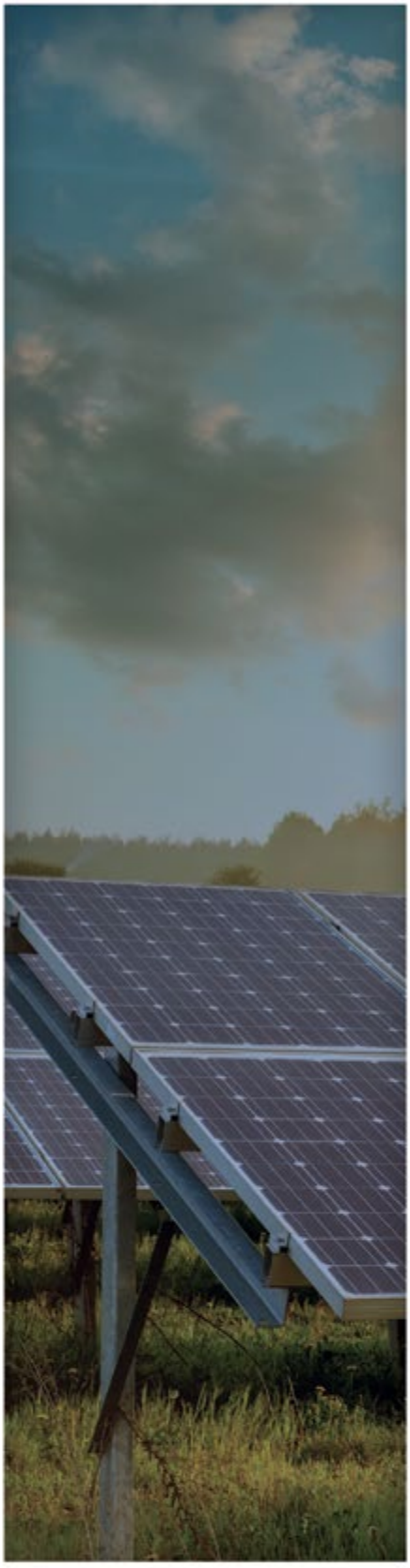
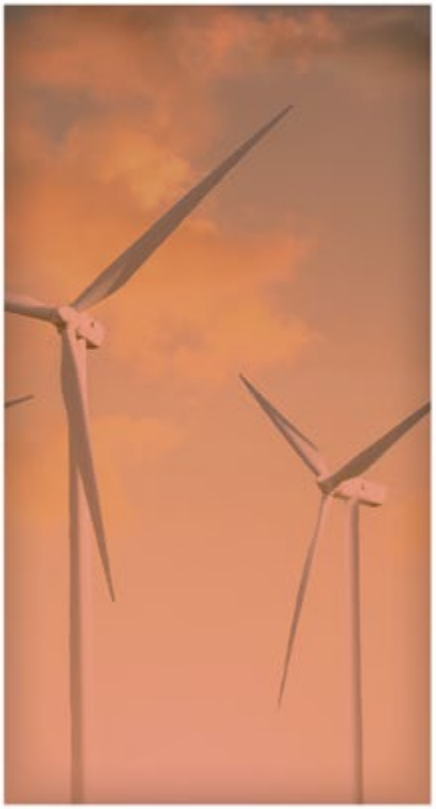
IRENA
International Renewable Energy Agency





