Distribution Tariffs, https://www.anre.md/tarife-pentru-serviciul-de-distributie-3-69

ANRE (2021b), Rapoarte de Monitorizare/ Monitoring Reports, https://www.anre.md/rapoarte-de-monitorizare-3-73)

Berlin Economics (2020), "Reaching Ukraine's Energy and Climate Targets", https://www.lowcarbonukraine.com/wp-content/uploads/LCU_Reaching-Ukraines-energy-and-climate-targets.pdf (accessed 31 December 2021).

EnC (Energy Community) (2020a), Moldova Annual Implementation Report.

EnC (Energy Community) (2020b), "First significant step towards a transparent and competitive electricity market in Moldova", https://energy-community.org/news/Energy-Community-News/2020/10/05.html

EnC (Energy Community) (2021), Moldova Annual Implementation Report, https://www.energy-community.org/dam/jcr:f597bac9-bd91-45f0-b627-2f62a3998708/IR2021_Moldova.pdf

European Union High-Level Advisors' Mission to Moldova, Regional Investment Plans, October 2018.

Energy Strategy to 2030 (2012), http://komorasns.cz/assets/attachments/EnStrategy-MOLD-draft310512.pdf

ENTSO-E (2016), Recommendations relating to the coordination of technical cooperation between Union and Third Country TSOs

ENTSO-E (2019), About the TYNDP, https://tyndp.entsoe.eu/about-the-tyndp/

European Union and the National Endowment for Democracy (2019), Energy Poverty: Guidance for State Policy and Public Discourse in the Time of Reform, Georgia, Moldova, Ukraine and Romania.

GoM (Government of Moldova) (2020), *Proposal for Amending Government Decision 689/2018*, https://cancelaria.gov.md/sites/default/files/document/attachments/proiectul_782.pdf

Gropa, V. (2018), Estimation of the Wind Power Impact on the Power System of the Republic of Moldova, Thesis for the Degree of Doctor of Engineering, Technical University of Moldova [in Romanian], http://www.cnaa.md/en/thesis/52069/

IEA (2022a), World Energy Statistics and Balances (database), https://www.iea.org/data-and-statistics

IEA (2022b), World Energy Prices (database), https://www.iea.org/data-and-statistics

IEA (2021), World Energy Statistics and Balances (database), https://www.iea.org/data-and-statistics

IEA (2019b) Status of Power System Transformation 2019 Power System Flexibility, https://iea.blob.core.windows.net/assets/00dd2818-65f1-426c-8756-9cc0409d89a8/Status_of_Power_System_Transformation_2019.pdf

IRENA (2019), Renewable Readiness Assessment: Republic of Moldova, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_RRA_Moldova_2019_EN.pdf

IEA (2019c), System Integration of Variable Renewables in Moldova: A Roadmap: https://iea.blob.core.windows.net/assets/2f272890-0b12-42fa-9959-269ec576302a/SystemIntegrationofRenewablesinMoldova_Aroadmap.pdf

MIRD (Ministry of Infrastructure and Regional Development) (2020)

MIRD (2019), Security of S*upply Statement*, Chisinau.

MIRD (2017), Security *of Supply Statement*, Chisinau.

Moldelectrica (2021a), *Surse de Energie/ Energy Sources*, https://www.moldelectrica.md/ro/electricity/energy_sources

Moldelectrica (2021b)**,** *Indicatorii Tehnico-economici*, https://moldelectrica.md/ro/network/annual_report

Moldelectrica (2017), Electricity Transmission-network Development Plan for 2018-2027 Period, https/moldelectrica.md/files/docs/tyndp_en.pdf.

Moldelectrica (2018), Operational and technical information on the operation of the power system [in Moldovan/Romanian], https://moldelectrica.md/ro/activity/operative_info

NBS (National Bureau of Statistics of the Republic of Moldova), Website, http://statbank.statistica.md

NBS (2022), *Stocks, Inputs and Electricity Consumption, Monthly, 2015-2021,* http://statbank.statistica.md/PxWeb/pxweb/en/40%20Statistica%20economica/40%20Statistica%20economica__15%20ENE__serii%20lunare/ENE010100.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774)

RoM (Republic of Moldova) (2018), *Government Decision No. 689 of 11-07-2018 on the Approval of Capacity Limits, Maximum* Quotas *and Capacity Categories in the Area of Electricity from Renewable Sources to 2020* [in Romanian], https://www.legis.md/cautare/getResults?doc_id=108822&lang=ro (a Russian version is also available at this site).

Szabó, L., Mezősi, A. and Kácsor, E. (2020). 'Interim Report on Economic Analysis of the Ukrainian and Moldovan wholesale electricity markets and benefits of EU continental grid integration'. REKK.

6. District Heating

Key data*

(2020 provisional)

Total heat generation: 0.22 Mtoe, -22.2% since 2010

Heat sources: natural gas 96.0%, bioenergy 3.7%, oil 0.2%

Heat consumption: 0.19 Mtoe (residential 57.3%, industry 23.1%, services 18.9%, energy sector 0.6%), -20.6% since 2010

Exchange rate: 100 Moldovan lei (MDL) = 5.77 USD; 5.06 EUR (2020)

* Includes all heat produced by utility companies and excess heat sold by industries.

Overview

District heating (DH) provides heat to households and businesses in only seven cities of the Republic of Moldova. More than 99% of consumption is in Chisinau and Balti (with a combined total population of over 800 000 people). The rest of the country is heated by other sources, primarily individual stoves, accounting for over 56% of total dwellings in 2016 (NBS, 2016). In 2016, just over 1% of dwellings in Moldova lacked a home heating system. In rural areas, Moldova has seen a rise in biomass consumption, particularly in poorer households (EU and NED, 2019). Some of the urban poor also use biomass for heating. The Moldovan Energy Efficiency Agency estimates that more than 100 MW of biomass heating capacity was added from 2011 to 2017, with EU support. Individual gas-fired heating systems also are increasingly used, especially by wealthy households in urban areas, who are moving away from district heating. Electric radiators are rarely a source for heating (NBS, 2016). This chapter discusses the district heating systems only. The use of biomass for heating is addressed in Chapter 9 on Renewable Energy, and the extension of the gas networks is discussed in Chapter 3.

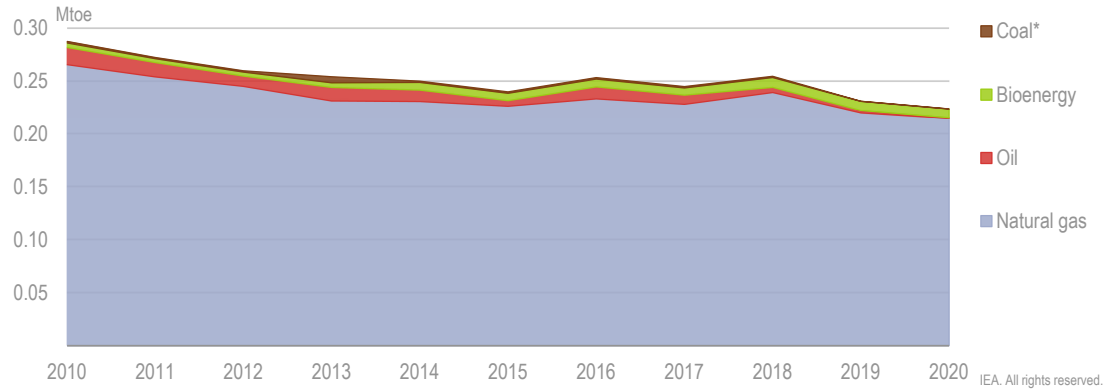
Supply and demand

Consumption of district heat is modest in Moldova (0.19 Mtoe in 2020, or 7% of TFC), and has decreased by over 20% since 2010. The reduction in consumption can be attributed to retirement of some of the natural gas-fired capacity. Operating without substantial rehabilitation or retrofit since construction, the remaining capacity has suffered from a gradual decline in efficiency, maximum output and reliability. Given the deterioration in

district heating services and chronic problems with inefficiency, a certain share of the decrease might also be due to disconnections of wealthy consumers and their switching to the use of individual gas boilers and other heating technologies, having a strong negative impact on the welfare of the vulnerable population with no alternative for heating.

The heat generation mix has changed only slightly over the last decade: natural gas remains the primary fuel (accounting for around 95%); the share of coal averaged below 1% in 2010-2018 and since 2019 coal has not been used for heat generation (Figure 6.1). Similarly, the share of oil has dropped from over 5% in 2010 to below 1% in 2020. Domestic biofuel solutions (solid biofuels, biogas) account for 4% of heat production, and might be able to allow for the replacement of more of the imported fossil fuels for heat generation. The National Renewable Energy Action Plan adopted in 2013 focused on the use of biomass in individual systems and did not prioritise fuel switching in district heating (see Chapter 9), but this may change with the development of the new renewable energy policy as part of the National Energy and Climate Plan (see Chapter 7).

Figure 6.1 District heat generation by source, 2010-2020



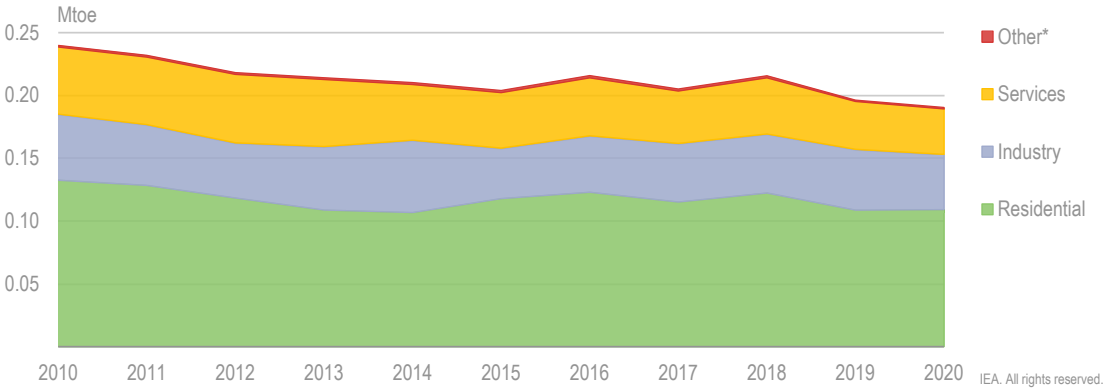
Virtually all heat is derived from natural gas.

* Coal not used for heat generation since 2019; previous amounts are not visible at this scale.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

The residential sector dominates district heat consumption in Moldova, accounting for 57% of total consumption in 2020. The industrial sector accounted for 23%, with services virtually consuming the remainder (19%) of the heat (Figure 6.2).

Figure 6.2 District heat consumption by sector, 2010-2020



Most heat produced by district heating systems is consumed by the residential sector.

* Includes energy industry own use and agriculture and forestry.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

District heating sector structure

The main district heating operators in Moldova are Termoelectrica in Chisinau and CET-Nord in Balti (Table 6.1). They are both state-owned and produce and supply thermal energy and electricity using natural gas in Combined Heat and Power (CHP) plants. In addition, there are also several small enterprises, which produce and supply thermal energy.

Termoelectrica owns four district heating (DH) production plants in Chisinau. CHP-1 is the main source of DH production and is located in the eastern part of the network. This plant operates mainly during the heating season. CHP-2 is an older plant located west of CHP-1 and operates mainly in the summer, providing domestic hot water heating. HOB (heat-only boiler) West and HOB South, heat-only plants, are operated independently in the winter months. In the summer, water-heating needs are provided by CHP-1 or CHP-2 to the HOB West and HOB South areas.

Table 6.1 District heating investment and capacity from 2014 to 2018

	2014	2015	2016	2017	2018
Total investment in district heating (million USD)	**11.25**	**5.22**	**5.63**	**22.17**	**37.03**
TERMOELECTRICA	10.49	4.59	4.99	21.57	26.98
CET-Nord	0.76	0.63	0.64	0.60	10.05
Total heat supply capacity					
thermal energy delivered (TJ)	**2 059**	**2 118**	**2 216**	**2 129**	**2 237**
available capacity (MW)	**1 845**	**1 845**	**1 845**	**1 845**	**1 845**
TERMOELECTRICA (incl. CET1 and CET 2)					
thermal energy delivered (TJ)	1 839	1 888	1 978	1 905	1 991
available capacity (MW)	1 448	1 448	1 448	1 448	1 448
CET-Nord					
Thermal energy delivered (TJ)	220	231	238	224	246

	2014	2015	2016	2017	2018
Available capacity (MW)	397	397	397	397	397
Number of consumers connected	**239 406**	**239 591**	**239 364**	**241 225**	**241 161**
TERMOELECTRICA (incl. CET1 and CET 2)	207 448	207 397	207 634	209 053	208 968
apartments (incl. individual houses)	206 108	206 053	206 278	207 641	207 532
public institutions	556	557	571	589	591
private enterprises	784	787	785	823	845
CET-Nord	31 958	32 194	31 730	32 172	32 193
apartments (incl. individual houses)	31 555	31 785	31 322	31 751	31 756
public institutions	34	38	38	36	36
private enterprises	369	371	370	385	401

Source: Ministry of Infrastructure and Regional Development, data provided at the IEA's request.

CET-Nord operates three plants with a total installed electrical capacity of 24 MW and heating capacity of 242 Gcal/h. It covers 205.7 km of the district heating network in Balti. The plants rely on natural gas. They were built from 1954 to 1967. CET-Nord also owns an HOB plant using coal that is located in the western part of the city. This plant supplies heat to a small district of residential buildings.

Modernisation of the district heating infrastructure

The Moldovan government decided to invest in improving existing district heating infrastructure as this would allow citizens to receive more efficient and reliable heating services. The first District Heating Efficiency Improvement Project (SACET I) with the budget of USD 40.5 million, funded by the World Bank and EBRD sovereign loans, contributed to improved operational efficiency and the quality and reliability of heating services delivered to the population of Chisinau. It supported investments aimed at optimising and modernising the heat distribution network, with the objectives of reduced heat losses, improved service quality and increased efficiency and security of supply of heat and hot water to end users. It also supported the streamlining of the operational and corporate structure of the district heating system, including the eventual closure of CHP-1. Technical and financial support for project management was also provided.

The project outputs, as of February 2020, included:

- a new pumping station and interconnection pipes between the CHP-1 and CHP-2 circuits
- three main pumping stations modernised with the replacement of pumps and motors, installation of variable frequency drives (VSD) and associated electrical equipment
- 107 individual heating systems (IHS), and associated pipes, installed in 36 public institutions and three residential blocks; and 22 public institutions and three residential blocks with 78 IHSs reconnected to the district-heating system
- 170 IHSs (and associated pipes) installed in residential buildings, horizontal distribution installed in 15 residential blocks, 59 IHSs (and associated pipes) installed in 28 public buildings
- 14.4 km district-heating priority-networks established
- the development of a Social Impact Mitigation Plan (SIMP) and a Grievance Redress Mechanism; the introduction of a staff optimisation programme at Termoelectrica which

led to the dismissal of 47 employees and severance payments to 17 employees who were laid off

- instituting an Environmental Audit at CHP-1 which includes a complete analysis of the final decommissioning scenarios, including evaluation of their environmental aspects
- an assessment of heat losses in the Chisinau DH network.

The World Bank has allocated USD 100 million (EUR 92 million) to Moldova for a second project to improve the efficiency of the district heating system in Chisinau (SACET II) (MEPIU 2020) (Table 6.2).

Table 6.2 District heating efficiency improvement projects

	SACET I	SACET II
Total Project Cost	USD 61.1 million	USD 100 million
Commitment Amount	USD 40.5 million	USD 100 million
Last Update Date	25 June 2020	28 May 2020
Status	Closed	Active
Borrower	Ministry of Finance	Republic of Moldova
Approval Date	21 November 2014	18 June 2020
Implementing Agency	Moldova Energy Projects Implementation Unit (MEPIU),Ministry of Economy, Termoelectrica	Moldova Energy Projects Implementation Unit
Approval FY	2015	2020
Closing Date	30 June 2020	31 December 2025

Source: WB (2014) and WB (2020).

Another energy efficiency project, financed by the EBRD, was developed in 2017-2019 for CET-Nord in Balti to increase the efficiency of heat generation and to modernise and upgrade the district heating system. The project results included:

- the installation of four combined heat and power generation plants (with a total generating electric capacity of 13.4MW and thermic capacity of 12.5MW)
- the rehabilitation of the heat generation system, including the replacement of the pumps and fans and the installation of frequency converters
- the installation of 169 individual heating substations in 130 residential buildings
- the conversion of a coal-fired HOB to biomass fuel use with a total thermic capacity of 650KW.

As a result, consumers are now able to better regulate their heat consumption and pay only for the heat consumed. The implemented measures are also expected to decrease operating and maintenance costs for CET-Nord, improving energy efficiency and cutting CO_2 emissions (EBRD, 2019).

In 2020, CET-Nord initiated negotiations with the EBRD to continue the financing of the modernisation of the Balti district heating system (DHS). Phase II is expected to have a

budget of around EUR 10 million and will focus on distribution infrastructure and end user energy efficiency measures:

- installation of 'horizontal' heating systems in apartment buildings, apartment level metering or allocation and reinstatement of domestic hot water (DHW) supply
- a Supervisory Control and Data Acquisition (SCADA) system
- implementation of a network hydraulic model and management information system (EBRD, 2020).

Policies and measures

The EU Directive 2012/27/EU on energy efficiency in the district heating sector was transposed partially in Moldova through primary legislation. The Moldovan Parliament approved the Law on Heating and Cogeneration Promotion (Law no.92 of 29.05.2014) in May 2014. The law is designed to regulate the specific activities of the centralised systems of thermal energy supply, improve the energy efficiency of the entire economy and reduce the negative impact of the thermal energy sector on the environment, including by using cogeneration technologies. According to this law, ANRE, the Moldovan regulatory authority, is responsible for the approval of tariffs for district heating, and all consumers are supplied at regulated rates. In November 2019, ANRE approved a new methodology for calculation, approval and application of regulated prices and tariffs for the production of electricity and heat, for the services of distribution and supply of thermal energy (ANRE, 2019a).

Moldova provides subsidies to household consumers in the district heating sector through different channels. The VAT rate for district heating used by households is 0%, while the standard VAT rate in Moldova is 20% which is applied to DH supplied to the non-residential/public sector. For comparison, the VAT rate for natural gas for the non-residential sector/public is 8%. (RoM 1997, 2020, Tax Code). In addition, there are compensation schemes to protect the most vulnerable consumers, at both the national and local levels. At the national level, such schemes pay fixed amounts (e.g. per family or person), regardless of the amount of energy used. However, some local schemes (e.g. the compensation paid in Chisinau to low-income families) provide payment as a percentage of the energy bills.

There are several local programmes in Moldova that provide energy subsidies for vulnerable groups. These programmes are however limited and the allowed consumption levels are restricted. Since 2012, according to a Chisinau Municipal Council Decree, low-income residents living in the city qualify to receive compensation from the local government equivalent to 40% of their heating bills (Chisinau City Hall, 2019).

According to the Law on Heating and Cogeneration Promotion, switching from the centralised heat-supply system, including for the purpose of connecting to other heat supply options, is prohibited, unless economic profitability can be demonstrated through a feasibility study. The feasibility study must be coordinated with the Moldovan Agency for Energy Efficiency (Law 92/2014). However, reportedly this provision is not always respected in practice.

Box 6.1 IEA best practices for improving heating efficiency

The heating equipment market continues to be dominated by fossil fuel-based equipment and less-efficient conventional electric heating technologies, which constitute almost 80% of new sales. However, sales of heat pumps and renewable heating equipment such as solar hot water systems have increased, representing more than 10% of overall sales in 2019. To be in line with the IEA's Sustainable Development Scenario (SDS), the share of clean heating technologies – heat pumps, district heating, renewable and hydrogen-based heating – needs to more than double to 50% of sales by 2030.

Most reductions in heating energy intensity have resulted from improvements in construction energy performance thanks to building energy codes that reduce space-heating demand, particularly in Canada, China, the European Union, Russia and the United States.

Governments have a key role in setting long-term market signals to direct industry and investor decisions towards sustainable equipment for buildings. On a global scale, fuel-pricing strategies (including taxes and subsidies) need to ensure market equality for all technologies; removing subsidies for fossil fuels is a first step. In addition, many countries could build upon ongoing efforts to implement CO_2-based taxes. This could be done in Europe via the energy taxation directive, and the EU Emissions Trading System (ETS) which could be adjusted to cover fossil fuels used in heating systems of less than 20 MW.

Ambitious commitments related to end-use equipment efficiency (e.g. Minimum Energy Performance Standards [MEPS]), emissions (e.g. mandating a share of renewable energy in primary energy use for heat production for buildings) and flexibility (e.g. using smart-readiness labels and incentivising heat storage in water tanks and district energy networks) can take advantage of the synergies gained by using sustainable heating products to achieve multiple climate goals. At the very least, governments everywhere need to implement and update MEPS for heating equipment to steer markets towards clean energy technologies. These could be technology-neutral to encourage product innovation and industry competitiveness.

As energy efficiency improvements will generate long-term system cost reductions, governments could also promote clean energy technologies by offering public subsidies for low-income households that may find it difficult to afford them. For instance, Canada aims for the energy performance of all space heating technologies to be greater than 100%, but it has not specified which technology or fuel should be used to meet this goal. Countries can also expand and improve labelling schemes for heating equipment (e.g. through energy labels) to increase consumer awareness of energy technology choices. Informational tools could make use of the increasing quantity of building energy data available through digitalisation, as long as the underlying data management frameworks address data privacy and cyber-related issues.

In addition, governments could work together to improve monitoring, verification and enforcement of heating technologies, and collaborate with industry and trade associations to ensure proper equipment installation and maintenance. Regulators can

set performance standards or targets that are more stringent than the minimum life cycle cost (which is common practice) and apply more ambitious requirements, including technology-forcing standards that could stimulate further innovation of clean energy solutions for heating.

To put heating in line with the Net Zero Emissions by 2050 Scenario, policies should set ambitious targets, followed by rigorous performance standards to introduce a larger proportion of high-efficiency low-carbon equipment into the market. This is especially important given the long lifespans of many heating technologies (for example, some gas boiler installations are guaranteed for 25 years). Policies, including innovative business models proposed by energy service companies, need to address the upfront costs of clean energy products. Innovative instruments also include guarantees of origin for renewables-based heat as a source of additional revenue for operators.

Source: IEA (2020b), Heating, https://www.iea.org/reports/heating.

Assessment

Moldova has made considerable progress in attracting investment to strengthen its district heating systems. The companies Termoelectrica and JSC CET-Nord secured loans from the World Bank and EBRD to improve operating efficiency and financial viability in the district heating systems in Chisinau and Balti. Energy efficiency measures, such as the modernisation of pumping stations and the rehabilitation of segments of the distribution network, have been implemented.

Nevertheless, heat losses remain high, 19.8% (average) in 2019 (ANRE, 2019b), which is well above the level of 5 - 10% in more modern district heating systems of a similar size. There is a great need for further investments in the district heating infrastructure in Moldova, including new heat generation plants and insulation of grids. In many countries, these improvements have led to significant reductions in energy consumption and heat losses. More innovative improvements could include thermal storage units and renewable heating as part of the district heating system. This would improve flexibility and allow greater interaction with the electricity market. Installing meters at generation plants and in buildings would allow for greater detection of heat losses and accelerate the location of defective infrastructure and abnormally high consumption. Replacing inefficient central heat substations with modern fully-automated individual building level heat substations would ensure a more efficient and secure heat supply to end users.

According to Moldova's current regulatory framework, district heating is subject to regulation in setting tariffs and approval for investment projects. The methodology for calculating tariffs for district heating, however, differs from methodologies applied to tariffs for electricity and gas and does not include certain criteria, such as taking measures inside of apartments. This has stymied efforts by district heating operators to generate enough revenue for necessary rehabilitation measures and capital investments. Protection of vulnerable customers must continue, but continuous under-pricing has led to an inefficient

use of resources, higher operational costs, and a delay or deferral of investments, all driven by the lack of funding and the vulnerability of DH companies' autonomy.

For district heating companies to be financially viable, tariffs should be set at such a level that allows companies to recover costs related to improving the efficiency of operations and maintenance, and fuel and capital costs (including depreciation and financing costs). They should also be set so that companies can cover the return on capital expenditures, both past and current. This would enable them to access the debt and equity required to improve the operational performance of their assets. The regulator should make every effort to determine the actual costs of owning and operating a district heating company.

Because of quality-of-service improvements achieved through SACET I, Termoelectrica has managed to substantially lower the number of disconnections from the district heating network. District heating operators, however, still face the challenges of consumers who disconnect and those who choose to opt out of the network when moving to a new building, preferring, instead, natural gas boilers or another alternative heating option. A sufficient customer load is a prerequisite for the economic sustainability of the district heating system in Moldova. Due to heat migration between apartments, in multi-apartment buildings, the disconnection of single apartments may result in a revenue loss for the district heating companies, even while there is no reduction in heat production. These disconnections result in making heat more expensive for the remaining customers of the district heating system.

One of main reasons why customers opt out of district heating networks is a lack of public awareness about their benefits. Quality of service has improved considerably over the past several years, but customers are largely unaware of this and continue to assume that district heating is the most expensive and the least convenient means of heating their homes. Authorities should thus provide information to the public about the functioning and advantages of district heating.

Another reason is that many customers prefer individual heating systems in order to control consumption. Thus, it is important to further pursue efforts towards a demand-driven heat supply. The residential sector is by far the sector with the most buildings connected to DH networks. Different VAT rates for natural gas, at 8%, and for centralised district heat, at 20% for the non-residential/public sector, create an incentive for industry and commercial/public buildings to switch to individual gas boilers. By adjusting tax rates, a level playing field for DH can be established. Further, the Law on Thermal Energy and Cogeneration favours DH by stipulating mandatory connection for new buildings and restrictions on disconnection rights for already connected buildings unless the user proves, by the means of a feasibility study, that this would cause unreasonable cost. This policy, however, is not being enforced, and illegal disconnections or omitted connections are not sanctioned.

Finally, energy-efficiency improvements in district heating systems can be achieved only if done in unison with energy-efficiency improvements in buildings. For the most part, the building stock in Moldova, 20 to 60 years old, does not comply with EU standards. By improving the energy performance of buildings, the released heating capacity can be directed to new buildings without increases in the total consumption of the network. Potential barriers for homeowners to implement energy-efficient refurbishments, particularly for condominium owners, need to be identified and addressed.

Recommendations

The Government of Moldova should:

- Support the regulator in setting a clear and transparent methodology allowing the DH companies to earn sufficient revenues to cover their costs and make the much-needed investment in modernisation, rehabilitation of infrastructure and to improve the operational performance of the assets.
- Support DH companies in ensuring a sufficient customer load by strengthening the enforcement of mandatory connections for new buildings and restrictions on disconnection rights, by providing equal tax rates for district heating and natural gas for the public sector and by information campaigns on DH.
- Develop a strategy for stimulating private investment in demand-driven customer-oriented heat supply and energy efficiency measures in the building sector, including the identification and elimination of barriers for homeowners to implement energy-efficient refurbishments.

References

ANRE (2019a), Methodology for Calculation, Approval and Application of Regulated Prices and Tariffs for the Production of Electricity and Heat, for the Services of Distribution and Supply of Thermal *Energy*, Chisinau, www.legis.md/cautare/getResults?doc_id=119203;

ANRE (National Agency for Energy Regulation) (2019b), *Annual Activity Report 2019*, https://www.anre.md/en/raport-de-activitate-2-10.

Chisinau City Hall (2019), *Aid and Social Benefits for Disadvantaged People and Families in the Municipality*, Chisinau, https://www.chisinau.md/libview.php?l=ro&idc=403&id=27338&t=/Presa/Comunicate-de-presa/Ajutoare-i-prestatii-sociale-pentru-persoane-i-familii-defavorizate-din-municipiu;

ECS (Energy Community Secretariat) (2020), *Annual Implementation Report 2020*, https://www.energy-community.org/implementation/IR2020.html;

EBRD (European Bank for Reconstruction and Development) (2020), *GrCF2 W1: Balti District* Heating – *Phase, 2020 II,* https://www.ebrd.com/cs/Satellite?c=Content&cid=1395290685943&pagename=EBRD%2FContent%2FContentLayout&rendermode=live%3Fsrch-pg%3Fsrch-pg%3Fsrch-pg%3Dadv;

EBRD (European Bank for Reconstruction and Development) (2019), *Balti Upgrades District Heating System*, https://www.ebrd.com/news/2019/balti-upgrades-district-heating-system.html;

EU (European Union) and NED (National Endowment for Democracy) (2019), *Energy Poverty: Guidance for State Policy and Public Discourse in the Time of Reform, Georgia, Moldova, Ukraine, Romania*, https://eap-csf.eu/wp-content/uploads/Energy-Poverty-2019-WEB.pdf;

GoM (Government of *Moldova*) (2014), Law on Heating and Cogeneration Promotion, No.92 / 29.05.2014, http://www.legis.md/cautare/getResults?doc_id=106077;

IEA (2020a*), Data and statistics 2020*, www.iea.org/statistics

IEA (2020b), *Heating*, https://www.iea.org/reports/heating

MEPIU (Moldova Energy Projects Implementation Unit) (2020), *District Heating Efficiency Improvement Projec*t, https://mepiu.md/eng/current-projects/district-heating-efficiency-improvement-project, (accessed 4 June 2020);

NBS (National Bureau of Statistics) (2016), *Energy Consumption in Households. Results of the Survey on Energy Consumption*, Chisinau, https://statistica.gov.md/public/files/publicatii_electronice/Consum_energie_gospoda/Consum_energie.pdf;

RoM (Republic of Moldova) (1997; updated 2020), *Tax Code*, https://sfs.md/uploads/files/Docs/tax-

code/Tax_Code_of_the_Republic_of_Moldova3.pdf;
www.legis.md/cautare/getResults?doc_id=117668;

WB (World Bank) (2020), *Second District Heating Efficiency Improvement Project 2020*, https://projects.worldbank.org/en/projects-operations/project-detail/P172668; Worldbank.org/en/news/press-release/2020/06/18;

WB (World Bank) (2014), *Moldova - District Heating Efficiency Improvement Project 2014*, https://www.worldbank.org/en/news/loans-credits/2014/11/21/moldova-district-heating-efficiency-improvement-projectWorldbank.org/en/news/press-release/2014/11/21 (Projects.worldbank.org/en/projects-operations/projectdetail/P172668).

7. Energy, environment and climate change

Key data

(2020 provisional)

Total GHG emissions without LULUCF* (2019):** 13.8 Mt MtCO2-eq

Total GHG emissions with LULUCF* (2019):** 14.1 Mt MtCO2-eq

Energy-related CO_2 emissions*:**

CO_2 emissions from fuel combustion: 4.7 $MtCO_2$ (+4% since 2010, -85% since 1990)

CO_2 emissions by fuel: oil 55.8%, natural gas 37.5%, coal 6.7%

CO_2 emissions by sector: transport 42.9%, residential 21.2%, electricity and heat generation 15.6%, agriculture 7.6%, industry 7.6%, services 5.2%

CO_2 intensity (CO_2 emissions per GDP): 0.16 $kgCO_2$/USD (2015 PPP) (World average 2019 0.26)

* Land-use, land-use change and forestry.

** For non-Annex I countries of the Kyoto Protocol, recent data availability is limited. The latest national inventory report submitted to the UNFCCC covers 1990-2019 (ME, 2021).

*** The official GHG data include Ministry of Environment (ME) estimates for Transnistria whereas for the purposes of this review, energy-related CO_2 emissions exclude them.t

Overview

The Republic of Moldova joined the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 and ratified the Kyoto Protocol in 2003. As a Non-Annex 1 Party to the Convention, it reports to the UNFCCC through national communications and biennial update reports. In May 2017, Moldova ratified the Paris Agreement and pledged to reduce its net GHG emissions 64-67% below 1990 levels by 2030.

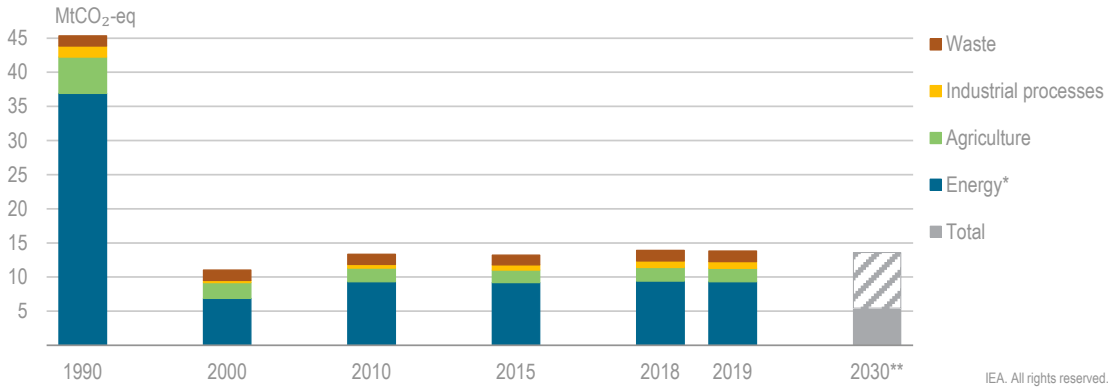
The Republic of Moldova was one of the first countries in the world to develop a Long-Term Low Emissions Development Strategy (LEDS2030 (2016)) and was the fourth country to submit to the UNFCCC a Second (updated) Nationally Determined Contribution (NDC). The country's new voluntary unconditional target is to reduce its GHG emissions by 70% below its 1990 level in 2030. The 70% figure could be further decreased to 88% if international low-cost financial resources, technology transfer and technical cooperation are ensured.

The Republic of Moldova's contribution to global GHG emissions is low. In 2019 (the most recent year for which data are available), the Republic emitted 13.8 $MtCO_2$-eq (without LULUCF) and 14.1 $MtCO_2$-eq (with LULUCF), which is around 0.04% of the world's current emissions. At the same time, the economy accounts for around 0.02% of the global GDP.

The share of CO_2 in the total direct GHG emissions in 2019 was around 68%, CH_4 contributed 19% and N_2O emissions accounted for 12% of the total. The share of fluorinated gases (F-gases) (HFCs, PFCs, SF_6) is insignificant, only about 1.6% of the total (ME, 2021).

According to ME data, energy-related emissions account for roughly two-thirds of Moldova's total greenhouse (GHG) emissions (including Transnistria estimates, excluding effects from land use) (Figure 7.1). The official reported data to the UNFCCC also indicate that the overall GHG emissions remained essentially flat between 2010 and 2019 (increase of 3.6%). In comparison with the 1990-year levels, by 2019 the Republic of Moldova's GHG total and net emissions were respectively, 69.5% and 67.9% lower (ME, 2021).

Figure 7.1 Moldova's greenhouse gas emissions by sector, 1990-2019



Moldova's total GHG emissions have remained flat since 2010.

* Includes fuel combustion (for power and heat generation, and for industry, transport, residential and commercial energy consumption), fugitive emissions from fuels and energy industry own consumption.

** Voluntary target for 2030 70% reduction in GHG emissions by 2030 compared to 1990; potential 88% reduction indicated in solid colour.

Note: $MtCO_2$-eq = million tonnes of carbon dioxide equivalent.

Source: ME 2021.

In 2019, the total per capita emissions in the Republic of Moldova were 35% lower than the world's average (4.4 t CO_2 equivalent per capita compared to 6.8 t CO_2 equivalent per capita) (ME, 2021; GoM, 2020a).

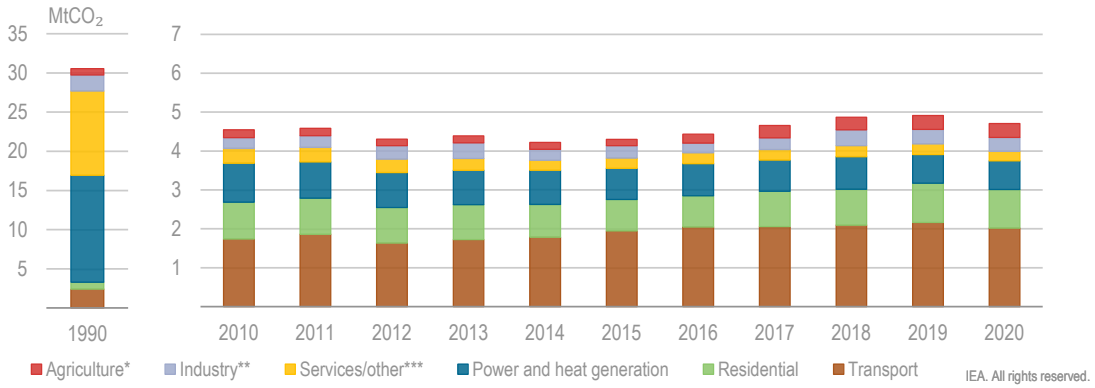
CO_2 emissions from fuel combustion and carbon intensity

In 2020, Moldova's CO_2 emissions from fuel combustion (excluding Transnistria) were 4.7 million tonnes of carbon dioxide ($MtCO_2$) (+4% from 2010)[1] (Figure 7.2). The transport sector was the main source of emissions with a share of 43% of the total and with the largest absolute growth (+0.28 $MtCO_2$ or +16% since 2010).

[1] The official figure from the Ministry of Environment is much higher as it includes Transnistria estimates.

The residential sector share has remained essentially stable at 20% since 2010. It is noteworthy that power and heat generation is responsible only for 16% of the emissions (-27% since 2010).[2] The remaining emissions are mainly attributed to the agriculture (8%), industry (8%) and service sectors (5%).

Figure 7.2 Moldova's CO_2 emissions from fuel combustion by sector, 1990-2020



Transport is responsible for over 40% of the combustion-related CO_2 emissions.

* Includes only emissions from energy consumption in the sector.

** Includes CO_2 emissions from combustion at construction and manufacturing industries.

*** Includes commercial and public services and emissions from unspecified consumption.

Notes: $MtCO_2$ = million tonnes of carbon dioxide.

Source: IEA (2022), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics

A country's CO_2 emissions are determined by population changes and economic development, measured as GDP per capita. Emissions are also affected by the energy intensity of the economy and the carbon intensity of the energy supply.

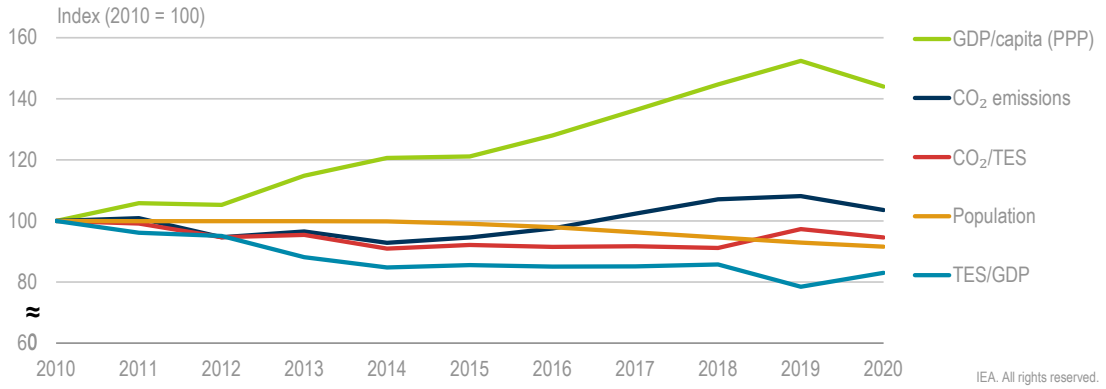
The significant reduction in the level of socio-economic indicators over the 1990-2020 period is a consequence of the deep transformation processes common during the transition from a centralised economy to a market economy, specifically after the breakup of the Soviet Union and the declaration of the Republic of Moldova's independence in 1991.

In Moldova, total CO_2 emissions have increased by only 4% since 2010. Over the same time period, the economy (measured by GDP per capita) has expanded almost 50% (Figure 7.3). The emissions were actually in decline until 2014, but have since then steadily grown. This indicates that economic growth as a driver of the emissions is becoming weaker.

While none of the other presented indicators seems to correlate explicitly with the emissions, their growth is mostly explained by increased transport sector activity. While energy consumption in the residential and transport sectors has increased around 15% since 2010, households use mostly bioenergy not counted in towards the emissions, whereas mobility is based primarily on fossil fuels.

[2] The share would be much higher if the electricity procured from MGRES power plant was considered domestic production. The official GHG inventory also includes these estimates.

Figure 7.3 Energy-related CO_2 emissions and main drivers in Moldova, 2010-2020

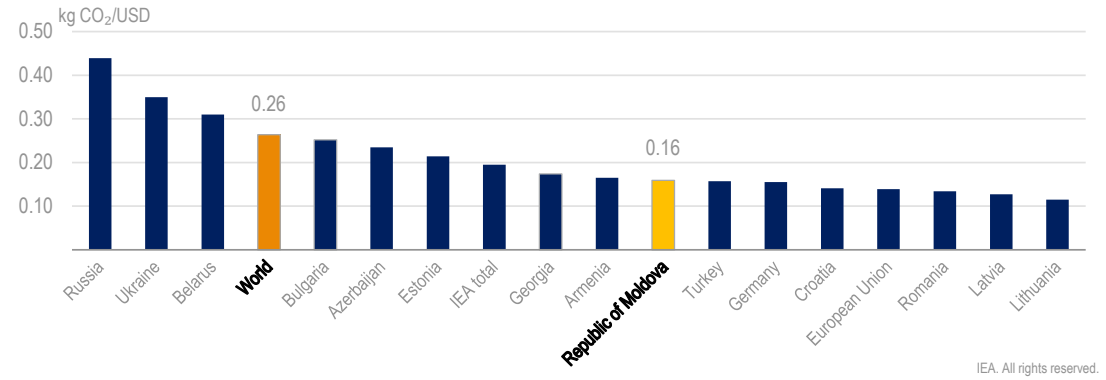


Energy-related CO_2 emissions have grown less than 5% since 2010 whereas GDP per capita has grown almost 50%.

Note: TES = total energy supply. GDP is in constant USD 2015 prices and purchasing power parities.
Source: IEA (2022), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics

Moldova's CO_2 intensity, 0.16 kilogrammes of carbon dioxide ($kgCO_2$)/USD (2015 PPP), is below the world average (Figure 7.4). Economies that use high shares of coal for electricity and heat generation and in industry, have notably higher CO_2 intensity.

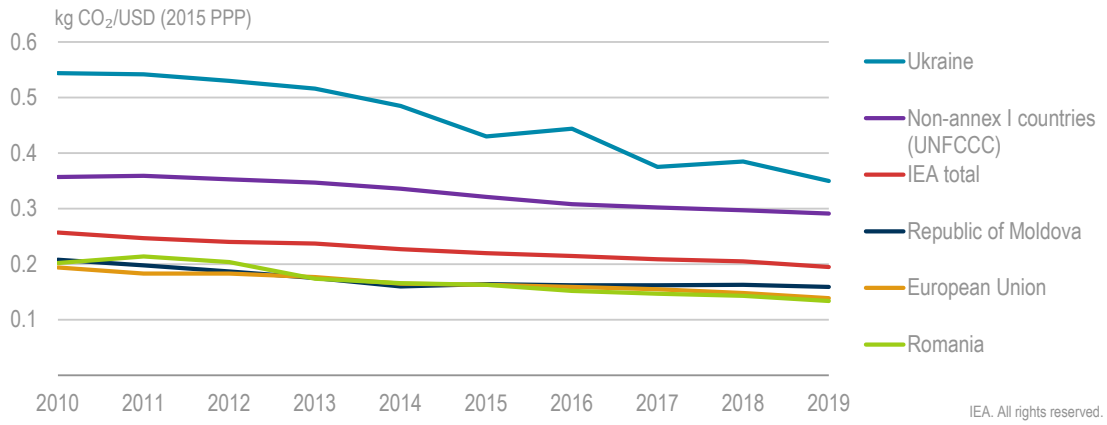
Figure 7.4 CO_2 intensity in the Republic of Moldova and selected countries, 2019



Moldova's CO_2 intensity is below the world average.

Notes: Real GDP is in USD 2015 prices and purchasing power parities (PPP).
Source: IEA (2021), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics

Figure 7.5 CO_2 intensity in the Republic of Moldova and selected countries, 2010-2019

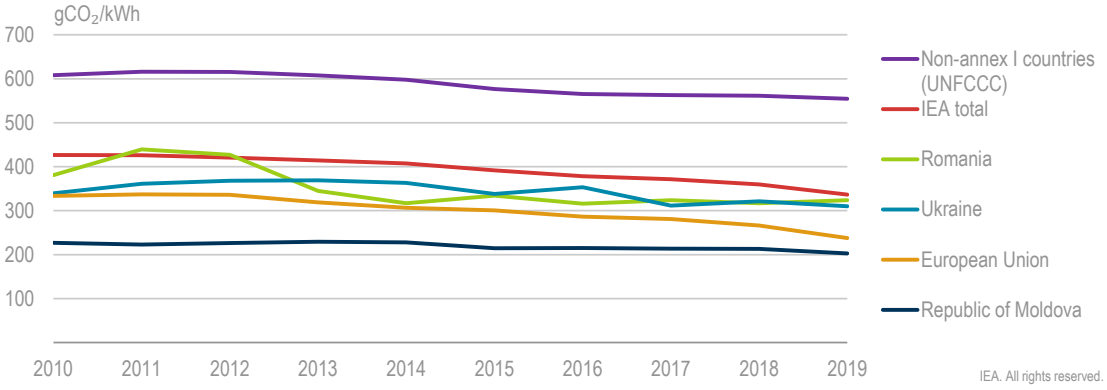


Moldova's CO_2 intensity is lower than its eastern neighbour Ukraine, but higher than in Romania.

Source: IEA (2021), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics

In 2020, Moldova's power and heat generation sector emitted an average of 205 grammes of CO_2 (gCO_2) per kilowatt-hour (kWh) of energy produced (Figure 7.6). The relatively low carbon intensity is due to the fact that most electricity is imported.

Figure 7.6 CO_2 intensity of power and heat generation in the Republic of Moldova and selected countries, 2010-2019



Moldova's specific emissions from electricity and heat generation remained stable in the 2010s.

Source: IEA (2021), *Greenhouse Gas Emissions from Energy* (database), https://www.iea.org/data-and-statistics

However, the Republic of Moldova is working towards establishing a strong foundation for low emissions and climate resilient growth.

Institutional framework

The **Ministry of Environment (ME)** of the Republic of Moldova is the state authority assigned to develop and promote policies and strategies addressing environment protection and climate change, as well as natural resources.

On behalf of the Government, ME is responsible for the implementation of international environment treaties to which the Republic is a Party. It is also the UNFCCC National Focal Point.

The **National Climate Change Commission (NCCC)** is steered by the Minister of Environment and has the highest representation of key stakeholders (sectorial ministries, NGOs, academia, research, private sector). The Commission has taken over the functions and responsibilities of the National Commission for Implementing Provisions of the UNFCCC and Mechanisms of the Kyoto Protocol and is the supreme authority in the Republic responsible for implementation of these provisions and mechanisms. The NCCC chairs the Climate Change Coordination Mechanism (CCCM) "in cross-sectoral coordination of all climate-related components: adaptation, GHG emissions and mitigation and is operationalised through a dedicated Government Decision" (GD) that establishes the mechanism for the coordination of activities in the field of climate change (GoM, 2020a, p. 14).

The **Climate Change Office** under the ME, established in 2004, is responsible for providing support to the Government, as well as to the central and local public administration authorities, non-government and academic organisations, in activities implemented and promoted by the Republic of Moldova under the UNFCCC and the Kyoto Protocol, as well as implementing climate change-related projects and programmes providing for such activities.

"Since its creation, the Climate Change Office has been fully responsible for activities related to the preparation of National Communications, and since 2014, of the Biennial Update Reports of the Republic of Moldova under the UNFCCC "(ME, 2018a, p. 28).

The **Environmental Agency,** established in 2018, is an administrative authority subordinated to ME, responsible for implementing the state policy in the field of environmental protection.

Policies

The Republic of Moldova was one of the first countries in the world to develop a Long-Term Low Emissions Development Strategy (LEDS), and the fourth country in the world and the first Contracting Party of the Energy Community Treaty to submit to the UNFCCC a Second (updated) Nationally Determined Contribution (NDC2).

Nationally Determined Contributions of the Republic of Moldova

The Republic of Moldova's INDC (NDC1) was submitted on 25 September 2015. On 21 February 2020, following the Decision 1/CP.21 UNFCCC (to update NDCs every five

years, starting in 2020), the Republic submitted its updated NDC (NDC2) to the UNFCCC Secretariat, which was posted on the Convention's platform on 4 March 2020.

In its updated NDC, the Republic intends to achieve more ambitious targets than in its First NDC. The country's new economy-wide unconditional target is to reduce its GHG emissions by 70% below the 1990 level in 2030, instead of 64-67% as committed in the First NDC, which could be further decreased to 88%, if international low-cost financial resources, technology transfer, and technical cooperation are ensured. The time frame of the commitment is from 1 January 2021 to 31 December 2030.

NDC2 is based on national development priorities oriented towards reaching Sustainable Development Goals expressed in the National Development Strategy "Moldova 2030". The Strategy presents a vision for Moldova's sustainable development, and sets long-term development priorities that will serve as the basis for all inter-sectoral and sectoral policy documents. The document envisages four basic pillars: sustainable and inclusive economy; strong human and social capital; fair and efficient institutions and healthy environment.

A robust domestic emissions measuring/monitoring, reporting and verification (MRV) system was established to inform the government and the international community of the progress of its NDC implementation. As a member of the Energy Community, by the Regulation on the organisation and functioning of the national monitoring and reporting of greenhouse gas emissions and other Information relevant to climate change (ME, 2018b), Moldova transposes Regulation (EU) 525/2013. However, the MRV system on mitigation policies and measures will be complemented with the reporting requirements of the progress made in implementing the NDC and the Long-Term Low Carbon Development Strategy. Moldova presented the third biennial report on the Paris Agreement Implementation in December 2021. Starting from 1 January 2024, the country has to present its biennial transparency report every two years.

Medium- and Long- Term Planning

With a view to achieving the NDC1 objectives, in 2016 the Government had approved the Low Emissions Development Strategy 2030 of the Republic of Moldova and its Action Plan (LEDS 2030) (ME, 2016), which entered into force on 24 March 2017. The measures proposed in the Action Plan to the Strategy include nationally appropriate mitigation actions (NAMAs) (ME, 2018c), as provided for the non-Annex I parties to the UNFCCC.

LEDS 2030 set out intermediary GHG emissions reduction objectives by 2020. The Environmental Strategy 2014-2023 (GD 301/2014) (GoM, 2014a) includes the same GHG emissions reduction objectives by 2020. According to preliminary estimates, in 2020 the Republic of Moldova exceeded the overall planned level of emissions by about 4%; while the energy sector reduced emissions by 7%. However, the contribution of different energy subsectors in reducing emissions against the planned level of reduction is varied: the electricity and heat production subsector achieved 19% reduction, but the buildings and transport subsectors exceeded the set target significantly: by 49% and 37%, respectively (EU4Climate, 2021).

To achieve the objectives of greenhouse gas emissions reduction as provided for in the NDC2, the Government plans to draft the new Low Emissions Development Program 2030 (LEDP 2030) and the Action Plan by 2022 and has already developed the Concept for LEDP 2030 and its Action Plan with the support of EU4Climate Programme.

Table 7.1 shows the specific objectives of mitigating GHG emissions by sectors set out in the current Strategy and in the Concept for LEDP 2030 unconditionally, in relation to the benchmark year.

Table 7.1 The new specific GHG emissions mitigation objectives by sector by 2030

Sector	Current version of LEDS 2030, not updated	LEDP 2030 Concept
Energy	74%	81%
Transport	30%	52%
Buildings	77%	74%
Industrial Processes	45%	27%
Agriculture	37%	44%
Forestry and land use, change in the designation of land use and forestry	62%	10%
Waste	38%	14%

These objectives could be more ambitious if there is forthcoming financial support from international donors, technical assistance and transfer of technologies (EU4Climate, 2021).

According to preliminary estimations, the overall amount required to achieve the unconditional GHG emissions reduction goals by 2030 will be about USD 8.3 billion, which includes USD 2.9 billion for the energy and heat production sector, USD 2.3 billion for buildings and USD 3.1 billion for transport, including road infrastructure. To achieve the conditional GHG emissions reduction objective by 2030, an additional USD 2.6 billion is required (EU4Climate (2021)).

Along with the LEDP 2030 (which is an update to LEDS 2030), the Low Emissions Development Strategy 2050 will be developed by November 2022 according to the Governmental Action Plan for 2020-2023 (GD No. 636/2019). It will be focused specifically on outlining the policies for accelerating GHG emissions reduction by mid-century, as stipulated in Article 4.1 of the Paris Agreement.

In 2018, Moldova registered its first NAMAs, seeking support for implementation in the UNFCCC Registry (UNFCCC, 2021). A total of 12 proposed actions address emissions from electricity generation and use, transport, forests and land use. The NAMAs seek, among other things, to promote heat pumps, wind power plants and the use of solar energy for water heating; introduce hybrid and electric buses in the city of Chisinau; substitute cement production technology; and implement soil conservation systems. The external support requested for these NAMAs totals USD 2.08 billion and the accumulated GHG reduction in 2030 would be 19.9 $MtCO_2e$ (IISD, 2018).