RENEWABLES READINESS ASSESSMENT

Republic of Moldova

February 2019

ISBN: 978-92-9260-109-6

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

About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international co-operation, a centre of excellence and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

www.irena.org

Acknowledgements

This report was prepared by IRENA in close collaboration with the Government of the Republic of Moldova, as represented by the Ministry of Economy and Infrastructure (MoEI). Special thanks are due to numerous other officials, especially from the Energy Efficiency Agency, National Energy Regulatory Agency and Moldelectrica. This report benefited from the inputs of various experts, notably including Alexandru Cosovan (European Bank for Reconstruction and Development), Gabriela Cretu (Energy Community Secretariat), Giuseppe Grimaldi (European Bank for Reconstruction and Development), Adil Hanif (European Bank for Reconstruction and Development), Marcela Lefter (Electra Norte), Tiago Oliveira (European Bank for Reconstruction and Development), Denis Tumuruc (MoEI), and Nicolae Zaharia (Sinergetika). IRENA colleagues including Abdulmalik Oricha Ali, Serkan Ata, Emanuele Bianco, Diala Hawila, Vanessa Interiano, Luis Janeiro, Sandra Lozo, Hameed Safiullah, Jeffrey Skeer, Costanza Strinati, and Naida Taso also provided valuable guidance and input.

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Disclaimer

RENEWABLES READINESS
ASSESSMENT

Republic of Moldova

FOREWORD
from the Minister of Economy and Infrastructure

Given its high dependence on imported energy resources, the Republic of Moldova is crying out for a more intensive use of renewable energy sources. Indeed, in a country where three quarters of energy needs are covered by imports, the consistent and feasible implementation of a renewable energy strategy has a tremendous importance for the Republic of Moldova's energy security.

Therefore, the main pillars and vectors of the country's energy policies are now orienting towards the enhancement of energy security and security of supply, the reduction of CO_2 emissions, and the sustainable development of the economy. In the context of this fundamental role for renewable energy in the transition towards a more competitive economy and towards ensuring a more secure and sustainable energy system – the Ministry of Economy and Infrastructure is working hard to scale-up the importance of renewable energy in the country's energy mix, with the support of the Energy Community Secretariat, development partners and the International Renewable Energy Agency (IRENA).

The development of this Renewables Readiness Assessment (RRA) report perfectly coincides with the Government of Moldova's efforts to align its national legislation with the commitments it has made under the Energy Community Treaty and Association Agreement, signed with the EU.

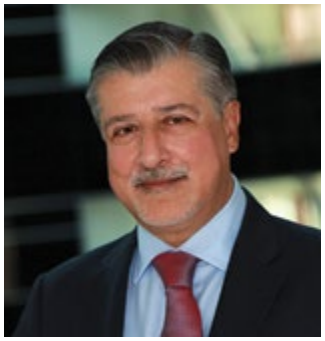
Indeed, despite recent developments in the renewable energy sector, the need for a systematic assessment of the sector's potential – and its bottlenecks – was still necessary. As a result of fruitful collaboration between the Ministry of Economy and Infrastructure and IRENA, this assessment has now been conducted. Its conclusions include the opinions of all major stakeholders, bilateral and multilateral co-operation agencies, financial institutions and private sector representatives. This study also sets the priority areas that the Ministry of Economy and Infrastructure would like to continue working on, while also defining perspectives for collaboration with all the relevant stakeholders. This is of paramount importance for the country and serves in achieving a common goal – improved energy security.

This RRA exercise will help a great deal and add to the major achievements reached by the national authorities during the last decade. One of the most important of these was the adoption of the Law on the Promotion of the Use of Energy from Renewable Sources, transposing European Directive 2009/28/EC. This provides a set of mechanisms for raising and supporting the interests of the national and international business community regarding renewable energy investments. The law lays down a set of rules to promote the use of renewable energy sources in the most transparent and competitive way. A support scheme, which is meant to increase the share of renewable energy in gross final energy consumption, will build the path to a sustainable development of the energy sector and of the country's economy, all to the benefit of final consumer.

Moreover, in addition to helping the government reduce consumption, optimise costs and secure the country's hope for a brighter and a more energy secure future, energy efficiency and renewable sources of energy represent some of the most promising ways in which almost half of the target set and agreed by the Paris Agreement on Climate Change can be achieved.

Last but not least, on behalf of the Ministry of Economy and Infrastructure, I would like to express our appreciation to IRENA, our development partners, the business community and other stakeholders for their commitment to develop the use of renewable sources of energy in the Republic of Moldova. Their support and technical assistance are of great importance for the benefit of our country and we look forward to a long and fruitful future relationship.