In addition to national strategies, the country has important strategic initiatives at the local level – for example, the Sustainable Energy Action Plans (SEAPs) elaborated by

municipalities within the framework of the Covenant of Mayors (EC, 2021). 52 Moldavian towns/municipalities had joined the Covenant of Mayors, undertaking a voluntary commitment to reduce GHG emissions by 20% from 1990 levels by 2020 and by 30-40% by 2030. 23 municipalities and towns have already submitted SEAPs that envisage emissions reductions, mainly in the transport, public and residential sectors.

Moldova still needs to adopt the National Energy and Climate Plan (NECP), to officially set up a national working group on NECP development and to start drafting.

Adaptation

In 2014 the Government approved the Climate Change Adaptation Strategy (CCAS), the first national strategic framework on adaptation, which aims to advance the resilience of the country's social and economic development processes. While the objectives stated in the CCAS are still valid, the associated Action Plan covers the timeframe 2014-2020 (ME, 2014).

As the Republic's NDC2 notes, the "medium- and long-term adaptation goal is to reach a sustainable social and economic state of development resilient to the impact of climate change by establishing a strong enabling environment for a coherent and effective adaptive action with mitigation benefits, integrating climate risk into investment decision-making and business planning, while remaining socially inclusive and sensitive to the gender impacts of climate change" (GoM, 2020a, p. 2).

According to the second, third and fourth National Communications (UNFCCC, 2018), the Republic of Moldova is most likely to be affected by three types of climate impacts: temperature increases, changes in precipitation regimes and increased climate aridity (Box 7.1). These are associated with the frequency and intensity amplification of extreme weather events (heatwaves and frost, floods, storms with heavy rains and hail, and severe droughts).

Moldova must promote efficient climate adaptation measures at the sectoral level in priority economy sectors: agriculture, forestry, water, health, transport and energy.

Box 7.1. Climate Change Impacts on the energy sector of the Republic of Moldova

- Increased demand for electricity due to higher summer temperatures and the need for indoor air conditioning and industrial processes cooling
- Increased natural gas consumption due to increased electricity demand
- High loss in electricity because of intensive use of electrical cooling equipment due to increased air temperature
- Reduced electricity and heat generation capacities of power plants (CHPs) caused by insufficient heat loading
- Increased electricity demand for irrigation caused by lower soil moisture

- Reduced electricity generation capacity of CHPs caused by the decrease in water flow in the Prut and Dniester rivers, as a result of reduced precipitation volume
- Decreased resilience of energy sector infrastructure, including assets' useful lifespan, higher capital expenditure and running costs
- Increased intensity of energy caused by higher electricity consumption for air conditioning and irrigation. Increased intermittency in electricity supply
- Climate change (drought) compromised wood production, including biomass production for energy generation and production of liquid biofuels
- Longer duration of unplanned power supply distortions due to the increase in the frequency of spontaneous fires and the need to protect airlines
- Decrease in the share of electricity production from renewable energy due to reduced back-up of balancing energy.

Source: UNFCCC, NDC2, 2020.

The adaptation priorities stated in the NDC2 derive from both the national climate change policies and related development national and subnational policies and plans.

According to the Republic of Moldova's Climate Change Adaptation Strategy by 2020 (ME, 2014), among the main adaptation priorities in the energy sector of the Republic of Moldova are:

- Promote renewable energy sources that operated based on environment-friendly technologies
- Promote the gradual transition from traditional fuel sources to the use of biofuels
- Promote efficient energy use and promote high energy efficient products
- Improve the sustainability of energy transmission and distribution infrastructure
- Increase the capacity of additional reserve maintenance teams and ensure viability of their full repair kits and other equipment
- Implement adaptation measures through mainstreaming into sector development strategies.

Environmental issues

The National Development Strategy 2030, Environmental Strategy 2014-23 and Energy Strategy of the Republic of Moldova to 2030 among other strategic documents, integrate green economy objectives, such as reducing air pollution, increasing energy efficiency, introducing sustainable transport and developing green growth indicators in order to achieve a low-carbon, resource-efficient and socially inclusive economy, significantly reducing environmental risks and the impacts on human health.

The National Programme for the Promotion of the Green Economy (2015) and the Road Map for a Green Economy for 2018-2020 (GD 160/2018) have been developed to guide government efforts to green economic development.

Inter-Ministerial policy dialogue on the green economy with integration of the green economy targets and other sustainability issues into planning has been reinforced by the

establishment of the Inter-ministerial Working Group on Sustainable Development and Green Economy, co-chaired by the MIDR and ME, and included in the active participation of the National Bureau of Statistics.

Moldova is working with EU4Environment to develop green investment strategies, finalise the Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) laws, implement Resource Efficient and Cleaner Production (RECP) in small and medium enterprise (SME) activities, assess Sustainable Public Procurement (SPP) and eco-labelling, develop waste management strategy, contribute to green innovation, strengthen green regulations for enterprises and compliance assurance, reinforce policy dialogues on green finance and investment, support public environmental expenditure management as well as the greening of SMEs, assess and reinforce administrative capacity and develop Green Growth Indicators (GGIs) (EU4Environment, 2021).

Progress has been made in achieving the green growth goals: improving energy efficiency, energy intensity and the use of renewables; reducing GHG emissions; and enhancing CO_2 productivity. Improvements have also been made in the drinking water supply and waste management.

However, sectoral challenges remain, including the significant level of pollution from the transport and agriculture sectors. The volume of air pollutant emissions from the transport sector, primarily from automobiles and trucks, has steadily increased, due to the increasing number of vehicles, the permission to import cars up to ten years old and more frequent and longer trips. Emissions from stationary sources have remained almost constant, but do not include emissions from all sources because emissions from small combustion plants are not considered (OECD, EaP Green, 2017).

Transposition of EU Directives

As part of the Association Agreement with the EU, the Republic of Moldova has committed to transpose a number of EU directives into national law, including the Directive 2008/50/EC on ambient air quality and cleaner air for Europe. As a result, Moldova must now carry out comprehensive air quality monitoring and strive to reach levels below the EU limit values.

Under the 2014 Law on Environmental Impact Assessment (GoM, 2014b), approximated to Environmental Impact Assessment (EIA) Directive 2011/92/EU, an EIA is mandatory for projects considered to have significant effects on the environment and listed in Annex 1 of the Law. For projects listed in Annex 2, the national authority must decide whether an EIA is needed, based on criteria in Annex 3. Also, the Law on Strategic Environmental Assessment, approximated to the Strategic Environmental Assessment (SEA) Directive, was adopted by the Parliament. The Law requires SEAs for national and local plans and programmes on land use, transportation, energy, waste, agriculture, etc. However, the amendments to Directive 2014/52/EU, which amends Directive 2011/92/EU, still need to be transposed into the national legislation.

The competent authority for both types of environmental assessments is the Environmental Agency. While the register of environmental impact assessments and strategic environmental assessments on its website is functional, improvements in the quality as well as the control of environmental reports are needed. In particular, further efforts are needed in the EIA screening procedures for small wind power projects. Effective measures for the public to participate in decision-making need to be ensured at both the project and plan/programme levels (ECS, 2021).

The environmental report for a Project of Energy Community Interest (e.g. the Romania-Moldova 400 kV interconnection line) was approved in 2020.

The Government Decision on the Reduction of the Sulphur Content of Certain Liquid Fuels transposes the relevant provisions in the EU *acquis communautaire* into national law. The State Environmental Inspectorate is in charge of implementing the transposed legislation.

The Large Combustion Plants and Industrial Emissions Directives have not been transposed yet. However, according to the ECS (Energy Community Secretariat) estimations, existing combustion plants meet the emissions limit values of the Large Combustion Plants Directive.

Assessment

Despite its very small contribution to global GHG emissions, the Republic of Moldova is committed to combatting climate change and contributing to maintaining the average global temperature increase below two degrees Celsius. After signing the Paris Agreement on climate change in 2016, Moldova was among the first countries in the EU4Energy region to develop and approve its Low Emissions Development Strategy (LEDS) in December 2016 and the National System of Monitoring and Reporting of Greenhouse Gas Emissions in 2018.

The country is to be praised for its decision to set more ambitious targets in its updated nationally determined contribution (NDC2), which was submitted in February 2020. The new economy-wide unconditional target is to reduce GHG emissions by 70% below its 1990 level by 2030, instead of 64-67% as committed in NDC1. The updated NDC also raises the conditional target to 88% (compared to 78% committed in NDC1). The government plans to update the current LEDS in order to implement the targets stated in the new NDC. Moldova was also one of the first countries in the region to pledge (by a Government decree adopted in December 2019) to develop by 2022, a new mid-century Low Emissions Development Strategy, outlining the policies for accelerating GHG reductions by 2050.

The NDC2 unconditional target is expected to be reached by implementing efficiency incentives and redirecting public investments to less emissions-intensive activities. The capacity to contribute to solving the climate change problem is closely related to the ability to invest in appropriate mitigation measures. Hence, one aspect of capacity is to take into account GDP growth levels and GDP per capita in fairness considerations. The mitigation potential and abatement costs are other core issues in considering the fair contribution of any given country.

Moving towards progressive decoupling of carbon emissions from economic growth and ensuring a decent level of real GDP per capita, will allow the Republic of Moldova to shift and adjust the development pathway towards a low-carbon economy. Therefore, along with the international financial support for covering these costs, the country will also need assistance in the form of technology transfer and capacity building.

The vulnerabilities of the energy sector to climate change, as well as the related challenges are recognised in the Moldovan official documents submitted to the UNFCCC. It is encouraging that the government is planning to update the Climate Change Adaptation Strategy that was approved in 2014. Further efforts could be made to ensure that the

energy policies integrate the possible impacts of climate change on the development of energy supply and demand trends, such as increased summer demand due to air conditioning, the possible decrease of biomass potential and increase in solar and wind potential.

The government has also made substantial reforms in the area of environmental protection, which can influence energy sector operations. Following the adoption in 2014 of the National Environmental Strategy for the years up to 2023, institutional reforms have been implemented and several new laws and regulations have been enacted related to Environmental Impact Assessments and air quality, among other areas. More efforts could be devoted to the integration of environmental policies into sectoral policies, such as energy and transport. Moldova has serious environmental challenges as a result of outdated technologies, the lack of self-monitoring of emissions, and an inadequate environmental damage assessment and compensation system. Therefore, the country needs to prioritise the promotion of sustainable development and the green economy, and also invest in the development of a strong environmental compliance assurance system.

As the energy sector is the key emitter of GHGs and air pollutants, energy policies should be closely coordinated with both climate change and environmental policies. A working group has been established by the Ministry of Infrastructure and Regional Development (MIDR) and the Ministry of Environment (ME) to prepare jointly the National Energy and Climate Change Action Plan. Coordination and information exchange between these two ministries should be further enhanced: for example, the energy demand and supply modelling prepared by the MIDR is helpful for ME's work on climate change projections, while the forecasts related to the impacts of climate change on the Moldovan economy should inform the energy sector development strategies, as discussed above.

The government has clear lines of communication within individual agencies and institutions, while cross-sectorial coordination of strategies and efforts needs improvement. This is a major constraint on the national government's ability to link sectorial and environmental strategies to the impact of climate change. Therefore, the government has created a multi-stakeholder Climate Change Coordination Mechanism to foster the dialogue, coordination, collaboration and coherence among sectors. The National Climate Change Commission (NCCC) has been established to ensure cross-sectorial coordination of all climate-related components: adaptation, GHG emissions and mitigation. This is a very positive initiative. This Commission – as a formal body with a permanent secretariat and Technical Committees on specific thematic areas – is established at a high decision-making level to ensure that it gets sufficient policy attention. The establishment of this new Commission was built upon the lessons learned from the operations of the previously established inter-ministerial bodies, such as the Committee on Sustainable Development and the Committee on the Green Economy.

Recommendations

The government of Moldova should:

- ☐ Enhance the linkages between the energy policies on the one hand and climate change and environmental policies on the other when developing, implementing and monitoring them:

- Improve further the coordination and information exchange between the Ministry of Infrastructure and Regional Development (MIRD) and Ministry of Environment (ME)
- Support the National Climate Change Commission (NCCC) to ensure cross-sectoral coordination of all climate-related components: GHG emissions, adaptation and mitigation
- Continue the efforts to ensure that energy policy takes into consideration the possible impacts of climate change on energy supply and demand trends; and that appropriate adaptation strategies are developed
- *Support* environment-related action, demonstrate and unlock opportunities for greener growth, and set mechanisms to better manage environmental risks and impacts.

References

EC (European Commission) (2021), Covenant of Mayors Initiative, https://www.covenantofmayors.eu/en/

ECS (Energy Community Secretariat) (2020), *Annual Implementation Report 2020*, https://energy-community.org/news/Energy-Community-News/2020/11/23.html

EU4Climate (2021), *The Concept of the 2030 Low Emissions Development Program of the Republic of Moldova and the Action Plan for its Implementation*, https://eu4climate.eu/download/the-concept-of-the-low-emission-development-program-of-the-republic-of-moldova-until-2030-and-the-action-plan-for-its-implementation-english/

EU4Environment (2021), https://www.eu4environment.org/where-we-work/republic-of-moldova

GoM (Government of the Republic of Moldova) (2020a), *Updated Nationally Determined Contribution of the Republic of Moldova*, https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Republic%20of%20Moldova%20First/MD_Updated_NDC_final_version_EN.pdf

GoM (Government of Moldova) (2020b), *Government Decision on the Establishment of the Mechanism for the Coordination of Activities in the Field of Climate Change, No. 444, 01.07.2020*, https://www.legis.md/cautare/getResults?doc_id=122314&lang=ro [also available in Russian at the site: https://www.legis.md/cautare/getResults?doc_id=122314&lang=ru]

GoM (2014a), *Decision No. 301 of 24.04.2014 on the Approval of the Environmental Strategy for the Years 2014-2023 and of the Action Plan for its Implementation*, https://wedocs.unep.org/bitstream/handle/20.500.11822/9507/-Environmental_Strategy_for_the_years_2014-2023-2014Moldova_EnvironmentalStrategy_2014-202.pdf?sequence=3&isAllowed=y [also available in Romanian at https://www.legis.md/cautare/getResults?doc_id=114539&lang=roand Russian at https://www.legis.md/cautare/getResults?doc_id=114539&lang=ru].

GoM (2014b), *Law on Environmental Impact Assessment (No.86/29.05.2014, amended by Law No.185/21.09.2017)*,

https://www.legis.md/cautare/getResults?doc_id=106006&lang=ro [in Romanian]; [also available in Russian at https://www.legis.md/cautare/getResults?doc_id=106006&lang=ru].

IEA (2022), Greenhouse Gas Emissions from Energy (database), https://www.iea.org/data-and-statistics/data-products/?filter=emissions

IEA (2021), Greenhouse Gas Emissions from Energy (database), https://www.iea.org/data-and-statistics/data-products/?filter=emissions

IISD (International Institute for Sustainable Development) (2018), *SDG Knowledge Hub*, https://sdg.iisd.org/news/nama-update-moldova-registers-twelve-actions-for-support-thailand-submits-unilateral-nama/

ME Ministry of Environment [RoM (Republic of Moldova) Climate Change Office] (2021), *National Inventory Report: Greenhouse Gas Sources and Sinks in the Republic of Moldova*, 1990-2019: Republic of Moldova 2021, http://clima.md/doc.php?l=en&idc=81&id=4256

ME (2018a), *Second Update Report of the Republic of Moldova 2018*, https://unfccc.int/sites/default/files/resource/Moldova_BUR2_EN_web_19.04.2019.pdf

ME (2018b), *Government Decision on the Establishment and Functioning of the National System for Monitoring and Reporting Greenhouse Gas Emissions and other Information Relevant to Climate Change, No. 1277 of 26.12.2018*, http://clima.md/lib.php?l=en&idc=276&

ME (2018c), *NAMA Projects 2018*, http://clima.md/lib.php?l=en&idc=278&

ME (2016), *Low Emissions Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its Implementation [LEDS 2030], GD No. 1470 of 30.12.2016*, http://clima.md/lib.php?l=en&idc=236&

ME (2014), *The Republic of Moldova's Climate Change Adaptation Strategy by 2020 and the Action Plan for its Implementation, GD No. 1009 of 10.12.2014*, http://clima.md/lib.php?l=en&idc=237&

ME (Ministry of Environment) and UNEP (United Nations Environment Programme), (2016), *Intended National Determined Contribution Report of the Republic of Moldova*, http://clima.md/doc.php?l=en&idc=82&id=3955

OECD (Organisation of Economic *Co-operation and Development) EaP ([EU] Eastern Partnership) GREEN (2017), Measuring the performance of the Green Economic Development in the Republic of Moldova. National Report based on the OECD set of Green Growth Indicators 2017*, https://wedocs.unep.org/handle/20.500.11822/37493

UNFCCC (2021), *United Nations Framework Convention on Climate Change (UNFCCC) Public NAMA,* https://www4.unfccc.int/sites/PublicNAMA/SitePages/Country.aspx?CountryId=142

UNFCCC (2018), *Fourth National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change 201*8, http://clima.md/lib.php?l=en&idc=81&

Further Reading

Gavrilita, P. (n.d), *National System: Guidelines for Non-Annex I Parties*, http://clima.md/doc.php?l=en&idc=94&id=2530

ME (Climate Change Office) and UNEP (2018), *Vulnerability Assessment and Climate Change Impacts in the Republic of Moldova (Researches, Studies, Solutions)*, http://clima.md/doc.php?l=en&idc=250&id=4290

8. Energy efficiency

Key data

(2020 provisional)

TFC: 2.61 Mtoe (oil 35.8%, bioenergy 24.6%, natural gas 16.9%, electricity 12.6%, district heat 7.3%, coal 3.0%), +14% since 2010

Consumption by sector: residential 48.2%, transport 25.7%, industry 11.4%, services 9.4%, agriculture/other 5.4%

Energy consumption (TFC) per capita: 0.99 toe (World average 2019: 1.30 toe), +24% since 2010

Energy intensity (TFC/GDP):

Exchange rate: 90 toe/USD million PPP (World average 2019: 78 toe/USD million PPP), -14% since 2010

*100 Moldovan lei (MDL) = 5.77 USD; 5.06 EUR (2020)

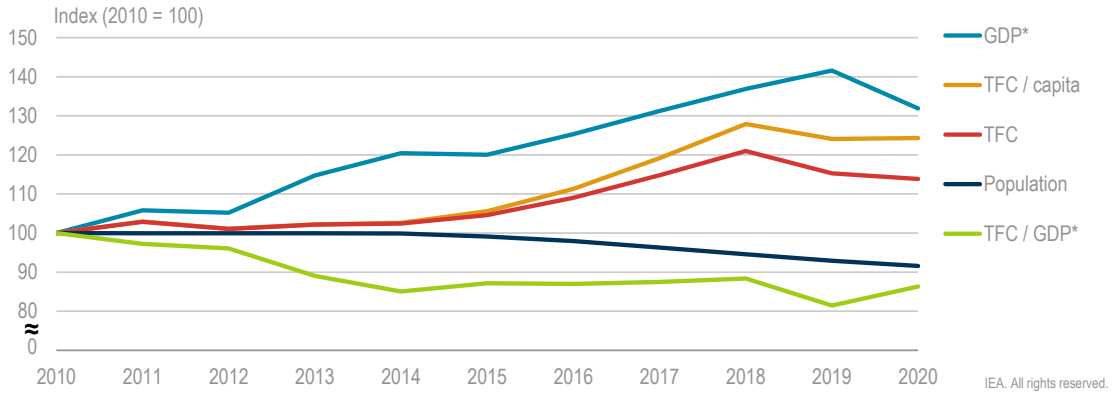
Overview

Moldova's energy intensity has declined in the last decade. While some energy efficiency indicators are already developed for residential and industry sectors, additional indicators would help policy makers understand the role of energy efficiency improvements, structural changes, economic activity and other factors in greater detail. Moldova's legal and regulatory framework in the area of energy efficiency is broadly aligned with the EU energy *acquis*. Significant legal reforms have been implemented to transpose the EU Energy Efficiency Directive and Energy Performance of Buildings Directive into national legislation, but several pieces of secondary legislation still need to be adopted. Implementation of legislation remains challenging, and energy efficiency improvements are hindered by several barriers, including difficult access to financing, low institutional capacity and weak enforcement of regulations.

Trends

Moldova's energy intensity has declined in the last decade. While gross domestic product (GDP) has grown over 30% since 2010, total final consumption (TFC) has increased by only 14% in the same period (Figure 8.1). As a result, energy intensity (TFC/GDP) improved by 14% between 2010 and 2020. In contrast, energy consumption per capita has increased by 24%.

Figure 8.1. Moldova's energy consumption and drivers, 2010-2020

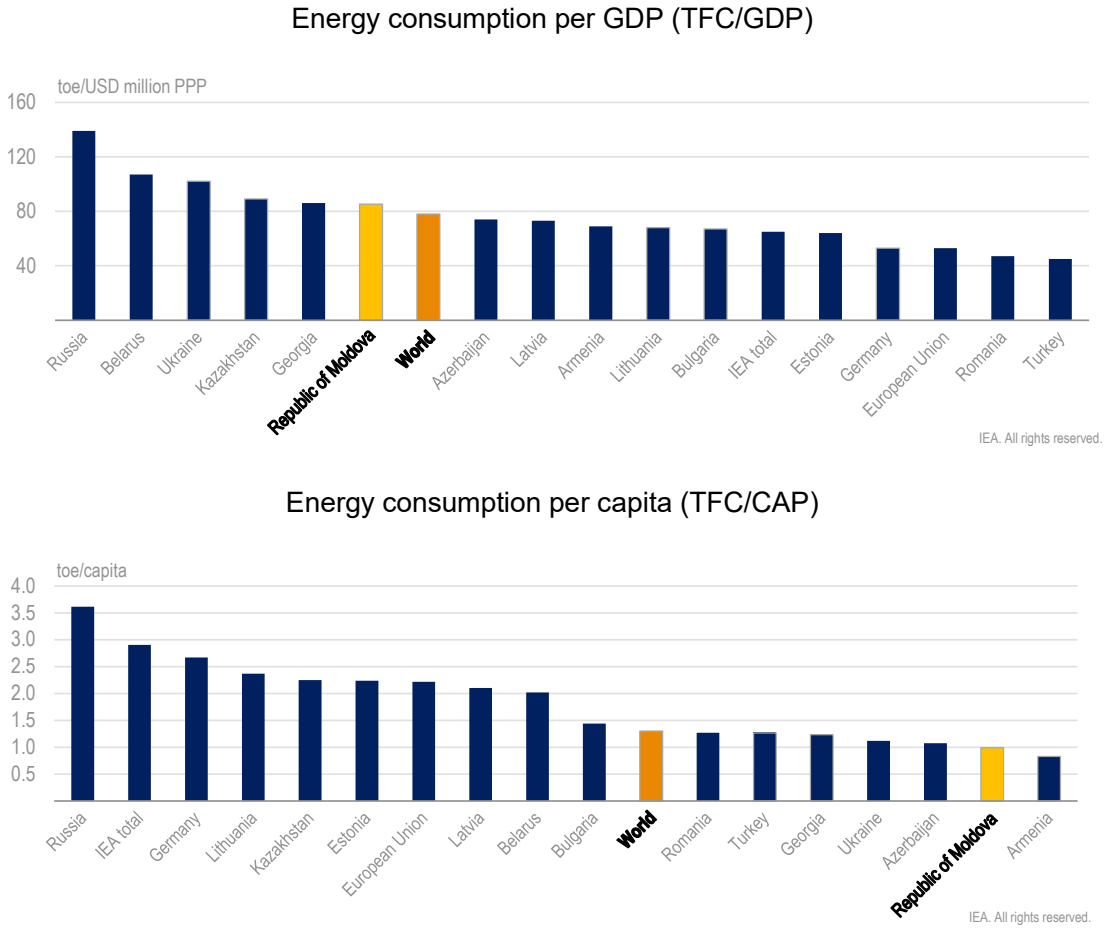


Final consumption of energy largely correlates with economic growth in Moldova.

* Expressed in constant 2015 USD billion and purchasing power parity (PPP).
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

In 2020, Moldova's energy intensity per unit of GDP at PPP was 90 tonnes of oil equivalent (toe) per million USD, 15% above the 2019 world average of 78 toe per million USD. In contrast, its per capita TFC was 0.99 toe, which is 24% below the 2019 world average of 1.30 toe (Figure 8.2).

Figure 8.2. Energy intensity per GDP (TFC/GDP) and energy consumption per capita (TFC/CAP) in Moldova and selected countries, 2019



Although Moldova's TFC/GDP energy intensity is above the world average, when measured as TFC per capita it falls below.

Notes: CAP = capita. TFC does not include the energy transformation sector. GDP is expressed in constant 2015 USD billion at purchasing power parity (PPP).

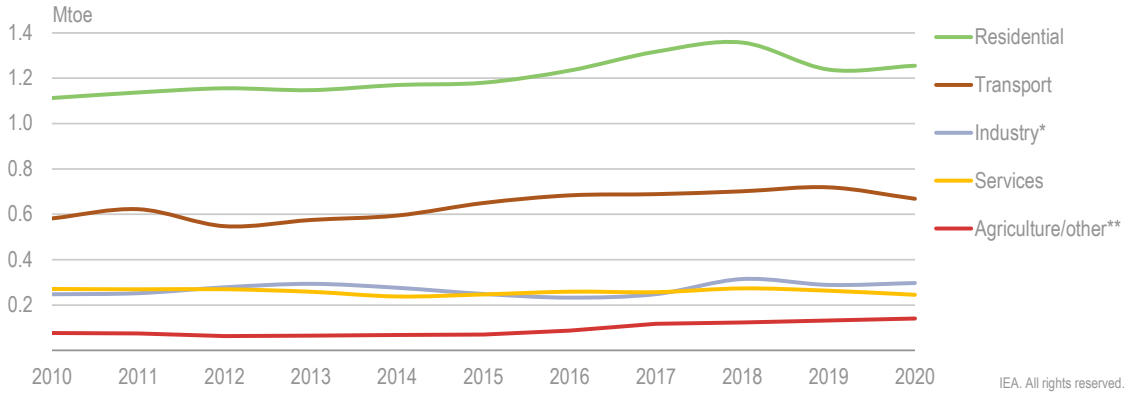
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Energy consumption by sector

Moldova's energy consumption was relatively stable over the last decade. In 2020, TFC was 2.6 million tonnes of oil equivalent (Mtoe), 14% more than in 2010. The residential sector was the largest energy consumer with 48% of TFC in 2020 (Figure 8.2). Transport accounted for 26% of TFC, services for 9% and industry for 11% in 2020. The remainder was consumed in agriculture (5%).

While consumption has generally increased in all sectors compared to 2010, the residential sector is responsible for most of the absolute growth (0.14 Mtoe or +13% since 2010). The analysis by sector gives further details.

Figure 8.3. Moldova's final consumption by sector, 2010-2020



The residential sector is by far the largest consumer of final energy in Moldova.

* Includes non-energy use. ** Includes agriculture, forestry and non-specified consumption.

Note: Mtoe = million tonnes of oil equivalent.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

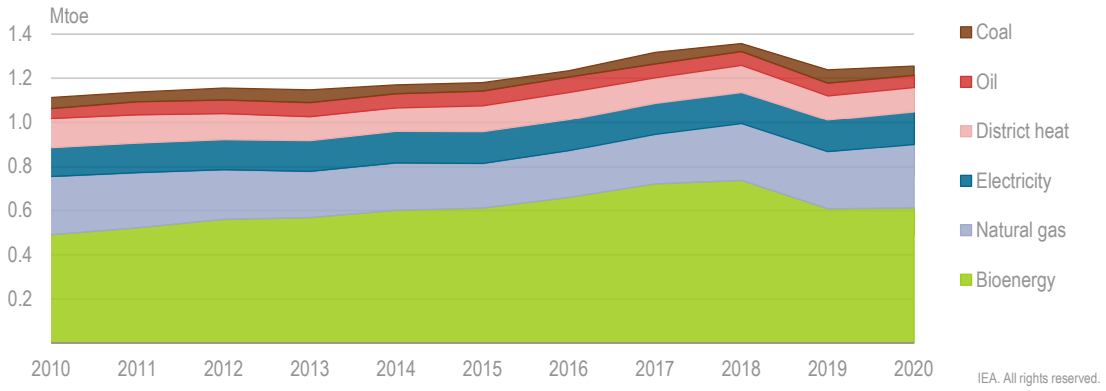
Residential

The residential sector consumed 1.3 Mtoe in 2020, accounting for 48% of TFC in the country. This is mainly energy consumption in buildings, largely for heating, which correlates with the severity of the heating season. The mild winter of 2018-2019 explains the drop in consumption in 2019 (Figure 8.2).

Bioenergy (solid biofuels) is the largest energy source in the residential sector, accounting for 49% of total consumption, followed by natural gas at 23% and electricity at 12% (Figure 8.3). The household energy consumption survey in 2017 for the first time quantified the widespread use of biofuels.

Similar to other European countries, around 80% of energy consumption in residential buildings is used for space and water heating (Figure 8.4). The rest is consumed mainly in cooking and by electrical appliances. Solid biofuels are the main source for space and water heating, supplying around half the energy consumed. The energy intensity of residential space heating per floor area decreased by 5% between 2015 and 2019 (IEA, 2021).

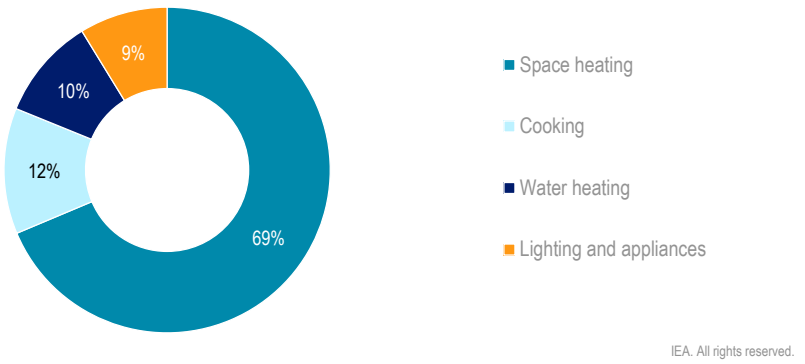
Figure 8.4. TFC in Moldova's residential sector by source, 2010-2020



Bioenergy, mostly in the form of solid biofuels, is the main energy source for the residential sector.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Figure 8.5. Breakdown of TFC in the residential sector, 2019



Most of the energy in the residential sector goes towards space heating.

Note: Space cooling is not visible in the chart as it accounts for less than 0.1% of total energy consumption in the residential sector.

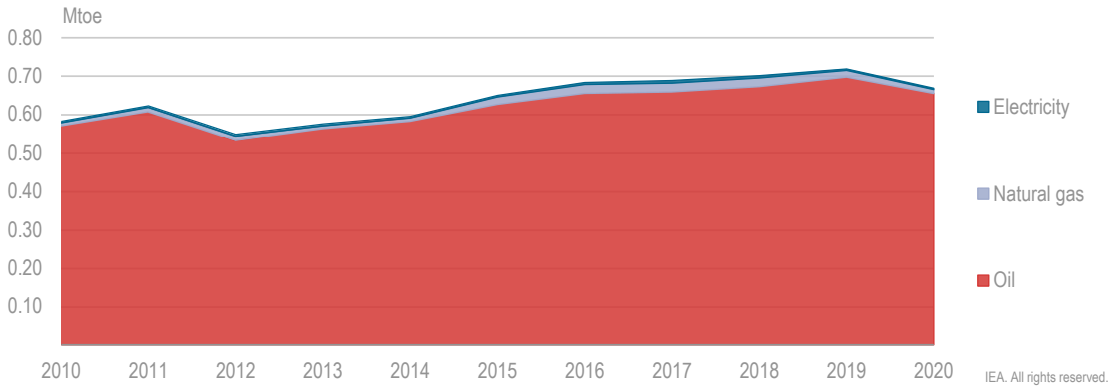
Source: IEA (2021), *Energy Efficiency Indicators* (database), https://www.iea.org/data-and-statistics

Transport

In 2020, the transport sector consumed 0.67 Mtoe, or 26% of TFC. Transport consumption increased 15% over the 2010 level.

Oil fuels dominate transport energy consumption, accounting for 98% in 2020 (Figure 8.6). Most of this is diesel fuels, which accounted for over 70% of total transport energy use in 2020, followed by around 25% for gasoline. Diesel engines are more energy-efficient than gasoline, but contribute to higher emissions of particulates and other pollutants. The high share of diesel used in road transport has been a major contributor to air pollution in many Moldovan cities. Natural gas consumption has accounted for 1-3% in the 2010s. Since 2015 NG consumption has more than doubled compared to 2010, but a major decrease occurred in 2020, likely driven by the Covid-19 pandemic and its associated price volatility. Electricity consumption remains marginal (<1%).

Figure 8.6. TFC in Moldova's transport sector by source, 2010-2020



Most transport consumption is based on oil products.

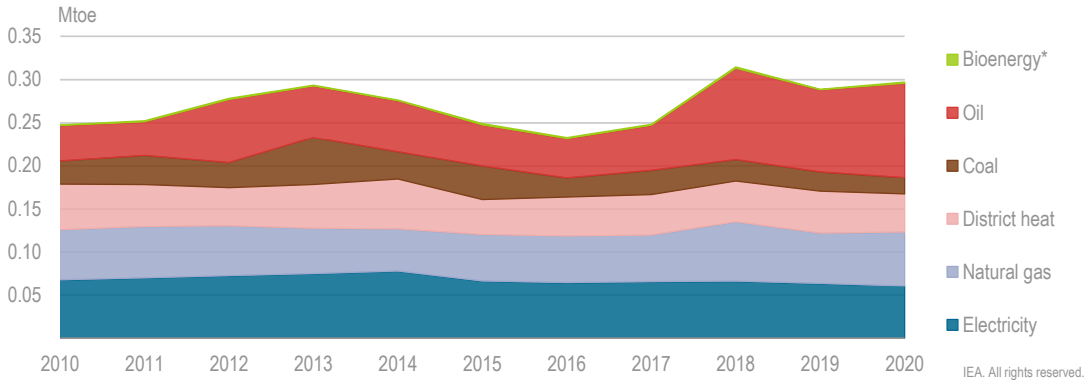
Note: Transport sector demand excludes international aviation and navigation.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Industry

The industry sector is a modest energy consumer in Moldova, with 0.30 Mtoe in 2020, equivalent to 11% of TFC. Industry's contribution to the economy is relatively low, and energy consumption has fluctuated in recent years. In 2018, after years of decline, consumption increased over 25% year-on-year- due to increased economic activity in mining and construction. The energy sources used by the industrial sector are diverse (Figure 8.6).

In 2020, oil accounted for 37%, natural gas 21% and electricity 20% of this sector's energy demand. Non-metallic minerals and the food and tobacco industries were the largest industrial energy consumers with 32% and 30% of total industry consumption in 2020 (Figure 8.8). The former used mostly natural gas, oil and coal for its needs, while the latter relied primarily on heat and electricity.

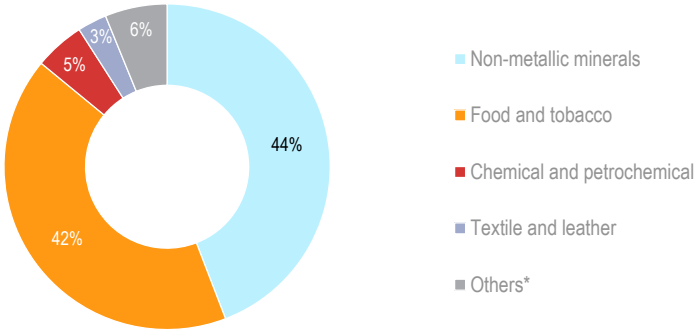
Figure 8.7. TFC in Moldova's industry sector by source, 2010-2020



While the industrial sector is small, it is diverse in terms of its energy consumption.

* Not visible at this scale.
Note: Includes non-energy consumption.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Figure 8.8. Energy consumption in manufacturing industry subsectors, 2020



Non-metallic minerals, food and tobacco were the main energy consuming sectors among the manufacturing industries in Moldova.

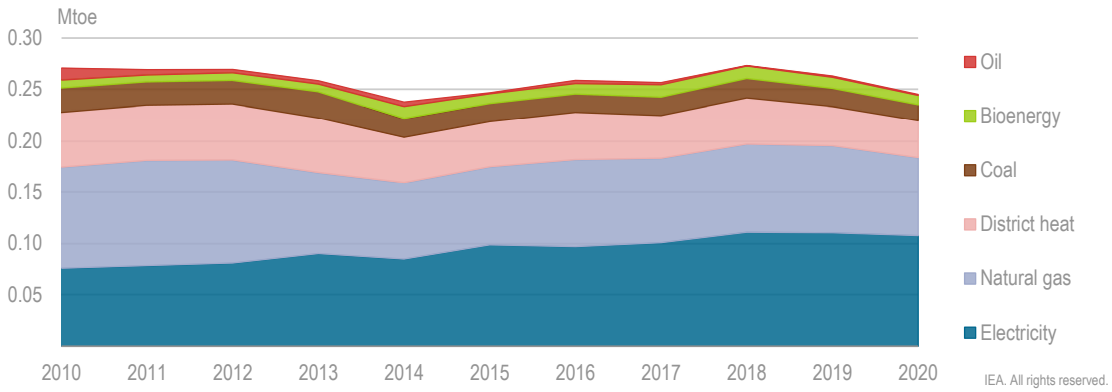
* Includes machinery, paper, pulp and printing, wood and wood products, transport equipment, iron and steel, and unspecified industrial consumption.
Notes: Manufacturing industry excludes mining, quarrying and construction and non-energy uses of energy products.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Services/other

The remainder of the country's TFC was consumed by the services sector (9% in 2020), and agriculture including forestry (5%). While representing only a small share of the TFC, energy consumption by agriculture and forestry grew over 80% since 2010. For most of its needs, the sector depended on oil products.

Looking at services alone, energy consumption decreased by 9% since 2010 to 0.25 Mtoe in 2020 In contrast, the energy consumption patterns have changed in recent years (Figure 8.9). Consumption of electricity increased over 40% since 2010 and from 2013 was the main energy source in the services sector. (In 2020 it accounted for 44% of the total energy consumption in the services sector). This increase meant that the consumption of natural gas dropped by 23% since 2010 and district heat declined by 32%.

Figure 8.9. TFC in Moldova's commercial and public services sector by source, 2010-2020



Electricity consumption in the services sector grew almost 50% since 2010.

Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Institutional framework

The Ministry of Infrastructure and Regional Development (MIDR) is the central public authority in the energy, construction and transport sectors, and its responsibilities include developing energy efficiency policies and measures for the whole Moldovan economy.

The Energy Efficiency Agency (EEA) is the administrative authority with the mandate to support the implementation of energy efficiency and renewable energy policies, and to attract and allocate resources for financing energy efficiency (EE) and renewable energy projects. It is a separate legal entity subordinated to the Ministry of Infrastructure and Regional Development. The EEA has existed since 2010 but it was restructured in 2019 when it absorbed the former Energy Efficiency Fund.[1] The restructured EEA has a division responsible for the implementation and monitoring of EE policies, and another division is responsible for the financing, implementation and monitoring of specific EE projects – the mission that was formerly performed by the Energy Efficiency Fund. In addition, the Agency disseminates information on EE and contributes to the elaboration of local energy efficiency programmes and plans, and the monitoring their achievement. (EEA, 2020).

Policies and measures

Legal framework

Moldova's legal framework in the area of energy efficiency stems from the country's commitment to transpose the EU energy *acquis*, particularly the Energy Efficiency Directive 2018/2002 and the Energy Performance of Buildings Directive 2018/844, which were adopted by the EU in 2012 and amended in 2018. The national legal framework consists of the following laws adopted and amended since 2014:

- Law on Energy Efficiency (No.139 of 19.07.2018)
- Law on Energy Labelling of Energy Related Products (No. 44 of 27.03.2014)
- Law on the Promotion of Cogeneration and Thermal Energy (No. 92 of 29.05.2014)
- Law on Energy Performance of Buildings (No. 128 of 11.07.2014) and
- Law on Eco-design Requirements for Energy-related Products (No. 151 of 17.07.2014).

The Moldovan government has drafted and/or approved many pieces of secondary legislation to implement these laws but this process has not yet been completed. The first National Energy Efficiency Action Plan (NEEAP) for 2013-2015 was adopted in 2013 and has been updated twice since then. The latest NEEAP for 2019-2021 was adopted in December 2019, describing progress achieved on the measures already adopted and establishing new policies and measures (GoM, 2019).

Following the adoption of the EU "Clean Energy for All Europeans" package and the respective amendments in the relevant directives, EU Member States and the Energy Community Parties are required to draw up integrated 10-year national energy and climate plans (NECPs) outlining how they intend to meet the energy efficiency and other targets

[1] Government Decision No. 45 of 30.01.2019.

for 2030 in a holistic manner (EC, 2020). Chapter 7 on energy and climate change provides more details on this process.

Energy efficiency targets

Law No. 139/2018 on Energy Efficiency defines national energy efficiency targets for 2020:

- total primary energy supply (TPES) must not exceed 2 968 thousand tonnes of oil equivalent (ktoe); and
- total final consumption (TFC) must not exceed 2 796 ktoe in 2020.

Targets beyond 2020 are not set in national legislation; the third NEEAP for 2019-2021 sets indicative targets for 2021 by extrapolating the 2020 targets set in the EE Law (Table 8.1).

Table 8.1 National and Sectoral Energy Efficiency Targets, 2019-2021

Indicator	Targets in EE Law 139/2018		Targets in NEEAP 2019-2021
	2019	**2020**	**2021***
Target according to EED article 3 *[ktoe]*	**144.4**	**167.2**	**193.6**
Public buildings (Art. 14)	*0.05*	*0.1*	
EE obligation scheme or Alternative Policies (Art. 8)	*12.23*	*24.46*	
Primary energy consumption *[ktoe]*	**2 936**	**2 968**	**2 990**
Final energy consumption *[ktoe]*	**2 723**	**2 769**	**2 808**
Residential buildings	*62.33*	*72.2*	*83.6*
Industry	*12.96*	*15.0*	*17.0*
Transport	*25.92*	*30.0*	*35.0*
Other	*43.18*	*50.0*	*58.0*
Primary energy intensity [ktoe/1000 EUR]	**0.22**	**0.19**	**0.17**

*2021 targets were extrapolated based on the targets set in the EE Law.

Sources: MEI (2020a) Fourth Annual Report under the Energy Efficiency Directive, Chisinau, July 2020;

GoM (2019) National Action Plan in the Area of Energy Efficiency for 2019-2021 (NEEAP), Government Decision 698/2019 of 27 December 2019.

According to the official national energy statistics,[2] the TES for 2020 was 2 857 ktoe (3.7% below the target) and the TFC was 2 670 ktoe (-3.6%).

Achievement of EE objectives would require mobilisation of significant financial resources, as Table 8.2 demonstrates.

[2] Official figures come from the Moldova National Bureau of Statistics. The IEA values are slightly different due to variations in methodology.

Table 8.2 Planned energy efficiency activities and estimated costs

#	Sector addressed by EE measures	No. of measures	Budget/ Cost million EUR	Energy savings in 2020 ktoe	Energy savings total ktoe
1	Horizontal measures	9	-	n/a	n/a
2	Construction -includes residential sector	2	108	6.7	21.1
3	Public -includes buildings, street lighting, water supply, etc.	3	131.2	8.4	22.7
4	Industry	2	105	22.2	68.1
5	Transport	2	13	0.4	2.1
6	Energy -measures influencing both primary and final energy consumption are clearly distinguished	4	232	4.7	18.1
	Final energy savings			**37.7**	**114**
	Primary energy savings			**51.8**	**203**

Source: MIRD (2020b) Promotion of the efficient use of energy in the Republic of Moldova, Chisinau, Presentation to IEA, 6 February 2020

Horizontal measures

Moldovan NEEAPs have envisaged EE policies and measures for various sectors (discussed below) as well as several horizontal measures including:

- Putting in place a monitoring and verification (M&V) platform: this has not been implemented yet.
- Promotion of energy performance contracting (EPC) and Energy Service Company (ESCO) models: regulation on provision of energy services was adopted in 2013 (Government Decision 1093/2013) but not implemented in practice. This Decision is being revised to meet the provisions of the Energy Efficiency Law of 2018.
- Measures to strengthen the capacities of local energy managers, including support to local public authorities in identifying and appointing local energy managers, support in the development of local energy efficiency action plans, encouragement of initiatives for vocational education and training of energy managers, etc. (GoM, 2019).
- Public awareness and communication activities: The Energy Efficiency Agency, supported by development partners, has implemented several campaigns over the recent years including more than 25 events related to EE and RE in 2019. One was a workshop on local energy efficiency action plans to help planning and attracting funding for the implementation of energy efficiency projects in districts (MIRD, 2020a).

Moldova's first and second NEEAPs envisaged introducing an Energy Efficiency Obligation Scheme (EEOS) in accordance with Article 7 of the EE Directive. However, the third NEEAP noted that a sufficient number of projects and programmes financed energy efficiency improvements in public buildings and the residential, industrial and energy sectors, contributing to the national target as "alternative measures" and reducing the need

to operationalise the EEOS (at least by 2020). Therefore, the development of the secondary legislation to establish the EEOS was suspended in 2020.

Industry

Policies and measures targeting the industrial sector include:

- An obligation for large companies to conduct mandatory energy audits every four years is envisaged but not yet enforced. A regulation of energy audits was approved by Government Decision 676 of 10 September 2020. It includes provisions on the authorisation of energy auditors and on the methodology for energy audit cost calculation. The EEA also developed guidelines on training and examination of specialists in the matter of energy auditing (Order of the EEA No. 04/AB of 29 January 2021). A regulation on mandatory energy audits in large enterprises has been drafted and is expected to be adopted in the second half of 2021.
- The possibility of introducing international energy management standards is promoted as an alternative option to mandatory energy audits among large companies. ISO 50001:2011 was adopted as the Moldovan national standard for energy management systems. It is not mandatory and was implemented in a number of Moldovan enterprises under the umbrella of the United Nations Industrial Development Organization (UNIDO) project “Reducing GHG emissions through improved energy efficiency in the industrial sector in Moldova”.

The third NEEAP highlights the limited scale of the industrial sector in the Republic of Moldova: according to the National Bureau of Statistics, there were 740 large enterprises in 2017. Therefore, even if the necessary funds were available (in the form of grants and preferential loans), the untapped potential for energy savings in industry is considered limited: according to the third NEEAP, Moldova is likely to fall short of the originally calculated sectoral target.

Buildings

In 2014, the parliament approved the Law on Energy Performance of Buildings to meet the requirements of the EU Directive (EU) 2018/844. The law introduces mandatory certification of residential and public buildings in line with the EU legislation. It also requires developers to comply with the minimum energy performance standards (MEPS) that are effective in the EU. In addition, Moldova’s Energy Efficiency Law of 2018 has provisions on the renovation of buildings owned and occupied by public authorities. To implement these laws, the government has started developing the required secondary legislation.

Strategic development

A long-term strategy for mobilising investment in the renovation of the national building stock (residential and public buildings) has been drafted, and public consultation is expected to start in 2022.

The EEA and MEI are establishing a national information system in the field of energy efficiency of buildings, supported by technical assistance provided in the framework of the “Moldova Energy Efficiency Project” funded by the European Investment Bank (EIB), EBRD and the Neighbourhood Investment Platform (NIP).

Residential buildings

The legal and regulatory framework to stimulate EE improvements in residential buildings is still under development, particularly the legislation related to condominiums and homeowner associations that would enable investments in the overall building envelope and common areas (GoM, 2019).

Public sector buildings

The Energy Strategy of Moldova to 2030 has a target to renovate 10% of public buildings by 2020. However, no monitoring and evaluation of the progress towards this target has been established yet. In accordance with Article 5 of the EE Directive, Article 14 of the national EE Law requires annual renovation of 1% of public buildings with a useful area above 250 m^2 that do not meet EE requirements.

Government Decision No 372/2020 approved the programme for renovation of the buildings owned and occupied by the central government in the period 2020-2022. The central government buildings stock inventory (CGBSI) contains 215 buildings with a total declared useful floor area of 426 056 m^2. The renovation programme for 2020-2022 – that will be supported by the EU and other development partners – targets two priority buildings with a total useful area of 10 086 m^2. This is expected to fulfil the yearly 1% renovation obligation, which is equal to 8 502 m^2. The total investment requirement for the programme is evaluated at MDL 37.95 million (about EUR 1.96 million) (MIRD, 2020a).

The Energy Efficiency Agency regularly launches calls for renovation projects in public buildings, supported by grants from the Government, the EU and other development partners (see section on Financing below). In addition to EE improvements in public buildings, EE improvements are planned in street lighting and in the water supply sector (MEI, 2020b). However, donor funds are not sufficient and not available to all local authorities, and the latter do not always understand and do not use other financing mechanisms, such as third-party financing (GoM, 2019).

Energy performance of buildings

Most new or amended regulations to fully transpose the provisions of the EU's Energy Performance of Buildings Directive (EPBD) have already been developed, mainly with the support of the Energy Community Secretariat and other development partners, and the following new regulations are expected to be adopted in 2021:

- Methodology for calculating optimal cost levels.
- Minimum requirements for the energy performance of buildings and their components.
- Methodology for calculating the energy performance of buildings, allowing the application of the Building Energy Performance Certificate tool and promoting buildings with low energy consumption.
- Methodology to calculate the minimum amount of energy from renewable sources (RES) in buildings. Some specific requirements for RES use in buildings were developed as part of the activity on revision of the minimal energy performance requirements.
- Additional requirements for the use of RES in buildings are to be developed and included in the National Plan for increasing the number of Nearly Zero Energy Consumption Buildings (nZEB). The Energy Efficiency Agency launched the procurement procedure for the elaboration of the nZEB National Plan.

Regulations on energy performance certification of buildings and on periodic inspection of the heating systems were adopted in 2016, and a regulation on periodic inspection of the air conditioning systems in 2018. The "Regulation on the authorisation of energy assessors, heating inspectors and air conditioning inspectors" was drafted and public consultation was expected to start in the second half of 2020 but was postponed.

Appliances

As required by EU Directives 2009/125/EC and 2010/30/EU, Moldova's legislation has eco-design requirements for energy-related products (Box 8.1) as well as labelling requirements (Box 8.2), i.e. mandatory indication through labelling and standard product information of the consumption of energy and other resources by energy-related products

Box 8.1 Eco-design Requirements Applicable to the Industrial Sector

Directive 2009/125/EC introduces eco-design requirements for the following energy-related products:

- no-load condition electric power consumption and average active efficiency of external power supplies
- fluorescent lamps without integrated ballast, high intensity discharge lamps, and ballasts and luminaires able to operate such lamps
- directional lamps, light emitting diode lamps and related equipment
- non-directional household lamps
- simple set-top boxes
- standby and off mode electric power consumption of electrical and electronic household and office equipment
- standby and off mode electric power consumption of electrical and electronic household and office equipment
- electric motors
- glandless standalone circulators and glandless circulators integrated in products
- televisions
- household refrigerating appliances
- fans driven by motors with an electric input power between 125 W and 500 kW
- air conditioners and comfort fans
- vacuum cleaners
- household tumble driers
- household washing machines
- household dishwashers
- water pumps

Source: Directive 2009/125/EC eco-design requirements for energy-related products.

Box 8.2 Energy Labelling Requirements

Directive 2010/30/EU introduces energy labelling requirements for the following energy-related products:

- household refrigerating appliances
- domestic ovens and range hoods
- air conditioners
- electrical lamps and luminaires
- household dishwashers
- household washing machines
- household tumble driers
- televisions
- vacuum cleaners
- water heaters, hot water storage tanks and packages of water heaters and solar devices
- space heaters, combination heaters, packages of space heaters, temperature control and solar devices and packages of combination heaters, temperature control and solar devices
- tires with respect to fuel efficiency and other essential parameters

Source: Directive 2010/30/EU.

Transport

NEEAP for 2019-2021 focuses on energy efficiency improvements in land transport and promotion of electrical vehicles. So far, there have been only a few small energy efficiency projects in the transport sector. (Several donor-supported projects to improve EE in railways and public transport have not achieved results yet). The adoption of the new draft Regulations on periodic technical inspection of vehicles (to replace the outdated regulation from 1999) has been delayed. As regards e-mobility, Moldova has introduced some financial incentives for EV acquisition: importers of EVs are exempted from custom duties, excise duties and VAT. In addition, there is a ban on the import of used vehicles older than 10 years.

The third NEEAP envisages that energy efficiency improvements in land transport are expected to lead to energy savings of 0.44 ktoe in 2021. The national-level measures include implementation of the Transport and Logistics Strategy for 2013-2022; implementation and enforcement of the Regulation on tyre labelling; and implementation of energy efficiency measures in the railway sector. In addition, municipal transport strategies – as well as municipal-level energy efficiency measures – are expected to be adopted and implemented in Chisinau and Balti.

These national and municipal measures are planned to be financed from the Road Fund, the donor-supported project for the restructuring of the railways of the Republic of Moldova; the budget of the municipality of Chisinau for 2019-2021, the budget of the project "Green and Sustainable Cities in Moldova – Catalysing Investments in Green and Sustainable

Cities in the Republic of Moldova, Using a Holistic Approach to Integrated Urban Planning", the project for the modernisation of public transport in Balti municipality (financed by the EBRD and the Eastern Europe Energy Efficiency and Environmental Partnership (E5P) Fund), and lending to the transport sector by local commercial banks.