Chiril Gaburici
Minister of Economy and Infrastructure
Republic of Moldova



FOREWORD
from the IRENA Director-General

The Republic of Moldova faces growing energy challenges, including dependence on energy imports and increasing demand for electricity to power economic growth. Imported fossil fuels already account for more than two-thirds of primary energy supply, making the country vulnerable to rising fuel costs and supply disruption.

On the other hand, the country has vast renewable energy potential, which remains still largely untapped. With renewables becoming increasingly cost-competitive, policy makers have recognised them as an important means to address the Republic of Moldova's energy challenges and achieve a sustainable future. Notably, the country has already met several major targets set out in its National Renewable Energy Action Plan for 2013-2020, including the objective to cover at least 17% of gross final energy consumption with renewables.

This Renewables Readiness Assessment (RRA) – undertaken by the International Renewable Energy Agency (IRENA) in close co-operation with the Government of the Republic of Moldova – examines the energy sector holistically, identifying key actions to accelerate renewable energy deployment. It underlines short- to medium-term regulatory, financing and public-awareness issues, as well as the need for long-term planning. Specifically, the report suggests the adoption of an ambitious renewable energy target for 2030 and ways to strengthen the government's on-going efforts to develop the bioenergy sector. It also proposes measures to improve the bankability of renewable energy projects and enhance the capacity of local banks to facilitate the financing of such projects.

Over 30 countries, spanning Africa, the Caribbean, Latin America, the Middle East and the Asia-Pacific region, have undertaken the RRA process since 2011, exchanging knowledge and supporting international co-operation to promote clean, indigenous renewable energy technologies.

I would like to thank Minister Gaburici and the staff of the Ministry of Economy and Infrastructure for their support in preparing this study. The report was also enriched by insights from other government agencies and a wide range of other stakeholders. IRENA looks forward to working with all partners to translate these recommendations into practical action.

I sincerely hope these RRA findings will strengthen the Republic of Moldova's pursuit of renewable energy solutions as a source of economic growth, job creation and energy security. IRENA stands ready to assist in accelerating the country's transition to a sustainable energy future.

Adnan Z. Amin
Director-General
International Renewable Energy Agency

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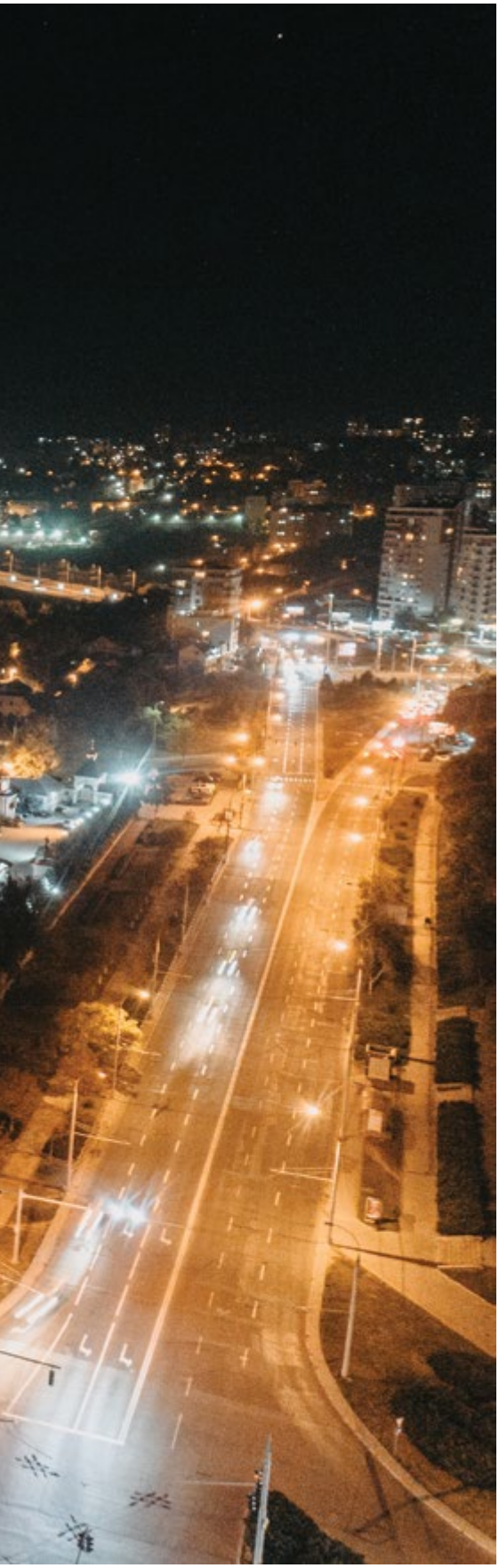
Abbreviations