The third NEEAP envisages continuous promotion of electric vehicles in order to provide a modal shift in private transport, and promotion of public electric urban and intercity transport, which is projected to have resulted in savings of 0.39 ktoe (the data is not yet available). Financing is expected to come from the budgets of the relevant local public administration authorities for 2019-2021, the budget of the above-mentioned project “Green and Sustainable Cities in Moldova”, including the financial resources provided by the Energy Efficiency Fund (2 million MDL= 101 200 EUR) and the budget of the project "Integration of Public Transport with Zero CO_2 " on the intercity routes of the Republic.

Energy sector

NEEAP envisages several measures in the energy sector, which are expected to improve the efficiency of primary energy consumption (contrary to the measures in end-user sectors which are intended to improve the efficiency of final consumption):

- Improvement of the performance of existing district heating systems (expected savings: 1.05 ktoe in 2021).
- Improvements of the efficiency of power and natural gas transportation and distribution, financed by investment plans of electricity and gas system operators (approved by ANRE and investment projects supported by development partners: “Rehabilitation of electricity transmission grids of state enterprise (SE) Moldelectrica” with a budget of EUR 40.5 million. Expected savings: 4.07 ktoe in 2021.
- Improvements of the performance of electricity, natural gas and heating metering and billing: i) Development of a cost-benefit analysis associated with the use of smart meters for metering electricity, heat and natural gas consumption and establishing related benefits; and ii) Planning of investments required for the installation of meters, if necessary, “smart” ones, for measuring the consumption of electricity, heat energy and natural gas by the end users. These measures are to be financed solely by the budgets of operators of transmission and distribution systems of electricity, heat and natural gas, in conjunction with the programme "Policy Development and Management in the Energy Sector".
- Update of the existing assessment of the high-efficient cogeneration potential implemented by the MEI and EEA and financed from the budgetary programme: "Policy Development and Management in the Energy Sector" for the period 2019-2021 and the EEA budget.

Financing of energy efficiency

Donor support for implementing energy efficiency measures is considerable: numerous international financing institutions and bilateral donors are active in Moldova. Active projects financed by development partners include (MIRD, 2020b):

- Energy efficiency project SACET Chisinau (USD 40.5 million) financed by the International Bank for Reconstruction and Development (IBRD) of the World Bank Group.
- CET-Nord Efficiency Improvement Project/SACET Balti (EUR 10.7 million) financed by EBRD and E5P Fund.

- Rehabilitation of the electricity transmission network of transmission system operator (TSO) SE Moldelectrica (EUR 39.3 million) financed by EBRD, EIB and the EU Neighbourhood Investment Facility (NIF).
- Energy Efficiency and Thermal Public Building Rehabilitation Project in Chisinau (EUR 25 million) financed by EBRD, EIB and E5P Fund contribution.

In addition, there are several projects under preparation:

- Implementation of EE and RE projects financed by the E5P Fund (EUR 150 million, including a EUR 30 million grant).
- Green Cities Programme (EUR 30 million) financed by the EBRD with a GCF contribution.
- Moldova Energy Efficiency Project (EUR 75 million) to improve the energy efficiency of hospitals and other public buildings (Box 8.3).
- Municipal solid waste project in Chisinau – financed by the EBRD's EUR 9 million loan and a EUR 5 million grant to Autosalubritate municipal enterprise that will be implementing the project, as well as a EUR 9 million zero-interest loan from the EIB, which will be provided through MARDE, a EUR 5 million grant, and technical assistance worth EUR 850 000. The municipality will contribute EUR 7.96 million, of which 1.5 million has already been invested (InfoMarket, 2020a).

Box 8.3 The Moldova Energy Efficiency Project

The Moldova Energy Efficiency Project (EUR 75.5 million), is designed to improve the energy efficiency of hospitals and other public buildings and is financed by the EIB, EBRD and NIF (EU Neighbourhood Investment Facility). It is aimed at creating a financial instrument necessary to ensure energy efficiency of the Moldovan public buildings owned by central and local authorities. At the first stage, the project will target the energy efficiency of government institutions (hospitals) with a budget of about EUR 60 million, and at the second stage – the building of local public authorities with a budget of about EUR 15 million. Within the framework of the project, it is planned that1-1.1 million m^2 of public buildings (approximately 3-4% of the total area of public buildings) be repaired, mainly hospital facilities. According to the feasibility study, this will ensure energy savings of 16.8 GWh/year (annual consumption of 16 republican hospitals); heat energy savings of 55.3 GWh/year (the annual consumption of four republican hospitals) and money savings of EUR 5.2 million per year.

Sources: EBRD (2021) *Moldova Buildings Energy Efficiency*, and InfoMarket (2020b).

Assessment

Moldova has made commendable progress in adopting a legal and regulatory framework aligned with the relevant EU directives in the area of energy efficiency, in compliance with the country's commitments as an Energy Community Party. One praiseworthy example is the nearly complete transposing into national legislation of the EU *acquis* on eco-design and labelling of energy-related products.

Moldova still needs to adopt several necessary by-laws to fully transpose the provisions of the Energy Efficiency Directive and Energy Performance of Buildings Directive, including regulations on mandatory energy audits for large enterprises, the long-term building renovation strategy, an updated national methodology for minimum energy performance of buildings, the minimum energy performance standards (MEPS), a methodology to calculate the minimum amount of energy from renewable sources in buildings, and the national action plan to increase the number of nearly zero-energy buildings. Most of the missing regulations have already been developed (with the support of the Energy Community Secretariat and other development partners), and the key challenge for the Government of Moldova will be their full implementation and enforcement.

Following the adoption of the EU "Clean Energy for all Europeans Package" and the amendments in the relevant directives, Moldova needs to further adjust its legislation to the more ambitious EU framework. This includes preparing integrated 10-year national energy and climate plans (NECPs) and outlining how the country intends to meet the energy efficiency and other targets for 2030.

As of early 2021, the Republic of Moldova did not have national legally binding EE targets. The overall targets up to year 2020, which are set in the Law on Energy Efficiency, are likely to have been met (but the final data is not yet available), and the new targets have not yet been established at the legislative level. The Third National Energy Efficiency Action Plan (NEEAP) for 2019-2021 set indicative targets for 2021 by extrapolation. Establishing legally binding targets for a relatively long period of time is important because they give clear signals to market players.

There are no reliable estimates of energy efficiency potential in Moldova. Disaggregated energy end-use statistics by sector are not yet available, which makes it difficult to make reliable projections and assess progress in tapping the EE potential. Numerous targets were adopted for different sectors of the economy, but the lack of reliable and validated data on energy savings achieved is a clear indication that greater attention should be paid to the collection and analysis of end-use energy data at sufficient levels of disaggregation.

Despite numerous strategies, action plans, programmes and an extensive body of legislation, progress in improving energy efficiency has been limited. Moldova needs to make additional efforts to ensure the effective implementation of energy efficiency strategies, policies and programmes. This can be done through better enforcement of legal and regulatory requirements, enhanced public awareness of energy efficiency benefits and possible improvements, facilitated access to financing and further legal and regulatory improvements, particularly to facilitate decision-making and enable EE improvements in condominiums. The government should also consider means to amend residential price energy subsidies and create additional incentives to provide proper price signals for energy efficiency improvements while avoiding exacerbating inequality and energy poverty.

The Energy Efficiency Agency (EEA) is supposed to facilitate access to financing and also finance energy efficiency and renewable projects that are not commercially viable at market interest rates. Despite considerable donor support from various development partners active in Moldova, the funding available through the EEA and donor-funded programmes is not sufficient to implement energy efficiency measures across the whole country. Investment needs for energy efficiency improvements up to the OECD level can be met only with the leverage of private investments.

The relatively high cost of capital in Moldova and difficulties in accessing affordable banking financing are serious impediments for energy efficiency improvement in the industrial sector. Small and medium enterprises (SMEs) are especially constrained in attracting commercial financing for energy efficiency improvements. EE improvements in residential buildings are also hindered by difficult access to financing as many homeowners cannot finance EE investments with their own financial resources.

There are no active ESCOs in Moldova. However, ESCOs can perform the important role of middlemen between banks, equipment producers and clients. The potential of an ESCO market should be considerable in the country and Moldova could support the development of ESCOs by providing additional training, certification and accreditation.

In the buildings sector, the Law on Energy Performance of Buildings makes mandatory the certification of residential and public buildings in line with the EU legislation. It also requires developers to comply with the minimum energy performance standards (MEPS) that are already in effect in the EU. To enforce the law, the government needs to approve the bulk of secondary legislation, as mentioned above. Box 8.4 demonstrates a range of policies that support the decarbonisation of new and existing buildings, and also highlights the need for greater collaboration involving a range of stakeholders at the national and local levels.

Box 8.4 Global Roadmap for Buildings and Construction

The IEA has prepared a Roadmap for the Global Alliance for Buildings and Construction (GlobalABC), to support decarbonising new and existing buildings. It concludes that effective policies and regulations need to cover the entire building life cycle, including the design, development, operation and decommissioning stages, and also act beyond site boundaries through neighbourhood planning and clean energy. It also highlights the need for greater collaboration involving a range of stakeholders, including policy makers, urban planners, architects, construction companies, materials suppliers, utility companies, developers and investors.

National roadmaps and strategies set priorities for the sector

National ministries and city agencies should develop ambitious, comprehensive strategies and roadmaps to outline the pathway to a zero-emission, efficient and resilient buildings and construction sector. These should be developed through consultation and engagement, address the multiple dimensions of urban planning, new and existing buildings and their operation, appliances and systems, embodied carbon of materials, resilience and clean energy.

Governments should partner with key stakeholders to develop metrics which include energy performance benchmarks and sector targets and data collection mechanisms that include the use of materials with low-embodied carbon, building energy performance, building ratings systems and building resilience.

Governments and industry coalitions should work to close key information gaps by establishing data collection systems and methods which can provide essential evidence to inform decarbonisation and efficiency planning, as well as highlight the concrete, quantifiable benefits of efficiency and sustainability interventions.

Local agencies should undertake risk mapping and resilience assessment, and develop integrated strategies to improve the resilience of the building stock as well as strategies to address resilience risks in new building developments to inform zoning and building performance standards.

Standards and codes gradually drive up performance

Regulators should develop or expand minimum energy performance standards (MEPS) to set ambitious product energy performance requirements which cover all major appliances and systems. MEPS could be especially effective if developed in collaboration across regions to enable cross-border applicability. To support energy-efficient purchasing decisions, regulators should implement both voluntary and mandatory energy ratings and labelling programmes.

Regulatory frameworks to facilitate integrated action

City-level actors should collaborate across sectors and government levels to develop integrated urban planning policies and frameworks that address land-use efficiency, transit-oriented design, access to green spaces, resilience and district clean energy planning.

National and local agencies should develop ambitious regulatory and incentive frameworks to increase investment in energy efficiency improvements and reduce carbon emissions from the production of major building materials.

National and local agencies should develop clear regulatory and incentive frameworks to promote the use of on-site and building-integrated renewable energy, including solar photovoltaics (PV), solar thermal, geothermal, micro-wind and advanced biofuels, where appropriate.

Narratives and engagement to drive demand

National and subnational governments, industry coalitions and civil society should promote the multiple benefits that zero-emission, energy-efficient and resilient buildings have for different stakeholders.

National and subnational governments and large organisations can take leadership in zero-carbon procurement and standards to promote investment in low-carbon building construction and renovation and encourage the adoption of efficient technologies at scale.

Governments and industry coalitions should craft narratives that promote good practices, such as the use of digital information systems for building operations and energy use, effective data collection and the use of traditional low-carbon materials.

Capacity building

Governments and industry coalitions should promote opportunities for capacity building on topics like embedding circular economy concepts into building design through life-cycle assessment, data collection for efficiency improvement, reuse of construction materials and phasing out of high global warming potential refrigerants.

Government and industry coalitions should promote the adoption of existing efficient building construction and operation techniques and low-cost technologies that can improve building performance and lower embodied carbon.

Source: GlobalABC/IEA/UNEP (Global Alliance for Buildings and Construction, International Energy Agency, and the United Nations Environment Programme) (2020): *GlobalABC Roadmap for Buildings and Construction: Towards a zero-emission, efficient and resilient buildings and construction sector*, IEA, Paris.

In transport, several measures have already been taken to promote electrical vehicles (financial incentives for EV acquisition). Although these measures make EVs more competitive with vehicles that have internal combustion engines, they might not be effective as long as there are no additional measures to promote and facilitate e-mobility.

In addition to several on-going initiatives at the national and local levels, more efforts could be made to improve energy efficiency in transport. The government adopted the Regulation on Tyres Labelling but needs to undertake additional efforts for its effective enforcement. At the same time, the government delayed the adoption of the new draft Regulations on Periodic Technical Inspection of Vehicles.

In district heating, despite improvements over the last several years, losses are reported to be around 19-20% across the country, although the exact level varies between DH systems. Such high losses are attributed mainly to inadequate maintenance, pipeline leakages, poor insulation and old equipment. Modernising district heating systems in Moldova could lead to substantial energy savings.

Recommendations

The government of Moldova should:

- Extend capacities to collect and analyse energy data. Ensure the availability of robust and meaningful disaggregated energy efficiency indicators by sector for subsequent use in monitoring, evaluation and enforcement of approved policies and measures.
- Leverage private investment in energy efficiency by:
  - Enhancing the capacity of local banks to facilitate the financing of energy efficiency and renewable energy projects
  - Developing financing instruments and dedicated credit lines for energy efficiency projects with financial institutions
  - Supporting the Energy-Service Company (ESCO) industry by improving the legislation, standardising the contractual frameworks and streamlining accreditation procedures
  - Implementing tax incentives for some EE products.
- Enhance the institutional capacity of the Energy Efficiency Agency and of the bodies responsible for checking and enforcing the technical characteristics and quality of equipment used in Moldova, and the compliance with EE standards and regulations. All should strive to increase their cooperation with academia and the private sector.
- Require and enforce building energy codes and energy performance certificates in line with the Law on Energy Performance of Buildings, taking a holistic approach that includes the building envelope, lighting, ventilation and water-heating systems within the building. The effect of these policies could be maximised by:
  - Supporting capacity building and the institutional set-up required for the implementation and enforcement of building energy codes and MEPS, as well as monitoring the resulting savings
  - Supporting infrastructure development, testing and rating.
- Encourage modernisation of district heating networks through enforcement of full cost–reflective tariffs, energy measurement and reporting, investment and advice from ESCOs and replication of successful pilot projects already implemented.
- Design and promote energy efficiency policies and measures for SMEs: ease access to affordable financing, support energy audits and disseminate information on proven energy efficiency practices relevant to SME operations.
- Accelerate the market penetration of new efficient vehicle technologies to improve energy efficiency in transport:

- > Adopt, enforce and regularly update mandatory vehicle fuel efficiency standards for road vehicles, and enforce periodical obligatory technical inspection of vehicles
- > Consider other measures such as labelling, incentives and taxes to boost vehicle efficiency.

☐ Leverage the latest in behavioural sciences to inform energy efficiency policy design and awareness campaigns to improve efficacy and uptake by residents.

References

EBRD (European Bank for Reconstruction and Development) (2021), *Moldova Buildings Energy Efficiency*, https://www.ebrd.com/work-with-us/projects/psd/50601.html (accessed 20 May 2021)

EC (European Commission) (2020), *Energy Efficiency Directive*, https://ec.europa.eu/energy/topics/energy-efficiency/targets-directive-and-rules/energy-efficiency-directive_en#content-heading-0 (accessed 28 April 2021)

EEA (Energy Efficiency Agency) (2020), *Institutional Set-up of the Energy Efficiency Agency, Core Functions and Responsibilities*, Energy Efficiency Agency, Chisinau, presentation to IEA 6 February 2020

EnC (Energy Community) (2020), *Moldova Annual Implementation Report,* Energy Community Secretariat.

GlobalABC/IEA/UNEP (Global Alliance for Buildings and Construction, International Energy Agency, and the United Nations Environment Programme) (2020), *GlobalABC Roadmap for Buildings and Construction: Towards a zero-emission, efficient and resilient buildings and construction sector*, IEA, Paris.

GoM (Government of Moldova) (2019), *National Action Plan in the Area of Energy Efficiency for 2019-2021* (NEEAP), Government Decision 698/2019 of 27 December 2019.

IEA (2022), World Energy Statistics and Balances (database), https://www.iea.org/data-and-statistics

IEA (2021) *Energy Efficiency Indicators* (database) https://www.iea.org/data-and-statistics

InfoMarket (2020a), “The EBRD will provide 9 million euros to Autosalubritate municipal enterprise for the implementation of the municipal solid waste project in Chisinau”, http://infomarket.md/en/analitics/The_EBRD_will_provide_9_million_euros_to_Autosalubritate_municipal_enterprise_for_the_implementation_of_the_municipal_solid_waste_project_in_Chisinau

InfoMarket (2020b), “Moldova will receive 30 million euros from the EIB for the implementation of a project to improve the energy efficiency of hospitals and other public buildings with a total value of 75 million euros”, http://infomarket.md/en/pwengineering/_Moldova_will_receive_30_million_euros_from_the_EIB_for_the_implementation_of_a_project_to_improve_the_energy_efficiency_of_hospitals_and_other_public_buildings_with_a_total_value_of_75_million_euros

MIRD (Ministry of Infrastructure and Regional Development) (2020a), *Fourth Annual Report under the Energy Efficiency Directive*, Chisinau, July 2020.

MIRD (2020b), *Promotion of the Efficient Use of Energy in the Republic of Moldova*, Chisinau, presentation to IEA, February 2020.

9. Renewable energy

Key data

(2020 provisional)

Renewable energy: 0.668 Mtoe (24.3% of TES) and 0.131 TWh (13.4% of electricity generation)

World renewable energy shares (2019): 13.8% of TES and 26.0% of electricity generation

Bioenergy: 660 ktoe (24.0% of TES) and 29 GWh (3.0% of electricity generation)

Wind: 4 ktoe (0.2% of TES) and 51 GWh (5.2% of electricity generation)

Hydro: 4 ktoe (0.1% of TES) and 47 GWh (4.8% of electricity generation)

Solar: 0.3 ktoe (0.01% of TES) and 4 GWh (0.4% of electricity generation)

Overview

Renewable energy sources (RES) contributed almost a quarter of Moldova's total energy supply in 2020. This consists mainly of solid biofuels, and only a small part of renewable electricity. The country has put in place several schemes to support electricity generation from RES: net metering and feed-in tariffs (FiTs) for smaller-scale installations, and auctions for larger projects. In the heating sector, traditional biomass use is predominant, but a new market for modern RES heating technologies has been recently created with donor support. Practically no actions have been taken yet to encourage the use of RES in transport.

Supply and demand

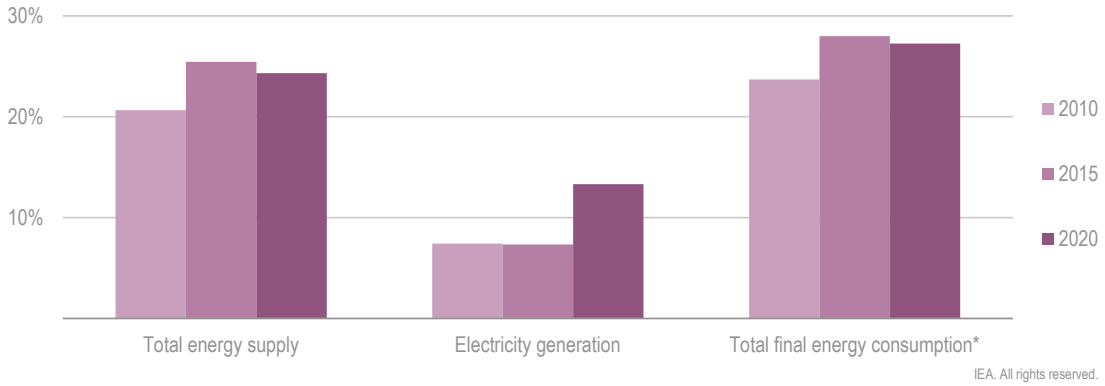
In Moldova, the contribution of RES in the energy system is high – nearly a quarter of total energy supply (TES) in 2020 - mostly consisting of final consumption of solid biofuels, and with only a small contribution of renewable electricity (Figure 9.1). In Europe, solid biofuels satisfy energy demand to a similar extent in only Latvia (33% of TES) and Finland (27% of TES).

There is notable potential to increase renewable electricity generation via wind and solar photovoltaic (PV), whereas hydro potential has already largely been tapped. The technical potential for RE generation in Moldova is estimated at over 27 GW, including 20.9 GW of wind, 4.6 GW of solar, 0.9 GW of biomass and 0.8 GW of hydro potential (IRENA, 2017). Only a portion of this theoretical potential can be practically tapped today because of various barriers including limited capacity to balance the power system and competitive usages of land (e.g. for agriculture).

Since 2018, non-hydro renewable electricity sources combined have already produced more electricity than hydro power plants. In 2020, the share of renewable electricity generation climbed to 13% mostly due to wind capacity additions.

In final consumption, renewables cover almost 30% (27% in 2020) of the energy demand. In practice this consists mostly of solid biofuel consumption in the residential sector.

Figure 9.1 Share of renewable energy in Moldova's energy system, 2010-2020



Share of renewable energy is relatively high in final consumption due to the use of solid biofuels.

* Includes direct use in total final consumption and indirect use through electricity and heat consumption.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

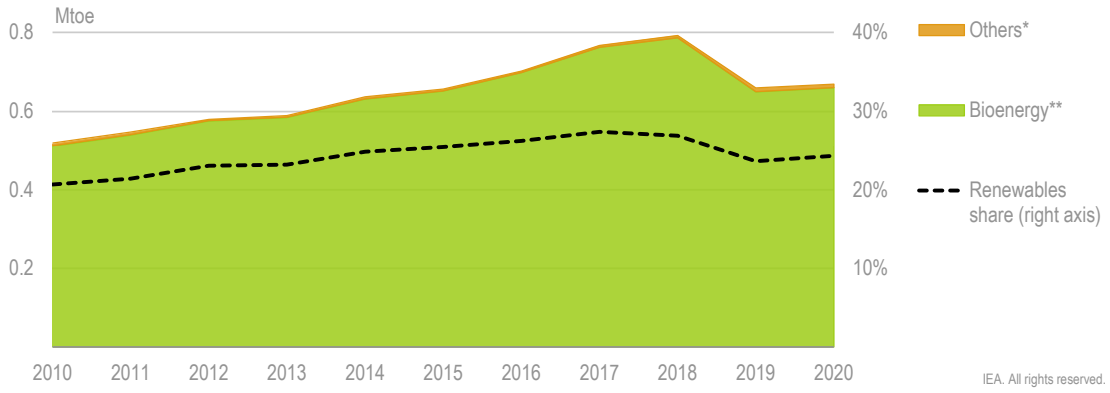
Renewable energy in total energy supply

The contribution of RES to TES has grown steadily in recent years, totalling 0.67 Mtoe in 2020 (or 24% of TES) (Figure 9.2). As it primarily consists of bioenergy (solid biofuels), it strongly correlates with the average temperature of the heating season. This also explains the drop in consumption between 2018 and 2019 when Moldova had a mild winter.

The use of solid biofuels in the residential sector was quantified in the household energy consumption survey conducted in 2016-2017. The survey gave – for the first time – a realistic magnitude for biomass energy consumption. The finding was that around 20% of the energy demand in the country was satisfied by solid biofuels.

Solid biofuels used in the country are counted as renewable energy even though not all may meet the sustainability criteria for biomass laid down in the EU Renewable Energy Directive (see Box 9.1).

Figure 9.2 Renewable energy in Moldova's TES, 2010-2020



The share of renewable energy is high and is mostly due to bioenergy use.

* Includes wind, hydro and solar PV; not visible at this scale.
** Includes solid biofuels and biogases.
Note: Mtoe = million tonnes of oil equivalent.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Box 9.1 EU sustainability criteria for biomass

To ensure that bioenergy is produced sustainably to support the EU climate and energy targets, Article 29 of the EU Renewable Energy Directive of 2018 introduced sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels used for heat and power production. The key criteria are summarised below:

- For biofuels, bioliquids and biomass fuels produced from waste and residues derived not from forestry but from agricultural land, operators or national authorities must have monitoring or management plans in place in order to address the impacts on soil quality and soil carbon.
- Biofuels, bioliquids and biomass fuels produced from agricultural biomass shall not be made from raw material obtained from: a) land with a high biodiversity value, b) land with high-carbon stock, and c) land that was peatland in January 2008, unless evidence is provided that the cultivation and harvesting of that raw material do not involve drainage of previously undrained soil.
- Biofuels, bioliquids and biomass fuels produced from forest biomass shall meet the detailed criteria (listed in the Directive) to minimise the risk of using forest biomass derived from unsustainable production, as well as the land-use, land-use change and forestry (LULUCF) criteria (listed in the Directive).
- The GHG emissions savings from the use of biofuels, bioliquids and biomass fuels shall be: (a) at least 50% for biofuels, biogas consumed in the transport sector and bioliquids produced in installations in operation on or before 5 October 2015; (b) at least 60% for biofuels, biogas consumed in the transport sector and bioliquids produced in installations starting operation from 6 October 2015 to 31 December 2020; (c) at least 65% for biofuels, biogas consumed in the transport sector and bioliquids produced in installations starting operation from 1 January 2021; (d) at least 70% for electricity, heating and cooling production from biomass fuels used in installations

starting operation from 1 January 2021 to 31 December 2025 and 80% for installations starting operation from 1 January 2026.

In March-April 2021 the European Council published for public consultation a draft regulation that would lay down operational guidance for member states and economic operators on how to demonstrate compliance with the sustainability criteria for forest biomass, set out in Article 29 of the RE Directive. It was expected to be adopted in the second quarter of 2021.

Sources: EU (2018), Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN;

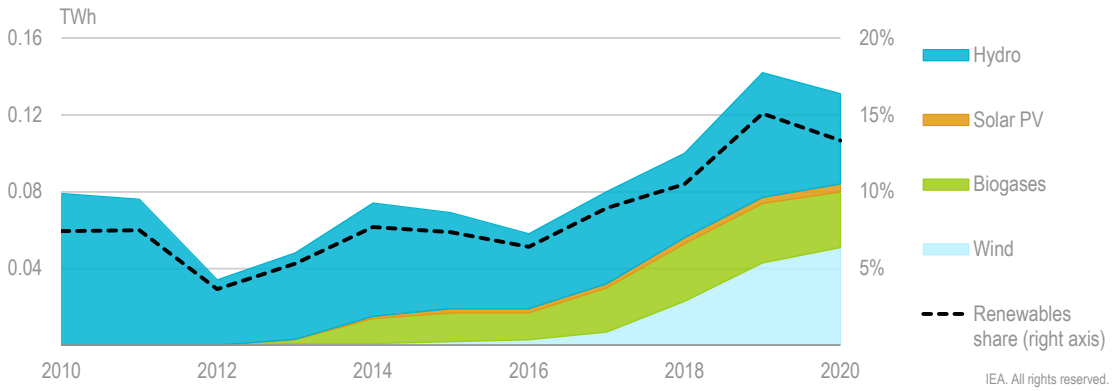
EC (European Commission) (2021a), Renewable Energy Directive – guidance on the sustainability criteria for forest biomass used in energy production, EU https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12943-Renewable-Energy-Directive-guidance-on-the-sustainability-criteria-for-forest-biomass-used-in-energy-production.