ANRE	National Energy Regulatory Agency
CHP	Combined heat and power
DFI	Development finance institution
EBRD	European Bank for Reconstruction and Development
ENTSO-E	European Network of Transmission System Operators
EU	European Union
EUR	Euro
GDP	Gross Domestic Product
GW	Gigawatt
IPS	Integrated Power System
IRENA	International Renewable Energy Agency
ktoe	Kilotonnes of oil equivalent
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
MDL	Moldovan lei
MW	Megawatt
MWh	Megawatt-hour
PPA	Power Purchase Agreement
PV	Photovoltaic
RRA	Renewables Readiness Assessment
UNDP	United Nations Development Programme
USD	United States dollar

Chisinau at night
Photograph: Shutterstock



Executive Summary

The Republic of Moldova has a vast renewable energy potential, now poised to play an important role in addressing the country's key energy challenges.

The 2017 report from the International Renewable Energy Agency (IRENA), *Cost-competitive renewable power generation: Potential across South East Europe*, found that wind could provide up to 21 gigawatts (GW) of power capacity, much of which could be deployed with the levelised cost of electricity (LCOE) below 90 EUR/MWh – the maximum level at which the report considers the potential to be cost-competitive. Furthermore, solar PV could provide up to 4.5 GW of capacity, more than 20% of which (1 GW) was considered already cost-competitive in 2016, if attractive financial conditions were provided.

At the same time, the Republic of Moldova heavily depends on imported natural gas, petroleum products and electricity. Almost 70% of the primary energy supply – around 2 012 ktoe of the total 2 939 ktoe – comes from imports. This is not only a huge economic burden, but also affects the country's energy security, making it vulnerable to risks related to fuel supply disruption. Indeed, domestic power production typically covers less than 20% of demand, with this mostly provided by local, gas-fuelled CHP stations (330 MW) and renewables-based capacity (53 MW).

Despite abundant resources, deployment of renewables has been limited, so far, except for the use of biomass in the heating sector. There, a decade-long effort to develop the solid biofuel sector led to a widely taken up programme of replacing coal- and gas-fired boilers, as well as basic stoves, with biomass heating units. These burn straw, pellets, briquettes and firewood.

The deployment of biomass continues to provide employment opportunities, as well. Existing government efforts are oriented towards strengthening the newly-created solid biofuel production industry (briquettes and pellets), which has already created about 400 new jobs in rural areas and had an assessed turnover of USD 6 million to USD 8 million in 2017.

In recent years, the Republic of Moldova has stepped up efforts towards developing non-biomass renewable energy sources, too.

In 2012, it pledged to achieve a 17% share of renewables in gross final energy consumption by 2020 and developed the National Renewable Energy Action Plan for the 2013-2020 period. This envisages development of solar PV and wind technologies, amongst others. It also builds on the first steps to advance the use of renewables in the power sector, which date back to 2007. The Renewable Energy Law (No. 160-XVI of 12.07.2007) introduced tariffs for 15 years, under the "cost-plus" principle, with these based on the actual eligible costs incurred.

Yet, as this framework was not considered sufficient to attract investments in the sector, the Law on the promotion of the use of energy from renewable sources (Law no. 10 of 26.02.2016) came into force in March 2018.

This provides necessary guarantees for investments, including: non-discriminatory grid connection; priority dispatch; and an obligation by the central electricity supplier to purchase all-renewable-generated electricity for 15 years. In addition, the new law is expected to lead to the construction of up to 168 MW of new capacity, mainly wind and solar PV, to be supported through administratively set feed-in tariffs and an auctions-based mechanism. Scheduled initially for 2019, these auctions are expected to result in a capacity of 80 MW of wind and 25 MW of solar PV.

The recent adoption of these new support schemes for renewable electricity has contributed greatly to the rising interest of the business community – but additional efforts are necessary to cement the foundations of the sector.

In this context, in 2018, the RRA elaboration process was launched at the request of the Ministry of Economy and Infrastructure of the Republic of Moldova. This provided a venue for multi-stakeholder dialogue to identify challenges in renewable energy deployment and to suggest the solutions required to further exploit indigenous renewable energy resources, while integrating growing shares of solar and wind energy in the Republic of Moldova's power system.

Challenges and recommended actions

Adopt a renewable energy target for 2030

The current share of renewables, 27.8%, was reached mainly through the revision of biomass consumption data for the years 2010-2016. Thus, it neither provides long-term predictability, nor reflects the country's vision of energy sector development. Although the announced development of 168 MW of renewables capacity in the coming years has captured the interest of several investors, this could be considered a one-off boost for the market, rather than an element of a solid strategy.

The Ministry of Economy and Infrastructure has now begun various initiatives, including discussions within the Energy Community, with a view to agreeing on a new renewable energy target for 2030. IRENA's recently-initiated regional REmap analysis for the countries of Central and Southeast Europe, including the Republic of Moldova, can contribute to these efforts and help identify cost-effective technology options for the deployment of renewables in the power and end-use sectors.

Conduct a production cost modelling study

As renewables are becoming an increasingly cost-competitive source of energy, they are poised to play a greater role in the power system of the Republic of Moldova. The increased use of solar PV and wind, however, would present a new challenge, as the country does not have sufficient capacity to balance its generation. Thus, a production cost modelling study would allow the determination of any potential operational constraints that could result in the unavailability of sufficient power to meet demand. Furthermore, it could investigate multiple scenarios for the generation mix, including those with higher shares of renewables.

The results could help build confidence among policy makers, system operators and investors, as well as identify the most cost-effective option for balancing the system. To support countries in the assessment of power systems' flexibility, IRENA

and the VTT Technical Research Centre of Finland Ltd. developed the cost-free FlexTool. This analyses not only the traditional concept of flexibility (concerning, for example, flexible thermal and hydro-generation with high ramping capability and very low start-up time), but also other innovative technologies, such as flexible demand, energy storage and sector coupling.

Strengthen the enabling regulatory framework

Even though the new Law on the promotion of the use of energy from renewable sources (Law no. 10 of 26.02.2016) came into effect in March 2018, additional pieces of legislation are required to ensure smooth implementation of the new support mechanisms.

In particular, clarity on all requirements and procedures to be followed needs to be ensured well in advance for both project developers and financial institutions. For auctions-based support scheme, essential secondary legislation needs to be adopted, including: standard documentation for the tendering procedure; eligible producer status confirmation for small renewable electricity producers; and grid connection, including provisions referring to renewables integration.

In addition, the regulatory framework could be strengthened by implementing a transparent methodology to calculate feed-in-tariffs and ceiling prices for tenders, as well as by facilitating introduction of the net metering scheme for distributed renewable energy generation. While legislative framework is in place, the mechanism is not widely used, due to lack of administrative clarity.