Electricity from renewable energy

Driven by strong policy support, Moldova increased the share of renewable energy in electricity generation from 7% in 2010 to 13% in 2020 (Figure 9.3).

While hydroelectricity potential has already been largely tapped, wind electricity generation is expected to grow rapidly. At only 1 MW in 2015, wind capacity totalled 45 MW in 2020 and continues to grow (Figure 9.3). Solar PV capacity grew more modestly, from 1 MW in 2015 to 5 MW in 2020. Some electricity is also generated with biogases. 0.13 TWh of renewable electricity was produced in 2020 (+67% since 2010).

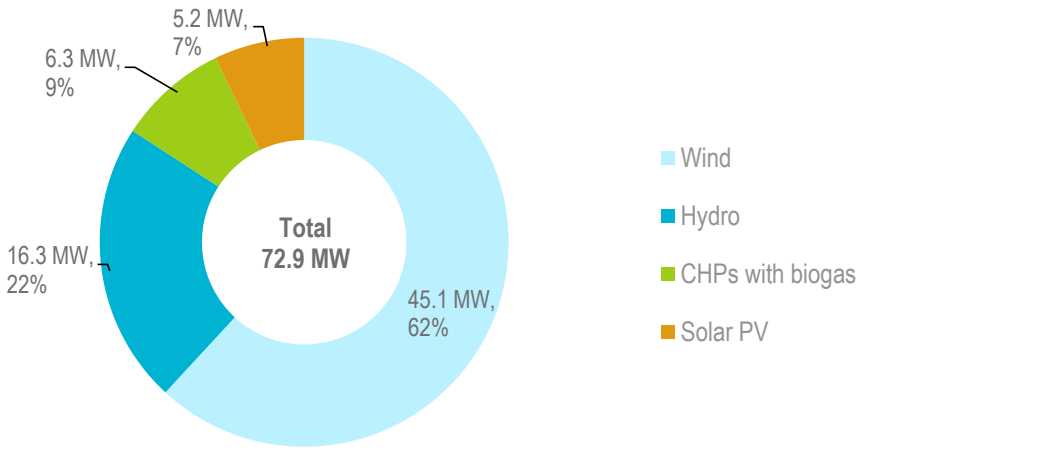
Figure 9.3 Renewable energy in Moldova's electricity generation, 2010-2020



Renewable electricity generation is expected to increase, mostly driven by wind capacity additions.

Notes: TWh = terawatt-hour.
'Hydro' includes both existing traditional hydropower plants and small hydropower stations eligible for support.
Source: IEA (2022), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Figure 9.4 Installed renewable capacity in Moldova, 2020

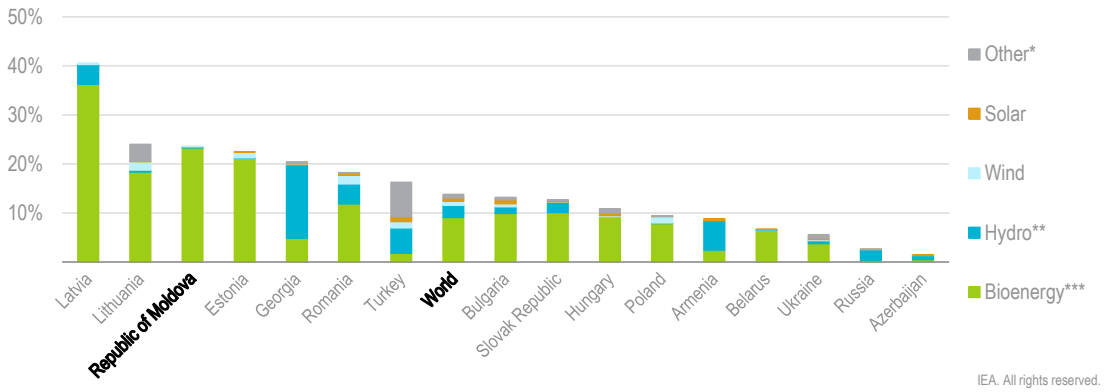


In 2020, wind accounted for the biggest share in installed renewable capacity.

Source: Ministry of Infrastructure and Regional Development of Moldova.

The share of renewable energy in Moldova's TES is well above the world average of 14% (2019). It is noteworthy that when only the share of bioenergy in TES is taken into account, Moldova outranks most countries in the comparison (Figure 9.5).

Figure 9.5 Renewable energy share of TES in selected countries, 2019



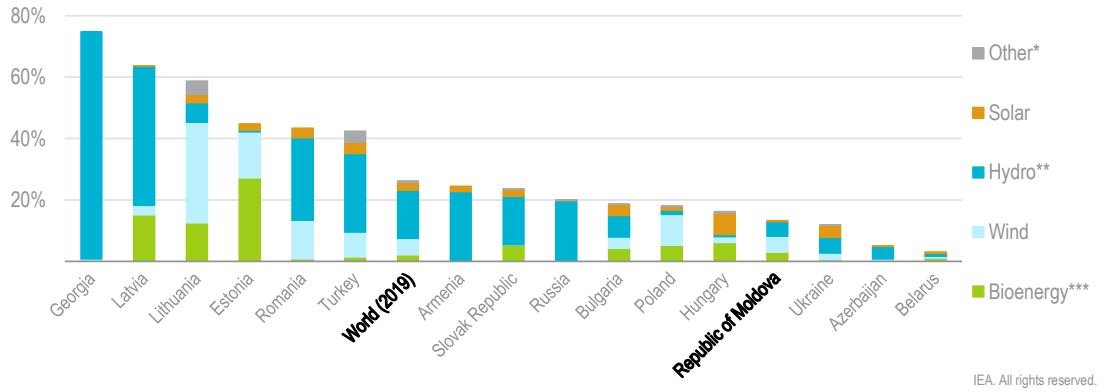
The share of renewables in Moldova's TES is above the world average.

* Includes geothermal and primary heat.
** Includes hydro power (excluding pumped storage), and tidal, wave and ocean energy.
*** Includes solid, liquid and gaseous biofuels and renewable waste.
Source: IEA (2021), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics.

Moldova's share of renewables in electricity generation (without considering MGRES) was 13% in 2020, which was below the world average (26%) (Figure 9.6).[1]

[1] Depending on the statistical treatment of electricity procured from MGRES, the share of renewables in electricity generation is roughly 3%.

Figure 9.6 Renewable energy share in electricity generation in selected countries, 2020



The share of renewables in Moldova's electricity generation was below the global average.

* Includes geothermal and primary heat.
** Includes, solid, liquid and gaseous biofuels and renewable waste.
*** Includes hydro power (excluding pumped storage), and tidal, wave and ocean energy.
Source: IEA (2021), *World Energy Statistics and Balances* (database), https://www.iea.org/data-and-statistics

Institutional framework

The Ministry of Infrastructure and Regional Development (MIRD) is the central public authority in the energy sector whose responsibilities include the development of renewable energy policies and measures.

The Energy Efficiency Agency (EEA), a separate legal entity subordinate to the Ministry of Infrastructure and Regional Development, is the administrative authority with the mandate to support the implementation of energy efficiency and renewable energy policies, and to attract and allocate resources for financing energy efficiency and renewable energy projects. The EEA has the following responsibilities related to RES (Chapter 8 provides more details on its mandate related to energy efficiency):

- promoting renewable energy sources in all sectors of the national economy
- implementing the qualification and registration systems for installers of RES technologies
- raising public awareness and consulting customers and public authorities on the potential benefits of RES technologies and practical aspects of their use
- implementing a qualification system and a registration system (creating and maintaining a registry) for installers of biomass boilers, stoves or furnaces, solar photovoltaic and solar thermal systems, geothermal systems and heat pumps (EEA, 2020, and Parliament of the Republic of Moldova, 2016).

The National Agency for Energy Regulation (ANRE) is the autonomous regulatory authority for the energy sector that has numerous responsibilities related to RES, including:

- licensing of electricity and heat production from renewable sources;
- production of biogas that is delivered to natural gas networks; and production of biofuels that is purchased by oil importers
- setting fixed tariffs and ceiling prices for RES electricity produced by eligible producers
- issuing relevant secondary legislation (regulations) related to RES

- supervision of compliance with regulatory, technical and safety norms and requirements during installation and servicing of RES installations such as biomass boilers, stoves or furnaces, solar photovoltaic and solar thermal systems, geothermal systems and heat pumps (ANRE, 2020).

The "Clean Technology Innovation Programme for SMEs and Start-ups in the Republic of Moldova" initiative was launched in 2019 to promote and support the use of technologies in the field of renewable energy in the Republic of Moldova by piloting an Entrepreneurial Accelerator, leading to the development of entrepreneurship, job creation and positive impacts on the environment (MIRD, 2020a).

Policies and measures

Targets and legal framework

The National Renewable Energy Action Plan for 2013-2020 (adopted by Government Decision № No.1073 of 27 December 2013) set the overall target for energy consumption from renewable sources at 17% in 2020; the values of sectoral RES targets were set at 10% for electricity, 27% for heating and cooling and 10% for the transport sector.

As mentioned in the section on Supply and Demand, the share of renewable energy in final energy consumption reached 27.3% in 2020. Therefore, the binding target for 2020 of 17% was largely exceeded. This large share of renewable energy is almost exclusively due to the use of biomass in the residential sector, which used to be underestimated until the National Bureau of Statistics revised the biomass consumption data for the period 2010-2016.

The 10% mandatory target for the transport sector is far from being met, as almost no action took place in this area.

The new targets to 2030 are to be included in the National Energy and Climate Plan (NECP), which was still being prepared as of early 2022 (see Chapter 7).

The renewable energy sector is governed primarily by the Law on Promoting the Use of Energy from Renewable Sources No.10 of 26.02.2016 (RES Law) that transposes the Directive 2009/28/EC and the EC Guidelines on State Aid for Environmental Protection and Energy 2014-2020. Some provisions of the Electricity Law No. 107 of 27.05.2017 and the relevant sub-laws also apply to renewable energy, particularly as regards to integration of RES in the power system, which is discussed in more detail in Chapter 5 on Electricity.

Renewable power

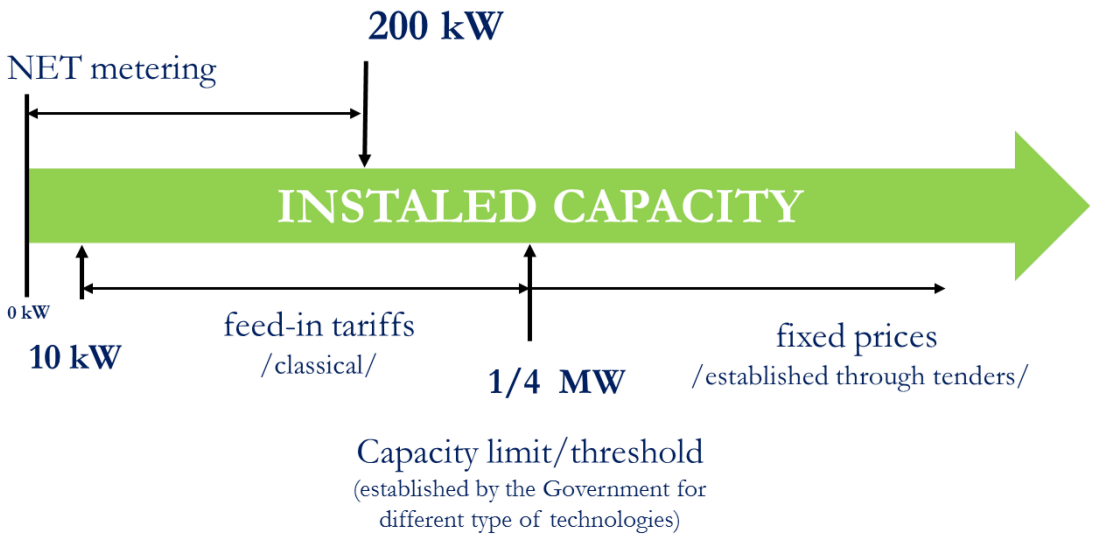
The RES Law, which entered into force in 2018, provides support for the eligible producers that generate electricity from RES. There are three support levels according to the project size (Figure 9.7):

- Net metering for small-scale installations with capacity up to 200 kW
- Administratively set FiTs for small-scale projects between 10 kW and 1 MW (up to 4 MW for wind) issued by ANRE according to the first come, first served principle
- Auctioned tariffs for larger projects.

The central electricity supplier Energocom has an obligation to purchase all eligible renewable-generated electricity for 15 years at the guaranteed tariff. Eligible producers also benefit from non-discriminatory grid connection and priority dispatch.

According to the RES Law, generators can also produce electricity from RES without applying for support schemes: either for their own use or for sale to any buyer on the electricity market (rather than to the centralised offtaker at the guaranteed tariff). In this case, they do not have to comply with all eligibility criteria, for example, the obligation to use only new equipment.

Figure 9.7 Support schemes for RES-electricity



Source: MIRD (2020b), *Promotion of the use of renewable energy in the Republic of Moldova*, MIRD presentation to IEA, February 2020, updated October 2020.

Since the adoption of the RES Law, the government and the regulator (ANRE) have developed and approved most of the regulations necessary to operationalise the three support schemes (Box 9.2). An electronic system for issuing, transfer and cancellation of guarantees of origin has not been established yet.

Box 9.2 Regulatory framework for supporting RES-electricity

Moldova's Law on Promoting the Use of Energy from Renewable Sources No.10/2016 (RES Law) was implemented by the following regulations:

- Regulation on Guarantees of Origin for the electricity produced from renewable sources (HANRE 376/ 2017)
- Decision on appointment of central electricity supplier (offtaker of electricity from RES) (GD 885/2017)
- Methodology on allocation of cost of purchase of renewable electricity to electricity suppliers (HANRE 212/2015 amended in 2020, HANRE 483/2017)
- Methodology on setting the FiT prices for small producers and of ceiling prices used in auctions (HANRE375/2017)

- Regulation on setting RES quotas and capacity limits until 2020 (GD 689/2018)
- Regulation on carrying out tenders for providing the status of eligible producers (GD 690/2018)
- Regulation regarding the confirmation of the status of eligible producers (HANRE 251/2019)
- Mandatory clauses of the contract for acquisition of electricity produced from renewable sources (template power purchase agreement) (HANRE 252/2019)
- Regulation on the connection to the power grid and supply of transport and distribution services (HANRE 168/2019)
- Decision regarding fixed tariffs and ceiling prices for electricity produced from renewable energy sources by producers who will obtain eligible producer status in 2020 (HANRE 54/2020)
- The electricity market rules (HANRE 212/2015) amended by ANRE in August 2020.

Source: Republic of Moldova, Ministry of Justice, https://www.legis.md/, database (accessed 15-30 April 2021).

Auctions and feed-in tariffs

To implement the RES Law, Government Decision 689/2018 set a total quota of 168 MW of RES capacity (mainly wind and solar PV) to be supported by FiTs and auctions. Decision 689/2018 was amended to set new quotas and limits to 2025, and was adopted in the second quarter of 2021. The version posted for public consultation in late 2020 suggested raising the total quota to 460 MW, including 260 MW for wind and solar, 195 MW for cogeneration and 5 MW hydro (GoM, 2020). The Ministry of Infrastructure and Regional Development, which prepared the proposal, intends to put more emphasis on the promotion of rooftop PV units and small-scale wind farms (distributed energy), and cogeneration on biogas of different origin (landfill, sewage, manure, etc.) (MIRD, 2020a).

Table 9.1 RE Capacity limits and quotas established by Government Decision 689/2018

Type of technology	Applicable support scheme, MW		Capacity limits, MW (for differentiating small-scale and large investors)
	Classic feed-in tariff (fixed rate)	Auctions	
Wind power plant	20	80	4
Solar PV	15	25	1
Cogeneration plants, biogas	12	8	1
Cogeneration plants, solid biofuels	5	-	1
Small hydroelectric power plants	3	-	1
Total	**55**	**113**	-

Source: MIRD (2020b) based on Government Decision 689/2018.

The following steps are required for organising auctions that grant eligible producer status to large investors (MIRD, 2020b, IRENA, 2019):

- The RES Law No.10/2016 is amended to improve the business environment.
- MIRD and ANRE amend relevant secondary legislation and regulatory acts including the power purchase agreement (PPA) (still in progress as of early 2022)
- MIRD defines the updated capacity limits and maximum capacity quotas which are approved by the government.
- MIRD prepares tendering documentation for public consultation (still in progress as of early 2022).
- MIRD launches the tendering procedure (still in progress as of early 2022).
- Bidders submit their offers and the qualification requirements documents.
- The Tendering Commission (which comprises representatives of the Ministry of Infrastructure and Regional Development; the Ministry of Agriculture, Regional Development and Environment; the Agency of Land Relations and Cadastre; the Energy Efficiency Agency; and the Public Property Agency) evaluates the offers and selects winners.
- Signing of the contract.
- After being selected and granted the status of eligible producer, the winners have 36 months to commission their power plants.

To participate in the auctions, the bidders must fulfil the following eligibility criteria:

- Financial credibility: proven financial viability (equity, credits, guarantees), business plan, project financing plan. A financial guarantee must be submitted together with the offer, equal to 0.2% of the capital investment cost per kW, which is used by ANRE in the methodology to set the ceiling price. The winners must provide an additional guarantee (2% of the capital investment cost per kW) within 30 days to ensure the project completion.
- Grid connection agreement from the relevant electricity system operator.
- Technical credibility: compliance with technical requirements; feasibility study; proof of equipment purchase or purchase intention (only new equipment is allowed to be used).
- Eligibility of location: ownership/right to use the land; proof of land designation change, if necessary.

The selection procedure is based on the lowest price criterion, provided that the price is below the ceiling price to be determined by ANRE and the proposed capacity is within the quota for each technology set out by the government.

According to ANRE, 67.43 million kWh were produced in 2019 by renewable energy producers eligible for the support schemes (Table 9.6). The central supplier issued guarantees of origin for 56.35 million kWh out of the 67.43 million kWh. The largest single RES installation is the biogas power plant of Südzucker Moldova SA with a capacity of 3.6 MW that generated 20.5 million kWh of electricity in 2019 (ANRE, 2020).

Table 9.2 Electricity generated from renewable energy sources eligible for support during 2016-2019

Unit: GWh	2016	2017	2018	2019
Solar photovoltaic	1 311	1 509	1 457	1 437
Biogas	14 030	21 576	27 961	28 748
Wind electricity	2 477	7 066	21 968	36 915
Hydroelectricity		38	279	330
Total	**17 818**	**30 189**	**51 665**	**67 430**

Source: ANRE, 2020.

Net metering

Net metering encourages households and businesses to cover their own electricity consumption from RES-based generation units having a capacity of up to 200 kW. Excess electricity, calculated in a one-year accounting period, is purchased by the centralised offtaker Energocom at the average wholesale market price. About 35-40 MW of distributed generation capacity was expected to be supported under the net metering scheme by 2020. In addition, to increase the use of distributed generation, the MIRD and EEA promote implementation of RES projects by local communities, but there is not much progress in this area yet (IRENA, 2019).

The number of final consumers who benefited from the net metering mechanism increased to 127 in 2019; they delivered about 470 100 kWh of electricity to the grid in 2019 (Table 9.7).

Table 9.3 Results of the net metering mechanism in 2019

Supplier	No. of final consumers	Installed capacity (solar PV), kW	Delivered electricity, kWh
Î.C.S. „Premier Energy" SRL	118	1 253.8	422 254
„Furnizarea Energiei Electrice Nord" SA	9	236.7	47 874
Total	**127**	**1 490.5**	**470 128**

Source: ANRE, 2020.

Grid connection and system integration

The electricity market rules (HANRE 212/2015) amended by ANRE in August 2020 implemented several provisions of the RES Law such as non-discriminatory grid connection for renewable energy producers, priority dispatch and an obligation for the central electricity supplier (Energocom) to purchase the electricity and cover imbalances for eligible producers (EnC, 2020).

The system operator Moldelectrica reports that in 2012-2013 it issued grid connection permits to renewable energy projects with a total capacity of over 1 GW (Moldelectrica, 2020). At the same time, it estimated that only 150 MW of variable renewables could be integrated into the system under present conditions, which is reflected in the total RES capacity cap set by the government. This amount can be increased by improving the flexibility of the power system and other measures, as discussed in Chapter 5 on Electricity.

Renewable heat and biomass

As demonstrated in the section on Supply and Demand, bioenergy is the most widely used renewable energy source. Almost all is used in the traditional manner, in the form of firewood and agricultural waste consumed for heating, especially in rural areas. Modern biomass use – in the form of pellets and briquettes burned in highly efficient boilers or stoves – represents only 3- 5% of biomass use, according to the Energy Efficiency Agency's estimates (IRENA, 2019).

The use of biomass in the heating sector has been promoted in Moldova over the last decade at the national and local levels with the support of several development partners. The most notable large-scale project, "Energy and Biomass" financed by the EU and implemented by the UNDP, laid down foundations for creating a market for biomass technologies and services, and contributed to replacing coal- and gas-fired boilers and traditional basic stoves, with modern biomass heating installations that burn straw, pellets, briquettes and firewood (Box 9.3).

It is estimated that the newly created industry of producing solid biofuels provided about 400 new jobs in rural areas and its turnover was in the order of USD 6 to 8 million in 2017. This market is driven by biomass-fired heat-only boilers with a total capacity of at least 155 MW (IRENA, 2019). Given the clear preference of consumers to use wood biofuels instead of less efficient straw and other residues while the country's afforestation rate is only about 12%, the Ministry of Infrastructure and Regional Development aims to promote the energy crop production industry (IRENA, 2019).

National RES policy documents and legislation focus primarily on the electricity sector, with only a few provisions related to RES use in heating and transport. The National Renewable Energy Action Plan (NREAP) highlighted that RES-based heat energy production was primarily based on the use of agricultural and wood residues in decentralised heating units, while the district heating systems used mainly natural gas, and this was not expected to change until at least 2022. After 2022, switching to biofuels in district heating could be re-evaluated. NREAP envisaged that in addition to biomass, solar energy would also be used for heating (GoM, 2013). The Law on Heat Supply introduces obligatory purchase and priority dispatch of heat produced from RES.

Regulation on the qualification and registration of installers of biomass boilers and stoves, solar heating and photovoltaic systems, heat pumps and geothermal systems (adopted by Government Decision 1051/2018 on 08.11.2018) sets up the rules on the procedures for certification of installers of equipment with a capacity of up to 50 kW.

Regulation on sustainability criteria for biofuels is under development and is expected to include provisions on the establishment of a verification body (EnC, 2020).

The Ministry of Regional Development and Construction conducts a review of regulations and construction codes introducing measures to increase the share of renewable energy in buildings, as part of the regulatory package to comply with the Energy Performance of Buildings legislation.

Box 9.3 Energy and Biomass Project, 2011-2018

The Energy and Biomass Project with a total budget over USD 25 million (EUR 34.8 million) was financed by the European Commission and co-financed and implemented by the UNDP in two phases over 2011-2018. The project objectives were to increase the use of biomass and other renewable energy sources, leading to improved heating comfort levels in public sector buildings. The project consisted of the following four interconnected components: 1: Creating municipal markets for biomass heating and fuel supply technology; 2: Laying down foundations for creating effective biomass heating markets and heat supply, and promoting demand of the private sector; 3: Capacity building: developing capability to grow biomass markets at regional and local levels; and 4: Raising awareness of the opportunities and benefits of biomass energy for Moldova, and promoting the results of the implemented projects. Key project accomplishments included:

Phase 1 (2011-2014):
Modern biomass heating systems installed in 143 public buildings, providing secure energy and more heating comfort to more than 89 000 people.
The creation of more than 300 new jobs (producing pellets and briquettes).
USD 1.4 million (EUR 1 million) was provided for the purchase of biomass fuel production and processing equipment through a leasing mechanism.
Hundreds of families were able to purchase modern biomass boilers, 1 300 EUR of the investment costs being reimbursed through project funds.

Phase 2 (2015-2018):
79 biomass heating systems and 49 solar hot water systems installed in public institutions.
121 schools, kindergartens, community centres, hospitals have modern biomass heating systems.
More than 108 000 people benefit from enhanced green heating comfort.
262 new green jobs created.
523 private household and small businesses heat their premises with green energy thanks to the subsidy programme.
30 local companies assemble or manufacture biomass boilers and offer them to the customers.
First testing laboratory for physical and chemical parameters of biofuels received accreditation.
Public Private Partnership for the provision of the bioenergy services launched in two districts (Ungheni & Nisporeni).
Remote system for the monitoring of the biomass heating plants developed.
A Biomass Energy Cluster and Bioenergy Association were launched.

In addition, both phases have resulted in enhanced public awareness and improved local capacity regarding the modern technologies of production and usage of biomass to produce heat thanks to pilot projects, training courses and other educational initiatives, web platforms, communication campaigns and other awareness raising activities.
Sources: UNDP, 2021a, 2021b, 2019, 2015.

Transport

As an Energy Community party, Moldova has had a legally binding target to have 10% of transport energy consumption from RES by 2020 (EnC, 2020). However, the share of renewables in transport is reported to be only 0.18% in 2020 (Eurostat, 2022). According to the Energy Community Secretariat, Moldova's legal framework related to RES in transport is completely non-compliant with Directive 2009/28/EC, and provisions related to the sustainability of biofuels are still not transposed.

The government is still developing a biofuels strategy considering different options for meeting the target: local production of transport biofuels or imports from Romania, or a mix of both.

Assessment

The Government of Moldova has made significant efforts over the last several years to create conditions for increasing the share of renewable energy in electricity and heating. The binding 2020 target of 17% of RES in final energy consumption has been largely exceeded. However, this remarkable share of renewable energy is mainly due to the traditional use of biomass for heating, which used to be underestimated until the revision of the data for the period 2010-2016. Therefore, the ongoing efforts to encourage the use of modern biomass technologies should continue.

The 10% mandatory target for RES in the transport sector is far from being met, as almost no action has taken place in this area. The government is encouraged to develop, as soon as possible, a clear strategy for the transport sector, supported by legal and regulatory instruments. The country still needs to transpose the provisions related to the sustainability of biofuels and implement an electronic system for guarantees of origin for RES.

To give visibility to the market players, it is important to develop longer-term targets for RES, at least to 2030, with a strategic direction beyond 2030. This is also required as part of Moldova's commitments to align with the EU energy and climate ambitions.