Streamline administrative procedures and facilitate their enforcement

Co-ordination between relevant stakeholders, including the Ministry of Economy and Infrastructure, the Ministry of Agriculture, Regional Development and Environment, the Ministry of Finance and the transmission system operator is required to clarify and simplify some procedures that are perceived by the private sector as an administrative burden and hinder the deployment of renewable energy.

While revising the National Renewable Energy Action Plan and developing an integrated National Energy and Climate Plan, key aspects raised during the RRA process could be addressed. These include: use of agriculture land for RE power plants; conduct of environmental impact assessments; taxation of RE-related equipment; and issuance of grid connection permits.

Develop a strategy for the bioenergy sector

With limited availability of wooden biomass, the government is advised to develop a country-wide programme for the use of solid biofuels.

This strategy should not only provide a comprehensive assessment of resource potential, but also provide clarity on the most suitable technology options for a wide group of beneficiaries in the Republic of Moldova. Some failures to match beneficiary and technology have turned out to be costly in the past. In this context, the government could analyse the opportunity to revise the relevant legislation with the objective of increasing the role of local public authorities in promoting the bioenergy sector. As the owners of a vast amount of land, those authorities could strengthen their commitment to developing the local industry and would benefit from locally harvested, cost-competitive heating resources.

The strategy should also address the potential for cultivation and wide use of energy crops that can be grown on marginal and/or depleted lands. Currently, despite promising resources, the energy crop sector faces several challenges, including land conversion issues, land suitability and the availability of financial support.

Encourage the use of and further develop the online platform for biomass trade

Lack of proper communication and exchange among actors in the biomass market is perceived as a major challenge of the sector, even though a dedicated online platform was recently launched. The increased use of the tool would facilitate market operations and the entry of new fuel suppliers, including producers of agricultural residues and local public authorities. It would also enhance

fuel price competition and supply liquidity. The platform should be actively promoted and further developed to provide a bridge between biomass producers and potential customers. It should also include information on the benefits stemming from the use of bioenergy and be a repository of available opportunities for local consumers to switch to this source of energy.

Identify an optimal pathway to increase the role of biofuels

The country has committed to a 10% share by 2020 for renewables in the transport sector, but limited actions have been taken, so far, to promote the use of liquid biofuels.

While there is a clear understanding among stakeholders of the need to ensure more sustainable use of energy sources in this sector, several concerns have been identified. These include the availability of land and infrastructure to cultivate crops for biofuels. Therefore, the country needs to identify an optimal pathway towards the use of biofuels in transport, either by focusing on domestic production, imports or combining these two options.

Improve the bankability of renewable energy projects

The high-risk perception of renewable energy projects in the Republic of Moldova affects substantially the cost of capital that is critical for the financial viability of those projects. Therefore, more confidence in the market by financial institutions needs to be ensured to improve the bankability of those projects. Despite recent efforts by the government, the current framework is not perceived as sufficient, as it seems to expose potential investors to several risks. In this context, the following additional actions are required:

- Enhancement of the templates of the key project documentation, including power purchase agreements (PPAs) to provide necessary guarantees and predictability to the stakeholders involved.
- Procedure for transparent assignment of the central electricity supplier.
- Design of a procedure for the transfer of all existing renewable energy producers to the support system, based on a contract for difference, which is envisaged to be implemented when the electricity market (day-ahead and intra-day markets) is declared liquid by the regulator.

Enhance the capacity of local banks to facilitate the financing of renewable energy projects

Securing funding from the financial sector for the investments needed to achieve a total capacity addition of 168 MW may be a challenge, under the new policy support environment. While large-scale renewable power plants can access the necessary financial resources from abroad – through the contributions of either foreign investors or international financial institutions – small-scale projects are limited to funding opportunities from the local financial market. Limited knowledge of the renewable energy sector, among local lenders appraising projects, along with insufficient understanding of the sector's support mechanisms, may obstruct the availability of financing.