A cross-sectoral approach to the development of renewable energy sources is recommended, taking into consideration possible synergies with and benefits for agriculture, forestry and municipal waste management, as well as positive impacts on energy security, development of local economic activities and welfare generation, improved environmental performance and reduced impact on climate change.

While large-scale projects can benefit from international financing, small-size renewables projects face difficulties accessing funding. Therefore, the government should engage in informing and training local financial institutions in order for them to finance local energy efficiency and renewable projects (see also Chapter 8).

Renewable heat and biomass

Moldova has successfully promoted the use of biomass in the heating sector over the last decade with the support of development partners. The installed capacity of biomass-fired heating boilers was more than 150 MW in 2019, according to the EEA. With the contribution of the EU-funded "Energy and Biomass Project", a new market of solid biofuels has been created, leading to job creation and generating welfare in the rural areas, which

is a very positive achievement. This programme is primarily aimed at replacing coal- and gas-fired boilers, as well as basic stoves, with efficient biomass heating units, which burn straw, pellets, briquettes and firewood in the public and residential sectors. The national government and local authorities are encouraged to pursue actions in this direction and further exploit the potential of local renewable resources.

However, the available biomass – especially wood – is limited and the use of the different sources should be coordinated to be deployed efficiently and in a sustainable way. Therefore it is recommended to adopt a comprehensive approach which would develop a clear strategy on biomass deployment based on a comprehensive study. This study would investigate (among other things) the best use of agricultural and municipal waste, wood and the option of an increased use of energy crops. In addition, the best deployment of the different sources (heat, electricity, biogas, biofuel) should be analysed. Moreover, the waste-to-energy question is worth further investigation in the context of the waste management strategy at the national level.

The soil degradation resulting from the lack of soil regeneration and from a potential depletion should be considered when implementing the strategy on the use of biomass residues. It is important to strive for a sustainable and balanced biomass deployment, thinking about all possible side effects.

Renewable electricity

Moldova has a significant unexploited potential for renewable electricity production. Only a portion of this theoretical potential can be practically tapped today because of various barriers including limited capacity to balance the power system and competitive usages of land (e.g. for agriculture). However, if these barriers are addressed and if Moldova transforms its electricity system into a more modern and flexible one, the share of variable renewables in the energy mix can be increased (see Chapter 5).

The adoption of the regulatory framework to implement the Law on the Promotion of the Use of Energy from Renewable Sources, which entered into force in 2018, is nearly completed, so that RES-electricity can be supported by all three of the legal instruments: net metering and FiTs for smaller-scale installations, and auctions for larger plants. The net metering and FiT schemes have already been implemented, resulting in growing electricity generation from RES. The government is now encouraged to finalise auction implementation details, and conduct the first RES auctions in accordance with best international practices. The auction design should include adequate risk mitigation measures for investors such as a bankable power purchase agreements (PPAs).

It is positive that the RES Law allows sufficient flexibility for RE technologies to be supported. The government should consider all pros and cons of technology-specific auctions (envisaged in the government decision) vs. technology-neutral ones, i.e. at which all RES projects using different technologies would compete. The latter can result in the most cost-efficient results, leading to lower prices, while the former can result in a more diversified energy mix and achieve other policy goals such as job creation or local economic development.

To reduce developers' and investors' risks and transaction costs, it is necessary to reduce various barriers related to administrative procedures, contractual negotiations, grid

access, taxation and accessibility of the land. The issue of the cost and availability of land for renewable power plants should be addressed in order to avoid entrance barriers for investors.

Recommendations

The government of Moldova should:

- ☐ Accelerate the implementation of the promotion schemes for RES electricity (RES-E) stipulated in the law No. 10/2016 in order to create a predictable investment environment for private investors:
  - > Clarify the auction procedure details, including schedules
  - > Finalise the regulatory and contractual documents including bankable power purchase agreements (PPAs)
- ☐ Remove the administrative, fiscal and other barriers such as land-related issues so that renewable energy can be developed in a free market.
- ☐ Apply a cross-sectoral approach to the development of bioenergy, taking into consideration possible synergies with and benefits for agriculture, forestry and waste management.
- ☐ Update the RES targets for 2030 in coordination with the transmission system operator (TSO) and other stakeholders, taking into account data on technology potentials, cost-benefit analysis, the projected development of the power system and the sustainability criteria for biomass.
- ☐ Enhance the capacity of local banks to facilitate the financing of renewable energy and energy efficiency projects.

References

ANRE (Agentia Nationala pentru Reglementare in Energetica/ National Agency for Energy Regulation) (2020) *Annual Activity Report 2019*, ANRE, Chisinau

EC (European Commission) (2021a), *Renewable Energy Directive – Guidance on the Sustainability Criteria for Forest Biomass Used in Energy Production*,

https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12943-Renewable-Energy-Directive-guidance-on-the-sustainability-criteria-for-forest-biomass-used-in-energy-production_en (accessed 29 April 2021)

EEA (Energy Efficiency Agency) (2020), *Institutional Set-up of the Energy Efficiency Agency, Core Functions and Responsibilities*, Energy Efficiency Agency, Chisinau, presentation to IEA, 6 February 2020.

EnC (Energy Community) (2020), *Moldova Annual Implementation Report*1 November 2020

EU (European Union) (2018), *Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources*, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

Eurostat (2022), SHARES (renewables), https://ec.europa.eu/eurostat/web/energy/data/shares

GoM (Government of Moldova) (2020), *Proposal for Amending Government Decision 689/2018*, https://cancelaria.gov.md/sites/default/files/document/attachments/proiectul_782.pdf

GoM (2013), *Government Decision № 1073 of 27 December 2013 on the National Action Plan in the Area of Renewable Energy Sources for 2013-2020* (NREAP)

IEA (2021), World Energy Statistics and Balances (database), https://www.iea.org/data-and-statistics

IEA (2022), World Energy Statistics and Balances (database), https://www.iea.org/data-and-statistics

IRENA (2019), *Renewables Readiness Assessment: Republic of Moldova*, International Renewable Energy Agency, Abu Dhabi.

IRENA, Joanneum Research and University of Ljubljana (2017), *Cost-Competitive Renewable Power Generation: Potential across South East Europe*, IRENA Abu Dhabi.

MIRD (Ministry of Infrastructure and Regional Development) (2020a), *Fourth Annual Report under the Energy Efficiency Directive*, Chisinau

MIRD (2020b), *Promotion of the Use of Renewable Energy in the Republic of Moldova*, MEI presentation to IEA, February 2020, updated October 2020.

MIRD (2020c), *Promotion of the efficient use of energy in the Republic of Moldova*, Chisinau, presentation to IEA, February 2020

Moldelectrica (2020), Istoria Întreprinderii/Company History, [in Romanian] https://moldelectrica.md/ru/about/company_history (accessed 20 May 2021) [also available in Russian at the site].

Parliament of the Republic of Moldova (2016), *Law No 10 of 26.02.2016 on the Support of Use of Energy from Renewable Sources*, published in Monitorul Oficial Nr. 69-77 on 25.03.2016

Republic of Moldova, Ministry of Justice (database), https://www.legis.md/ (accessed 15-30 April 2021)

UNDP (United Nations Development Programme) (2021a), *Energy and Biomass (Phase 1)*, UNDP Moldova, www.md.undp.org/content/moldova/en/home/operations/projects/climate_environment_energy/proiecte-finalizate/moldova-energy-and-biomass-project01.html (accessed 1 May 2021).

UNDP (2021b), *Energy and Biomass (Phase 2)*, UNDP Moldova, www.md.undp.org/content/moldova/en/home/projects/moldova-energy-and-biomass-project2.html (accessed 1 May 2021).

UNDP (2019), *Final Project Report: MOLDOVA ENERGY AND BIOMASS PROJECT, IInd Phase*, UNDP Moldova, 20 May 2019.

UNDP (2015), *Moldova Energy and Biomass Project: A FOUR-YEAR PATH (2011-2014)*, UNDP Moldova

10. Energy technology research, development and demonstration (RD&D)

Key data

Global Innovation Index (GII) ranking: 64 out of 132 (2021)

Research and development expenditure: 26.5 million USD (0.3% of GDP) (2018)

Exchange rate: 100 Moldovan lei (MDL) = 5.77 USD; 5.06 EUR (2020)

Overview

Investment in research, development and demonstration (RD&D) in general, and in the energy sector in particular, is not a national priority in the Republic of Moldova. The total costs for research and innovation per capita in the Republic amount to about EUR 6.6, 80 times less than the European Union average (EC Horizon 2020, 2016). The limited state funding for research and development (R&D) dropped from 0.55% of GDP in 2007 to 0.26% of GDP in 2018 (World Bank, 2020).

Support for research and innovation in the energy sector is based on the National Programme for Research and Innovation, the National Development Strategy, the Energy Strategy and the EU research and innovation framework programmes. Nevertheless, no strong synergies exist among these policy documents.

However, the Government has made a strong commitment to reform the national research and innovation system, in order to create conditions for an innovation-driven economy.

In the 2021 Global Innovation Index report (Cornell University, INSEAD and WIPO, 2021), the Republic of Moldova was classified as an innovation achiever whose innovation performance exceeded expectations given the level of economic development (overall ranked 64th).

Legal and institutional basis

The *National Program for Research and Innovation (NPRI)* (2019) is the main policy document, which provides a comprehensive vision and objectives for developing the national science and innovation system. The NPRI comes with an integrative vision on

research and innovation, thus “overcoming the past fragmentation created by the existence of two sectoral strategies”: the R&D Strategy of the Republic of Moldova until 2020 (Government Decision (GD) no. 920/2014) and the Innovation Strategy of the Republic Moldova for the period 2013-2020 "Innovations for Competitiveness" (GD no. 952/2013). (GoM, 2019a, p. 3)

The “development of the *National Program* complies with the provisions of the *Code on Science and Innovation of the Republic of Moldova* (No 259/2004) (RoM, 2004), with further amendments”. Also, “the National Program’s actions are congruent with the activities stipulated in the *2019-2021 Roadmap for the Integration of the Republic of Moldova into the European Research Area”* (GD No 1081/2018) (GoM, 2018), ensuring the strengthening of the research and innovation system capacity to explore the opportunities arising from the status of [a] country associated with the European Union's research and innovation framework programs and promoting the national priority of integration into the European Research Area (ERA)” (GoM, 2019a, p. 3).

“The strategic priorities in the field of research and innovation for 2020-2023, set in the National Program, correspond to the priorities in the National Development Strategy, to the sectoral strategies and the EU research and innovation framework programs” (GoM, 2019a, p. 7).

The third strategic priority, listed in the National Program, is "*Environment and Climate Change*", in which one of the strategic directions is "***Safe, Clean and Efficient Energy***":

a. ensuring the security and sustainability of consumers' energy supply
b. designing scenarios for diversification of energy sources by interconnecting to the European energy system, including the development of local generation sources
c. reducing the impact on the energy system and consumers when implementing different scenarios for the diversification of energy sources
d. identification of innovative technical solutions for the reliable operation of the energy system, conversion and use of energy
e. increasing the share of renewable energy sources in the country's energy balance and the efficiency of their use
f. identification of innovative solutions for the development and implementation of intelligent power networks
g. identification of innovative solutions to reduce energy losses in the entire chain of energy production, transport, distribution and use
h. reducing the level of pollution by increasing the share of clean energy. (GoM, 2019)

The National Program is expected to be implemented based on the respective Action Plan, in strict compliance with strategic priorities. (GoM, 2019b, p. 21).

Smart Specialisation is included in the *National Research and Innovation Program of Moldova for the years 2020-2023* (GoM, 2019b). Moldova joined **the Smart Specialisation Platform** (S3P) at the national level in 2016. “Moldova is one of the more advanced countries in the Eastern Partnership region in terms of developing its S3 strategy. Since the beginning of 2020 S3 is included in the Action plan of the

Government. The Entrepreneurial Discovery Process (EDP) started in June 2019 when the first 4 EDP workshops on Energy, ICT, Agriculture and Food processing and Biomedicine and Biopharmaceuticals were held" (EC, S3Platform).

Several government bodies play key roles in research and innovation in the Republic of Moldova. Since 2017, the Government empowered the *Ministry of Education, Culture and Research* (MECR) (MECR, 2021) to develop public policies in the field of research and development. The Ministry of Infrastructure and Regional Development (the central body in the energy sector) shares responsibility for supporting innovation activities, but its impact is rather limited.

At the same time, the Government established in 2018 the *National Agency on Research and Development* (NARD) (NARD, 2021), which implements the state policy according to the Action Plan approved by the Government to implement the National Program and sectoral strategies. NARD also manages national funds and funds from bilateral and multilateral programmes launched under cooperation agreements with international organisations and foundations, according to the Government's normative acts. Before that, the state budget for RDI was managed mainly by the National Academy of Sciences (NAS, n.d.).

NARD offers funding for four project types: state research programmes, technology transfer projects, international research projects and projects for postdoctoral research.

Energy sector R&D is mainly provided by two centres: the Institute of Power Engineering and the State Technical University of Moldova (TUM, 2021). In 2018, as a result of the reorganisation of the Academy of Sciences of Moldova, the Institute of Power Engineering came under the jurisdiction of the Ministry of Education, Culture and Research of the Republic.

However, the structural and institutional energy R&D capacity remains weak, a situation manifested in underfinancing, outdated equipment, low research output/performance, lack of incentive mechanisms and inefficient internal support structures.

The research institutions provide both fundamental and applied research. The main research areas of the Institute of Power Engineering are:

- Development of solutions to increase the performance of electricity and heat transmission and distribution networks, conversion and consumption systems and installations using different types of energy, including renewable energy sources (RES).
- Innovative solutions for the development of the district heating system with the advanced use of RES.
- Theoretical and experimental research in the field of energy security by elaboration and development of systems of indicators, methods and systems of calculation and forecasting taking into account internal and external factors of influence and trends in the development of energy supply systems.
- Theoretical and experimental research on the operating regimes of electricity and heat energy supply systems, of the units of production, transport, distribution and use of energy in the context of new challenges in the world and in the country;

- Theoretical and experimental studies of environmentally friendly innovative energy technologies on the development of new methods and equipment to increase the share of energy produced from renewable sources, energy efficiency of energy conversion of renewable sources, those with low thermal potential and transformation of energy flow parameters;
- Elaboration and argumentation of new approaches regarding the promotion of efficient energy policies for the security of energy supply of the country's consumers. (IPE, nd).

The human resource capacity situation for energy RD&D in Moldova is similar to that of RD&D in general: the research community has been contracting, an intense brain-drain has occurred internally and externally, research careers are not attractive for young researchers and the research community is steadily ageing. As a result, the overall numbers for R&D personnel have decreased considerably since the country's independence to reach 4 058 in 2019/2020. The number of researchers per 1 million people is 4.5 times lower than in EU (EC Horizon 2020, 2016).

Funding

R&D public funding is an important instrument of state policy in the Republic of Moldova and represents a major source of R&D funding, because of weak involvement of the private sector. However, gross expenditure on R&D in the Republic “has been declining over the past few years, falling below the Eastern Europe and South Caucasus (EESC) sub-regional average, to 0.26% of GDP in 2018” (World Bank, 2020; UNECE, 2020, p. 291). The National Bureau of Statistics does not keep any record of RD&D expenditures by sectors (NBS, 2020).

The *National Research and Innovation Program of Moldova for the years 2020-2023* (GoM, 2019b) includes provisions concerning State funding of RD&D. In 2020, it allocated USD 11.3 million to research projects and USD 440 000 to innovation and technology transfer projects (UNECE, 2020). Despite the increase in the RD&D funding in absolute terms, its GDP share remains very modest and is far behind the global and European levels. Although for 2020 the Programme allocated 40% of such funding to institutional strengthening (managed by the central public authority [CPA] responsible for policy development in those fields), NARD awards the other 60% competitively through State science grants for individual and collaborative research, including support programmes for young researchers (Table 10.1).

Table 10.1 ynamics of the distribution of funding for research and innovation (R&I) projects and for the maintenance and development of research infrastructure (2020 – 2023)

I. COMPETITIVE ACTIONS in the fields of research and innovation (R&I)				
Strategic prioritises	**Funding distribution, %**			
	2020	**2021**	**2022**	**2023**
(3) Environment and Climate Change, including ***Safe, clean and efficient energy***	*14.4*	*15.4*	*16.4*	*17.4*
Total COMPETITIVE ACTIONS in the fields of research and innovation	***60***	***65***	***70***	***75***
II. INSTITUTIONAL STRENGTHENING in the fields of R&I				
(1.1) Maintaining public infrastructure in the fields of R&I through institutional funding	*35*	*30*	*25*	*20*
(1.2) Development of public infrastructure in the fields of R&I through the CPA responsible for policy development in those fields	*5*	*5*	*5*	*5*
Total INSTITUTIONAL STRENGTHENING in the fields of research and innovation	***40***	***35***	***30***	***25***

Source: GoM (2019b), National Program for Research and Innovation for 2020–2023.

The National Program for Research and Innovation identifies a group of research priorities which would receive a 1% annual increase in competitive funding from 2019 to 2023: *Environment and climate change* is one of them. Private and public entities, as well as members of entrepreneurs' associations, apply for funding. The maintenance and development of the research infrastructure, including the remuneration of the staff, are financed from the state budget according to the needs identified from the results of the national research project competition.

However, the Action plan of the Programme allocated funding for only seven policy actions in priority areas. Funding of other measures depends on the State budget laws.

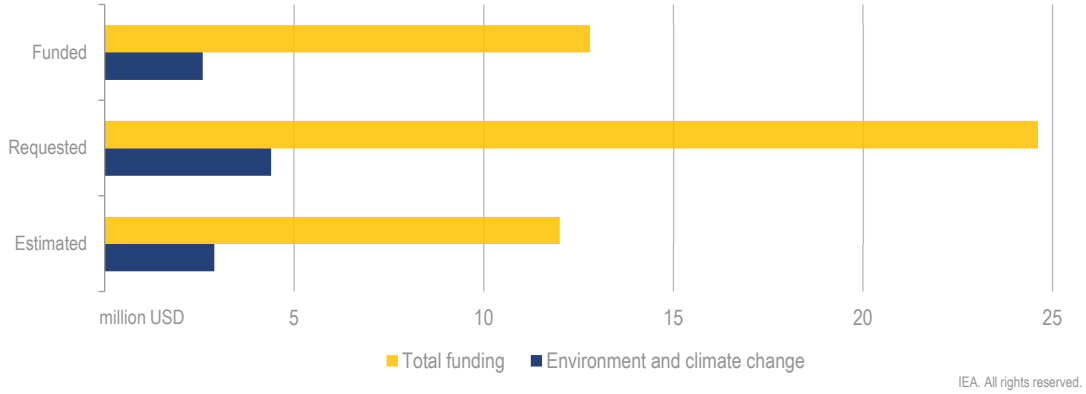
The State Programme for Innovation and Technology Transfer, administered by NARD, stimulates RD&D and provides incentives for businesses and public R&D institutions to collaborate.

Clusters are an efficient tool for increasing the competitiveness and innovation capacity of Moldovan SMEs while stimulating the attraction of foreign investment and technological transfer. In line with the State concept of cluster development in the industrial sector, eight cluster initiatives now exist, including one in the energy sector (biomass), established in 2017.

Government budgets for energy technology research have declined significantly in real terms since independence. Under the austerity budget, the funding of RD&D activities is very modest from the state, and the level of private sector development still does not allow the allocation of considerable amounts to this area. The reduced involvement of the business sector is due to the low level of innovative culture, weak links between research and entrepreneurship, the unfavourable structure of investments in research and the small size of the economy.

The Ministry of Education, Culture and Research must present to the Government annually, by April 30, the consolidated report on the implementation of the Action Plan of the National Programme in the fields of research and innovation for the years 2020-2023. Figure 10.1 shows the lack of prioritisation of research activities in the area of environment and climate change, where energy is included.

Figure 10.1 Funds allocated from the National Program 2020-2023 to strategic priority III "Environment and Climate Change"



Note: Original data converted to USD using official exchange rate for 2020, 17.3 MDL = 1 USD.

Source: NARD (2020), Activity Report for 2019.

The information published by NARD on their website (NARD, 2021), indicates that as part of the National Program (2020-2023) under the strategic direction *Safe, clean and efficient energy*, as of June 2020 two projects were approved for financing (total budget approximately EUR 215 000):

1. A study of wind and solar energy potential in the Republic of Moldova and the development of conversion systems for dispersed consumers (State Technical University) – MDL 1 653 000 (approximately EUR 83 000).
2. Eco-innovative technical solutions for energy efficiency in buildings and development of smart grids options with advanced integration of renewable energy in the Republic of Moldova (SYNERGY) (Institute of Power Engineering/State Technical University) – MDL 2 666 000 (approximately EUR 133 000).

International collaboration

The Republic of Moldova was the first country in the Eastern Partnership to obtain the status of associated state in the European Union Seventh Framework Programme for Research, Technological Development and Demonstration Activities (2007–2013), and subsequently under the "Horizon 2020" EU Framework Programme for Research and Innovation (2014–2020). Therefore, Moldovan entities had many more opportunities to access European research projects. Because of the vulnerability of the national science and innovation system, the country has however not been able to benefit fully from them. However, over the last decade, domestic RD&D has accumulated the knowledge and expertise required to foster cooperation with EU partners and apply for international funding.

Membership in “Horizon 2020” provided the Moldovan participants with a status equal to with their European partners, and also opened up opportunities for influencing the content of the Programme. By 2020, Moldovan scientists and entrepreneurs had submitted 528 applications to participate in Horizon 2020. 64 of them (14.54% success rate), with 82 organisations involved (10.2% being private business), were funded by the EU (nearly 7.1 mil EUR) (EU Webgate).

At the same time, the 2019–2021 Road Map for the Integration of the Republic of Moldova into the European Research Area, approved by the Government in 2018 (GoM, 2018), seeks to build the capabilities and skills of domestic institutions to apply synergies from this cooperation with the EU effectively to advance domestic research and innovation. The National Road Map outlines specific actions and support measures for six priorities, including a more effective national research system, optimal transnational cooperation and competition, and an open labour market for researchers.

Scientists from Moldova’s research institutes are actively involved as experts in energy projects implemented with external technical assistance (EBRD, EC, International Finance Corporation [IFC], United States Agency for International Development [USAID], WB). As a result, some vulnerabilities that limit the functionality and relevance of the RD&D system in the Republic of Moldova are partially eliminated. These include low efficiency of R&I activities and sporadic implementation of research results, the lack of convergence between the priorities of R&I activities in the public sector and the socio-economic needs of the country and reduced visibility of R&I at the society level.

Assessment

Implementation of Moldova’s energy policy objectives and the Nationally Determined Contribution (NDC) under the UNFCCC framework will require deployment of new energy technologies. Moldova’s RD&D system – with the presence of a strong scientific tradition and education, and a network of industrial research institutes and the Academy of Sciences – provides an opportunity for Moldova to secure a certain share of the value in the technology value chain, rather than import all the necessary equipment and technology components. It is encouraging that energy efficiency and renewable energy were identified as one of Moldova’s priorities in the EU Smart Specialisation Platform. This highlights both the importance of innovative energy technologies for the Moldovan economy and the sufficient scientific and innovation capacity in this area.

The active involvement of employees of the scientific institutions and local experts in projects implemented with external technical assistance (EBRD, EC, IFC, USAID, WB) and EU grant programmes for research and innovation is also noteworthy. This international exposure provides: a) additional financial support for RD&D; b) improved quality and practical orientation of the developed solutions due to a more comprehensive consideration of local features; c) higher qualifications of specialists through exposure and use of international best practices; and d) establishing of long-term working contacts between the parties.

However, the falling state funding for research and development is of concern: it dropped from 0.277% of GDP in 2016 to 0.255% in 2018. Under such severe underfinancing, energy RD&D in Moldova, similar to RD&D in general, cannot compete successfully at the regional level, and even less the EU level.

The allocation of public funding after the recent reforms also raises questions. In particular, the reform of the Academy of Sciences of Moldova, under the law of 2017, provides for the transfer of Academic research institutes to the budget of the Ministry of Education, Culture and Research. At the same time, an Agency for Research and Development has been created to distribute the funds for scientific research based on national research project competition. The new system of funding scientific institutions relies mainly on project-based funding and continuously lowers the base financing. Such a model threatens the development of theoretical and applied science in Moldova. Uncertainty in earnings created for employees of research institutes deprives them of financial security.

The reassignment of research institutes from the Academy of Sciences to the Ministry and the current funding allocation procedure increase the risk of erroneous subjective evaluation of the relevance/feasibility of the research projects of institutes. As a result, there is a high probability of a swift outflow of energy scientists from the industry. In view of the length of training of qualified scientists, this situation may lead to a decrease in the scientific and technical potential of Moldova.

To enhance the relevance of energy technology R&D to the energy policy priorities, it is important to improve the cooperation of research institutions and scientists with public authorities. This can be done, for example, by establishing a joint scientific and technical council in the Ministry of Infrastructure and Regional Development to set up specific tasks on energy RD&D with subsequent project financing for the necessary developments. Due to the constrained funding and limited human resources in most government institutions, such an approach would improve the quality and efficiency of complex science-intensive tasks.

Recommendations

The Government of Moldova should:

- Consider providing both the base funding for research institutes (to cover salaries, infrastructure and utility bills) and project financing for higher effectiveness and practical relevance of scientific work.
- Strengthen the links and cooperation between policy makers, scientific institutions and industry to address the concrete energy sector problems that need scientific research, for example assessment of renewable energy resource potential, demand forecasts, domestic biomass technologies, etc.
- Support the engagement of local experts in donor-funded technical assistance and EU grant projects.

References

Cornell University, INSEAD and WIPO (2021), Global *Innovation Index Report*, https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021.pdf

EC (European Commission) Horizon 2020 (2016), *Horizon 2020 Policy Support Facility - Peer Review of the Moldovan Research and Innovation System*, https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility/peer-review-moldovan-research-and-innovation-system

EC (European Commission) (n.d.), *Smart Specialisation Platform: Moldova*, https://s3platform.jrc.ec.europa.eu/moldova (accessed 26 December 2021).

EC (European Commission) Webgate (n.d.), *H2020 Country Profile: Moldova*, https://webgate.ec.europa.eu/dashboard/sense/app/a976d168-2023-41d8-acec-e77640154726/sheet/0c8af38b-b73c-4da2-ba41-73ea34ab7ac4/state/analysis/select/Country/Moldova (accessed 27 December 2021).