In addition, the Republic of Moldova's financial and banking sector is comparatively small, with limited resources. Frequent problems in this sector, evidenced by the collapse of three large banks in 2014, have also affected the banking sector's activities, in general.

Thus, for example, technical support in developing bankable project proposals and in structured finance principles, including project finance, can increase the capacities of local commercial banks and could be facilitated by international financial institutions that are well placed to provide such technical assistance.

At the same time, public capital, including that provided by development finance institutions, could be used to help de-risk, or lower the risk of renewable energy projects. This would, in turn, lower the cost of capital for renewables, via the provision of risk mitigation instruments.

Develop a national communication strategy on renewable energy sources

The deployment of renewables is an effective tool to fuel economic growth, create new employment opportunities, enhance human welfare and contribute to a climate-safe future. IRENA's analysis suggests that renewable energy jobs worldwide could rise from 10.3 million in 2017 to 23.6 million by 2030 and 28.8 million by 2050.

A national strategy is needed to raise awareness of renewable energy sources and their benefits across the Republic of Moldova

As the sector is still at an early stage of development, a national strategy is needed to raise awareness and boost understanding of renewable energy sources and their benefits across the Republic of Moldova.

This strategy should address several stakeholders, including state authorities, civil society, the banking community and donors. It could envisage necessary actions to: ensure proper ways to disseminate the most up-to-date information on renewables and the ongoing energy transition (*e.g.*, a dedicated website, translation of authoritative publications into local language); and improve the curriculum of schools and universities to reflect the growing role of renewables. At the same time, intensified government communication efforts on the ongoing legislative changes would be beneficial for stakeholders. This is especially true regarding local financial institutions, as the relevant mechanism to finance renewable energy projects is prepared.

Wind turbine in Busauca, Rezina
Photograph: Shutterstock

Introduction[1]

1.1 Country background

The Republic of Moldova, with its capital city of Chisinau, is a land-locked country situated in South-Eastern Europe and wedged between Romania and Ukraine. The population is 3 550 852 inhabitants, approximately 57% of whom live in rural areas, and its territory covers an area of 33 800 square kilometres (km) (NBS, 2017).

After gaining independence on 27 August 1991, following the collapse of the Soviet Union, the country introduced a parliamentary system and experienced a long transition period. This was characterised by political instability and numerous changes of government. Socio-economic and political stability has been recently ensured, however, and has been marked by economic growth and fruitful collaboration with neighbouring states. Common roots and cultural similarities between the Republic of Moldova and Romania are reflected in strong linkages in business and commerce.

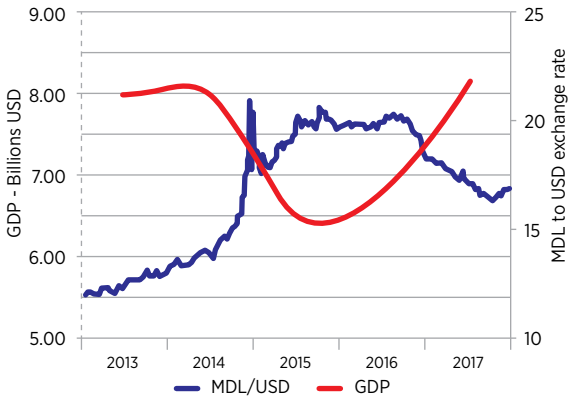
Several reforms carried out in recent years have positively impacted the economy, including the energy sector. These reforms have contributed to a process of gradual integration with European Union (EU) structures, with this process remaining a priority for the country.

In 2010, the Republic of Moldova joined the Energy Community, an international organisation that includes the EU and its neighbours. The Energy Community aims to create an integrated pan-European energy market. The Association Agreement signed in 2014 between the EU and the Republic of Moldova also established a framework for political and economic collaboration.