GoM (2019a), *Annex No 1 to Government Decision No 281/2019*, https://mecc.gov.md/sites/default/files/pnci_engleza.pdf

GoM (2019b), *Government Decision No. 381 from 01-08-2019 "On the Approval of the National Program in the Fields of Research and Innovation for the Years 2020-2023 and of the Action Plan on its Implementation"*, https://www.legis.md/cautare/getResults?doc_id=115747&lang=ro

GoM (2018), *Government Decision No. 1081 from 08-11-2018 "On the* Approval *of the 2019-2021 Roadmap for the Integration of the Republic of Moldova into the European Research Area"*, https://www.legis.md/cautare/getResults?doc_id=111352&lang=ro

IPE (Institute of Power Engineering IPE) (nd), IPE website, https://energetica.md/institutul-de-energetica

MECR (Ministry of Education, Culture and Research of the Republic of Moldova) (2021), MECR website, https://mecc.gov.md/ro

MIRD (Ministry of Infrastructure and Regional Development), MIRD website, https://midr.gov.md/en/about-the-ministry/mandate

NARD (National Agency on Research and Development) (2021) website, https://ancd.gov.md/

NARD (2020), Activity Report for 2019, https://ancd.gov.md/sites/default/files/document/attachments/Raport%20proiect%202019%20ANCD_0.pdf

NAS (National Academy of Sciences of the Republic of Moldova), NAS website, https://www.asm.md/ (accessed 27 December 2021)

NBS (National Bureau of Statistics of the Republic of Moldova) (2020), *Statistical Yearbook of the Republic of Moldova 2020*, https://statistica.gov.md/pageview.php?l=en&id=2193&idc=263

RoM (Republic of Moldova) (2004), *Code on Science and Innovation of the Republic of Moldova (with subsequent amendments), Code No. 259 of 15-07-2004*,

https://www.legis.md/cautare/getResults?doc_id=110232&lang=ro [in Romanian; also available in Russian at this site].

TUM (State Technical University of Moldova) (2021), TUM website,https://utm.md/en/

UNECE (United Nations Economic Commission for Europe) (2020), *Sub-regional Innovation Policy Outlook 2020: Eastern Europe and the South Caucasus – Republic of Moldova*, https://unece.org/fileadmin/DAM/ceci/icp/Capacity_building/IPO_launch/IPO_2020_7_MOLDOVA.pdf

World Bank (2020), World Development Indicators (database), https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=MD

ANNEX A: Organisations visited

Review criteria

The Shared Goals, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews (IDRs) conducted by the IEA. The Shared Goals are presented in Annex C.

Review team and preparation of the report

The IEA in-depth review team visited Chisinau 3-7 February 2020. The team met with government officials, energy suppliers, interest groups and other stakeholders.

This report was drafted on the basis of these meetings, the team's preliminary assessment of the country's energy policy, the government response to the IEA energy policy questionnaire, and other information. The preparation of the report was postponed due to the COVID pandemic, which began immediately following the team visit.

The members of the team were:

IEA member countries

- Laura ANTONINI, Deputy Head of Renewable Energy, Swiss Federal Office of Energy, SWITZERLAND
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EU4Energy countries

- Giorgi CHIKOVANI, Chief Executive Officer, Georgian Energy Development Fund, GEORGIA (Team Leader)
- Marine GOGOLADZE, Head of Industry, Construction and Energy Statistics Division under Business Statistics Department, GEOSTAT, GEORGIA
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Craig HART, Energy Analyst, Directorate of Energy Markets Security, Renewable Energy Division, System Integration of Renewables Unit

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- Mariana BOTEZATU, Country Expert for Moldova
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- Borys DODONOV, Country Expert for Ukraine
- Markus FAGER-PINTILÄ, Statistics Programme Manager
- Murman MARGVELASHVILI, Country expert for Georgia
- Elena MERLE-BERAL, Consultant, Key author of the IDR report
- Anna PETRUS, Programme Officer

The team is grateful for the cooperation and assistance of the many people it met throughout the visit. Thanks to their knowledge, openness and willingness to share information, the interviews were highly informative and productive. The team expresses its gratitude to Calin Negura, Head of Energy Policy Department, Denis Tumuruc, Deputy Head of Energy Policy Department, of the Ministry of Economy and Infrastructure at the time of the review, now – Ministry of Infrastructure and Regional Development, and to Vitalie Valcov, General Director, and Svetlana Bulgac, Head of General Division for Business Statistics, of the National Bureau of Statistics of the Republic of Moldova, for co-ordinating the response to the IEA energy policy questionnaire and for supporting the team visit. The team also expresses its sincere thanks to Mariana Botezatu, Country Expert for Moldova for the IEA's EU4Energy programme, for the organisational support she gave to the team throughout the mission, her immense personal commitment to the review and for being a constant and valuable source of all kinds of information relating to Moldova's energy sector.

Elena Merle-Beral drafted the Executive Summary and Chapters 2, 8 and 9. Elena also contributed to, reviewed and provided valuable comments to the rest of the chapters. Murman Margvelashvili drafted Chapter 3, and Andrej Malochka wrote Chapter 5. Mariana Botezatu drafted Chapters 4, 7 and 10. Several team members contributed to Chapter 6. Markus Fager-Pintilä prepared the graphs and drafted the sections related to statistics and energy data. Anna Petrus organised and coordinated the review process.

The review team also would like to thank Rebecca Gaghen, Head of the Europe, Middle East, Africa and Latin America Division for investing her time in reading the report and providing comments. Helpful comments and updates were provided by the review team members and IEA staff, including: Simon Bennett, Toril Bosoni, Alyssa Fischer, Craig Hart, Sara Moarif, Gergely Molnar, Kristine Petrosyan, and Talya Vatman. Therese Walsh managed the editing process and Elspeth Thomson edited the report. Astrid Dumond managed the production process, Isabelle Nonain-Semelin finalised the layout, and Taline Shahinian prepared the maps and images.

Organisations visited

Alexandru Ursu

Alliance for Energy Efficiency and Renewables, NGO

American Chamber of Commerce

CHP-Nord

Danish Renewables

David Lev-Ary
EBRD
European Investment Bank (EIB)
Elteprod
Energy Efficiency Agency
Energocom
Environmental Agency
EU Delegation to Chisinau
EU High Level Advisers Programme in Moldova
EU4Climate
EU4Environment
Furnizare Energie Electrica Nord
Institute of Power Engineering
Ion Comendant
MEPIU (Project Implementation Unit)
Ministry of Agriculture, Regional Development and Environment
Ministry of Infrastructure and Regional Development
Ministry of Finance
MoldElectrica
MoldovaGaz
MoldovaTransGaz
National Bureau of Statistics (NBS)
National Energy Regulatory Agency (ANRE)
National Environmental Centre
Premier Energy
Premier Energy Distribution
RED Nord
Termoelectrica
Tirex Petrom
United Nations Development Programme (UNDP)
Vasile Scorpan
Veaceslav Moldovan
Victor Parlicov

ANNEX B: Energy Balances and key statistical data

Republic of Moldova

Energy balances and key statistical data

Unit: Mtoe

SUPPLY		1990	2010	2015	2017	2018	2019	2020
TOTAL PRODUCTION		**0.08**	**0.52**	**0.66**	**0.77**	**0.80**	**0.67**	**0.68**
Coal		-	-	-	-	-	-	-
Peat		-	-	-	-	-	-	-
Oil		-	0.01	0.01	0.01	0.01	0.00	0.01
Natural gas		-	0.00	0.00	0.00	0.00	0.00	0.00
Biofuels[1]		0.06	0.51	0.64	0.76	0.79	0.65	0.67
Nuclear		-	-	-	-	-	-	-
Hydro		0.02	0.01	0.00	0.00	0.00	0.01	0.00
Wind		-	-	0.00	0.00	0.00	0.00	0.00
Geothermal		-	-	-	-	-	-	-
Solar		-	-	0.00	0.00	0.00	0.00	0.00
TOTAL NET IMPORTS		**9.82**	**1.94**	**1.93**	**2.04**	**2.16**	**2.12**	**2.08**
Coal	Exports	-	-	-	-	-	-	-
	Imports	2.01	0.10	0.09	0.12	0.09	0.09	0.08
	Net imports	2.01	0.10	0.09	0.12	0.09	0.09	0.08
Oil	Exports	-	0.01	0.01	0.03	0.03	0.01	0.01
	Imports	4.87	0.74	0.85	0.96	1.04	1.03	0.97
	Int'l marine and aviation bunkers	-0.07	-0.02	-0.02	-0.05	-0.06	-0.05	-0.02
	Net imports	4.79	0.72	0.81	0.88	0.95	0.97	0.94
Natural gas	Exports	-	-	-	-	-	-	-
	Imports	3.28	0.86	0.73	0.75	0.82	0.76	0.77
	Net imports	3.28	0.86	0.73	0.75	0.82	0.76	0.77
Electricity	Exports	0.65	-	-	-	-	-	-
	Imports	0.39	0.26	0.29	0.29	0.30	0.30	0.29
	Net imports	-0.26	0.26	0.29	0.29	0.30	0.30	0.29
TOTAL STOCK CHANGES		**-0.01**	**0.05**	**-0.00**	**-0.01**	**-0.01**	**-0.00**	**-0.02**
TOTAL SUPPLY (TES)[2]		**9.89**	**2.51**	**2.58**	**2.80**	**2.95**	**2.79**	**2.75**
Coal		2.00	0.10	0.10	0.10	0.08	0.10	0.08
Peat		-	-	0.00	-	-	-	-
Oil		4.79	0.76	0.81	0.89	0.95	0.97	0.94
Natural gas		3.28	0.87	0.74	0.75	0.82	0.76	0.77
Biofuels[1]		0.06	0.51	0.65	0.76	0.79	0.65	0.66
Nuclear		-	-	-	-	-	-	-
Hydro		0.02	0.01	0.00	0.00	0.00	0.01	0.00
Wind		-	-	0.00	0.00	0.00	0.00	0.00
Geothermal		-	-	-	-	-	-	-
Solar		-	-	0.00	0.00	0.00	0.00	0.00
Electricity trade[3]		-0.26	0.26	0.29	0.29	0.30	0.30	0.29
Shares in TES (%)								
Coal		*20.2*	*4.1*	*3.8*	*3.6*	*2.8*	*3.6*	*2.8*
Peat		-	-	*0.0*	-	-	-	-
Oil		*48.5*	*30.3*	*31.2*	*31.7*	*32.3*	*34.8*	*34.1*
Natural gas		*33.1*	*34.5*	*28.5*	*26.9*	*27.8*	*27.2*	*28.1*
Biofuels[1]		*0.6*	*20.4*	*25.3*	*27.2*	*26.7*	*23.3*	*24.0*
Nuclear		-	-	-	-	-	-	-
Hydro		*0.2*	*0.3*	*0.2*	*0.1*	*0.1*	*0.2*	*0.1*
Wind		-	-	*0.0*	*0.0*	*0.1*	*0.1*	*0.2*
Geothermal		-	-	-	-	-	-	-
Solar		-	-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Electricity trade[3]		*-2.6*	*10.4*	*11.1*	*10.5*	*10.2*	*10.8*	*10.7*

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND							
FINAL CONSUMPTION	**1990**	**2010**	**2015**	**2017**	**2018**	**2019**	**2020**
TFC	**6.68**	**2.29**	**2.39**	**2.63**	**2.77**	**2.64**	**2.61**
Coal	0.87	0.10	0.10	0.10	0.08	0.10	0.08
Peat	-	-	0.00	-	-	-	-
Oil	3.60	0.74	0.80	0.87	0.94	0.96	0.93
Natural gas	0.98	0.43	0.35	0.39	0.44	0.42	0.44
Biofuels[1]	0.06	0.50	0.63	0.75	0.76	0.63	0.64
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-
Electricity	0.89	0.28	0.32	0.32	0.33	0.33	0.33
Heat	0.28	0.24	0.20	0.20	0.21	0.20	0.19
Shares in TFC (%)							
Coal	*13.1*	*4.5*	*4.0*	*3.8*	*2.9*	*3.9*	*3.0*
Peat	-	-	*0.0*	-	-	-	-
Oil	*53.9*	*32.1*	*33.2*	*33.3*	*34.0*	*36.5*	*35.8*
Natural gas	*14.6*	*18.8*	*14.8*	*14.7*	*15.8*	*16.0*	*16.9*
Biofuels[1]	*0.9*	*21.8*	*26.4*	*28.4*	*27.6*	*23.8*	*24.6*
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-
Electricity	*13.3*	*12.3*	*13.2*	*12.1*	*11.9*	*12.4*	*12.6*
Heat	*4.1*	*10.5*	*8.4*	*7.7*	*7.7*	*7.4*	*7.3*
TOTAL INDUSTRY[4]	**1.12**	**0.25**	**0.25**	**0.25**	**0.31**	**0.29**	**0.30**
Coal	0.20	0.03	0.04	0.03	0.02	0.02	0.02
Peat	-	-	-	-	-	-	-
Oil	0.00	0.04	0.05	0.05	0.11	0.10	0.11
Natural gas	0.53	0.06	0.05	0.05	0.07	0.06	0.06
Biofuels[1]	-	0.00	0.00	0.00	0.00	0.00	0.00
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-
Electricity	0.39	0.07	0.07	0.07	0.07	0.06	0.06
Heat	-	0.05	0.04	0.05	0.05	0.05	0.04
Shares in total industry (%)							
Coal	*18.3*	*10.9*	*15.7*	*11.4*	*7.9*	*7.8*	*6.4*
Peat	-	-	-	-	-	-	-
Oil	*0.2*	*16.6*	*19.1*	*21.1*	*33.6*	*33.0*	*36.8*
Natural gas	*47.0*	*23.5*	*21.7*	*21.8*	*21.9*	*20.2*	*21.1*
Biofuels[1]	-	*0.3*	*0.6*	*0.4*	*0.5*	*0.2*	*0.5*
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-
Electricity	*34.5*	*27.4*	*26.7*	*26.5*	*21.1*	*22.0*	*20.4*
Heat	-	*21.3*	*16.2*	*18.9*	*15.0*	*16.8*	*14.8*
TRANSPORT	**0.84**	**0.58**	**0.65**	**0.69**	**0.70**	**0.72**	**0.67**
OTHER[5]	**4.72**	**1.46**	**1.50**	**1.69**	**1.75**	**1.63**	**1.64**
Coal	0.67	0.08	0.06	0.07	0.06	0.08	0.06
Peat	-	-	0.00	-	-	-	-
Oil	2.77	0.12	0.12	0.16	0.16	0.17	0.17
Natural gas	0.44	0.37	0.28	0.31	0.35	0.35	0.37
Biofuels[1]	0.06	0.50	0.63	0.74	0.76	0.63	0.64
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-
Electricity	0.49	0.21	0.25	0.25	0.26	0.26	0.26
Heat	0.28	0.19	0.16	0.16	0.17	0.15	0.15
Shares in other (%)							
Coal	*14.2*	*5.2*	*3.8*	*4.2*	*3.2*	*4.9*	*3.6*
Peat	-	-	*0.0*	-	-	-	-
Oil	*58.8*	*8.5*	*8.1*	*9.7*	*9.3*	*10.5*	*10.2*
Natural gas	*9.4*	*25.0*	*18.8*	*18.3*	*19.8*	*21.3*	*22.4*
Biofuels[1]	*1.3*	*34.1*	*42.1*	*44.0*	*43.5*	*38.5*	*38.9*
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-
Electricity	*10.5*	*14.4*	*16.5*	*14.5*	*14.7*	*16.0*	*16.0*
Heat	*5.9*	*12.8*	*10.8*	*9.3*	*9.5*	*9.0*	*8.9*

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1990**	**2010**	**2015**	**2017**	**2018**	**2019**	**2020**
ELECTRICITY GENERATION[6]							
Input (Mtoe)	4.28	-0.09	-0.12	-0.08	-0.09	-0.11	-0.13
Output (Mtoe)	1.40	0.09	0.08	0.08	0.08	0.08	0.08
Output (TWh)	16.22	1.06	0.94	0.90	0.95	0.94	0.98
Output Shares (%)							
Coal	*30.8*	-	-	-	-	-	-
Peat	-	-	-	-	-	-	-
Oil	*25.4*	*2.7*	*0.9*	*1.9*	*0.8*	*0.4*	*0.1*
Natural gas	*42.3*	*89.8*	*91.8*	*89.2*	*88.7*	*84.5*	*86.6*
Biofuels [1]	-	-	*1.6*	*2.6*	*3.1*	*3.3*	*3.0*
Nuclear	-	-	-	-	-	-	-
Hydro	*1.6*	*7.4*	*5.3*	*5.4*	*4.6*	*6.9*	*4.8*
Wind	-	-	*0.2*	*0.8*	*2.4*	*4.6*	*5.2*
Geothermal	-	-	-	-	-	-	-
Solar/other[2]	-	-	*0.2*	*0.2*	*0.3*	*0.3*	*0.4*
TOTAL LOSSES	**3.21**	**0.01**	**-0.04**	**0.01**	**-0.01**	**-0.05**	**-0.08**
of which:							
Electricity and heat generation[7]	2.88	-0.18	-0.21	-0.16	-0.17	-0.20	-0.22
Other transformation	-	0.00	0.00	0.00	0.00	0.00	0.00
Own use and transmission/distribution losses	0.33	0.19	0.17	0.16	0.16	0.14	0.14
Statistical differences	**-**	**0.00**	**-0.00**	**0.00**	**0.00**	**0.00**	**-**
INDICATORS	**1990**	**2010**	**2015**	**2017**	**2018**	**2019**	**2020**
GDP (billion 2015 USD)	7.42	6.45	7.75	8.47	8.83	9.14	8.51
Population (millions)	2.97	2.86	2.84	2.76	2.71	2.66	2.62
TES/GDP (toe/1000 USD)[8]	1.33	0.39	0.33	0.33	0.33	0.31	0.32
Energy production/TES	0.01	0.21	0.25	0.27	0.27	0.24	0.25
Per capita TES (toe/capita)	3.33	0.88	0.91	1.02	1.09	1.05	1.05
Oil supply/GDP (toe/1000 USD)[8]	0.65	0.12	0.10	0.10	0.11	0.11	0.11
TFC/GDP (toe/1000 USD)[8]	0.90	0.35	0.31	0.31	0.31	0.29	0.31
Per capita TFC (toe/capita)	2.25	0.80	0.84	0.95	1.02	0.99	0.99
CO_2 emissions from fuel combustion ($MtCO_2$)[9]	30.5	7.9	7.6	7.5	8.0	8.3	8.0
CO_2 emissions from bunkers ($MtCO_2$)[9]	0.2	0.1	0.1	0.1	0.2	0.2	0.1
GROWTH RATES (% per year)	**90-10**	**10-15**	**15-17**	**17-18**	**18-19**	**19-20**	**10-20**
TES	-6.6	0.5	4.3	5.2	-5.4	-1.5	0.9
Coal	-13.7	-1.4	2.2	-18.4	22.8	-23.8	-2.9
Peat	-	-	-100.0	-	-	-	-
Oil	-8.8	1.1	5.0	7.2	1.9	-3.5	2.1
Natural gas	-6.4	-3.2	1.3	8.8	-7.6	1.9	-1.1
Biofuels[1]	11.1	4.9	8.2	3.2	-17.4	1.6	2.6
Nuclear	-	-	-	-	-	-	-
Hydro	-5.7	-8.7	-2.0	-8.3	47.7	-27.7	-5.1
Wind	-	-	87.1	228.6	87.0	18.6	-
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	50.0	-	33.3	-
TFC	-5.2	0.9	4.7	5.4	-4.7	-1.3	1.3
Electricity consumption	-5.6	2.3	0.2	3.7	-0.7	-0.2	1.5
Energy production	9.6	4.6	8.2	3.7	-16.3	2.1	2.7
Net oil imports	-9.1	2.6	3.7	8.3	2.5	-3.2	2.8
GDP	-0.7	3.7	4.6	4.3	3.5	-6.8	2.8
TES/GDP	-6.0	-3.1	-0.3	0.8	-8.5	5.8	-1.8
TFC/GDP	-4.5	-2.7	0.2	1.1	-7.9	6.0	-1.5

0 is negligible, - is nil, .. is not available. Please note: rounding may cause totals to differ from the sum of the elements.

Notes

1. Biofuels in Moldova comprise solid biofuels and biogases. Data are often based on partial surveys and may not be comparable between countries.
2. Excludes international marine bunkers and international aviation bunkers.
3. Total supply of electricity represents net trade. A negative number in the share of TES indicates that exports are greater than imports.
4. Industry includes non-energy use.
5. Other includes residential, commercial and public services, agriculture/ forestry, fishing and other non-specified.
6. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
7. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 33% for nuclear and solar thermal, 10% for geothermal and 100% for hydro, wind and solar photovoltaic.
8. Toe per thousand US dollars at 2015 prices and exchange rates.
9. “CO2 emissions from fuel combustion” have been estimated using the IPCC Tier I Sectoral Approach methodology from the 2006 IPCC Guidelines. Emissions from international marine and aviation bunkers are not included in national totals.

ANNEX C: International Energy Agency "Shared Goals"

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries cooperate through the Agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International cooperation in the development and dissemination of energy technologies, including industry participation and cooperation with non-member countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Cooperation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 in Paris, France.)

* Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Lithuania, Luxembourg, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

ANNEX D: Glossary and list of abbreviations

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

Acronyms and abbreviations

AAGR	average annual growth rate
ABWR	advanced boiling water reactor
ANRE	Autoritatea Naţională de Reglementare în domeniul Energiei (National Agency for Energy Regulation)
APR	advanced pressurised reactor
BAU	business as usual
BEV	battery-electric vehicles
BOF	basic oxygen furnace
C	Centigrade
CAM	capacity allocation mechanisms
CCA	capital cost allowance
CCGT	combined-cycle gas turbine
CCS	carbon, capture and storage
CDM	clean development mechanism (under the Kyoto protocol)
CHP	combined production of heat and power
CO_2	carbon dioxide
CSP	concentrated solar power
DHC	district heating and cooling
DNI	direct normal irradiance
DR	demand response
DSO	district system operator
EA	environmental assessment
EAEU	Eurasian Economic Union
EAF	electric arc furnace
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EE	Energy efficiency
EEA	Energy Efficiency Agency
EET	energy efficiency technology
EIA	environmental impact assessment
EIB	European Investment Bank

ENTSO-E	European Network of Transmission System Operators for Electricity
EPCO	electric power company
ESCO	energy service company
ETC	early transition country
ETS	emissions trading scheme
FiT	feed-in tariff
FY	financial year
GCF	Green Climate Fund
GDP	gross domestic product
GDP PPP	gross domestic product based on purchasing power parity
GHG	greenhouse gas
GHI	global horizontal irradiance
GoM	Government of Moldova
GRES	(from Russian ГРЭС – государственная районная электростанция) – State regional power plant
HDV	heavy-duty vehicle
HEI	higher education institution
HFT	heavy-freight truck
HOB	heat-only boiler
HPP	hydro power plants
HWR	heavy water reactor
ICE	internal combustion engine
ICV	internal combustion engine vehicles
IFC	International Finance Corporation
IFI	International Financial Institution
INDC	Intended Nationally Determined Contribution
ISIC	international standard industrial classification of all economic activities
ISO	Independent System Operator
ITO	Independent Transmission Operator
LCOE	levelised cost of electricity
LED	light-emitting diode
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land-use change, and forestry
LWGR	light water-moderated graphite reactor
LWR	light water reactor
MABs	multi-apartment blocks
MDL	Moldovan leu
ME	Ministry of Environment
MEI	Ministry of Economy and Infrastructure
MEPS	minimum energy performance standards

MIRD	Ministry of Infrastructure and Regional Development
MRV	measurement, reporting and verification
MSW	municipal solid waste
NACE	statistical nomenclature of economic activities in the European Union (Fr. Acronym)
NAMA	nationally appropriate mitigation action
NBM	National Bank of Moldova
NBS	National Bureau of Statistics
NDC	nationally determined contribution
NCCC	National Climate Change Commission
NEEAP	National Energy Efficiency Action Plan
NECP	National Energy and Climate Plan
NES	National Energy Strategy
NREAP	National Renewable Energy Action Plan
OHVL	Overhead high voltage line
PHEV	plug-in hybrid electric vehicles
PHWR	pressurised heavy water reactor
PPA	power purchase agreement
PPP	purchasing power parity
PSO	Public Service Obligation
PV	photovoltaics
PWR	pressurised water reactor
RBP	Regional Booking Platform
R&D	research and development
RD&D	research, development and deployment [or demonstration]
RE	Renewable energy
RES	renewable energy source(s)
SMEs	small and medium enterprises
TBRF	Trans-Balkan Reverse Flow
TES	total energy supply
TFC	total final consumption
TPA	third-party access
TPES	total primary energy supply
TSO	transmission system operator
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar
VAT	value-added tax
VRE	variable renewable energy
WB	World Bank
WWER	water-water energetic reactor

Units of measure

bcm	billion cubic metres
b/d	barrels per day
CO_2-eq	carbon dioxide-equivalent
EJ	exajoule
Gcal/h	gigacalories/hour
GJ	gigajoule
GJ/t	gigajoules over tonne
GW	gigawatt
GWh	gigawatt-hour
Hz	hertz
kb/d	thousand barrels per day
km	kilometre
km^2	square kilometre
kW	kilowatt
kWh	kilowatt-hour
kWh/m^2	kilowatt hours per square metre
kWh/t	kilowatt hours per tonne
m	metre
m/s	metres per second
m^3	cubic metre
mb	million barrels
mBtu	million British thermal units
mcm	million cubic metres
Mha	million hectares
MJ	megajoule
ML	million litres
MPa	megapascal
Mt	million tonnes
$MtCO_2$	million tonnes of carbon dioxide
$MtCO_2$-eq	million tonnes of carbon dioxide-equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt

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Moldova 2022

Energy Policy Review

This in-depth review of the energy policies of Moldova follows the same format used by the International Energy Agency (IEA) for its peer reviews of member countries. Conducted under the auspices of the EU4Energy programme, it has been funded by the European Union and implemented by the IEA, along with the Energy Community and the Energy Charter.

Moldova is largely dependent on fossil fuel and electricity imports, with the vast majority of its natural gas imports coming from the Russian Federation. Moldova has made considerable efforts to diversify their supply sources and increase the security of both electricity and gas supply. Further integration with Europe for both gas and electricity imports is ongoing as Moldova prioritises moving away from Russian sources of energy. The March 2022 emergency synchronisation with ENTSO-E, triggered by Russia's invasion of Ukraine, has pushed Moldova closer to full electricity trade with Europe.

Since Moldova signed an Association Agreement with the European Union in 2014, it has been working to adopt core EU legislation. Moldova's National Energy Strategy for 2030 reflects this work, with key government priorities including: ensuring the security of energy supply; further developing competitive markets and integration on a regional and European level; and ensuring the sustainability of the energy sector while mitigating the effects of climate change. Increasing the share of renewables in Moldova's energy mix remains key to meeting the country's priorities as it aims to enhance regional and European integration.

This report assesses the energy sector and the related challenges facing Moldova, and it proposes policy recommendations to improve energy security, support the development of free and competitive energy markets, and accelerate its transition to a more sustainable, clean and efficient energy system.

International Energy Agency

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