The country has recently been experiencing economic recovery, following a crisis in 2014-2015 that was related largely to challenges in the banking sector. As a consequence of this crisis, the Republic of Moldova faced a severe devaluation of its currency, the Moldovan lei (MDL), while the country's Gross Domestic Product (GDP) shrank 0.5% in 2015 (Lupusor *et al.*, 2016). Figure 1 shows the impact of the crisis on GDP (in current USD) and the MDL/USD exchange rate. With GDP growth of 4.5% in 2017, however, the country became the third fastest growing economy in Europe that year, with its GDP totalling USD 8.13 billion. This gave a per capita GDP of USD 2 290, which was equal to 21% of the world average (WB, 2018b).

1 If not stated otherwise, data in this report is based on information relating to the right bank of the Dniester River only. The territory of the Republic of Moldova also includes the region of Transnistria, located on the left bank of the Dniester River, which declared independence in 1990. However, no United Nations member state recognises its sovereignty. The report refers to electricity produced by entities located in Transnistria as "purchased from MGRES".

Figure 1. Evolution of GDP and the MDL/USD exchange rate



Source: Based on WB (2018b), NBM (2018)

Economic activity is shifting progressively towards services, a sector that in 2017, accounted for nearly 65% of GDP and provided employment for more than half of the workforce. The sector is driven by insurance, legal consultancy and telecommunications, with foreign investment playing a substantial role.

As the country has a moderate climate, along with favourable climatic and soil conditions, agriculture is also an important sector, accounting for 16% of GDP and employing nearly 30% of the workforce, in 2017. The main areas of agricultural production include vegetables, fruits, grapes, grain, sugar beets, sunflower seeds, tobacco, beef and milk.

In 2017, the national employment rate was 40.5% and the unemployment rate was 4.1%, although the labour market varies greatly across the country (NBS, 2017).

The Republic of Moldova is also the 129th largest export economy in the world. In 2016, the country exported USD 2.43 billion and imported USD 3.95 billion, resulting in a negative trade balance of USD 1.52 billion. Petroleum products are listed high among the imported commodities, at USD 370 million (OEC, 2016).

1.2 Renewables Readiness Assessment

The International Renewable Energy Agency (IRENA) developed the Renewables Readiness Assessment (RRA) as a tool for carrying out a comprehensive evaluation of the conditions for renewable energy deployment in a particular country.

The RRA is a country-led and consultative process. It provides a venue for multi-stakeholder dialogue to identify challenges to renewable energy deployment and to come up with solutions to existing barriers. Short- and medium-term recommendations are presented to governments to guide the formation of new policies, or the reform of existing ones, opening up a more enabling environment for renewable energy. The RRA also consolidates existing efforts and mobilises resources for priority actions.

The RRA elaboration process was launched at the request of the Ministry of Economy and Infrastructure of the Republic of Moldova, in the context of IRENA's recently initiated South East Europe Initiative (see Box 1). This coincided with the government's ongoing efforts to develop and finalise renewable energy-related legislation. These efforts have boosted the dialogue between policy makers and other interested parties, including potential investors, relevant state authorities, international financial institutions and civil society.

During the first stage of the process, a background paper was prepared outlining a general overview of the Moldovan energy sector, with a special focus on renewable energy. In addition, an issues paper was elaborated to identify potential barriers and bottlenecks that need to be addressed to ensure successful deployment of renewables. The paper includes the suggestions of interviewed experts.

With the aim of validating these findings and providing an open dialogue among a wide range of stakeholders, IRENA and the Ministry of Economy and Infrastructure organised an expert workshop on 4 June 2018. The main objectives were to discuss challenges for renewable energy development and to provide preliminary recommendations on the required actions to ensure favourable conditions for the sector. The event provided the opportunity to review global renewable energy developments, highlight the country's international energy commitments and present an overview of the national energy sector.

Subsequently, a set of recommended actions to further advance the renewable energy sector was validated by local stakeholders within the

framework of the second RRA workshop that took place on 15 October 2018 and was endorsed by the national owner of the process, the Ministry of Economy and Infrastructure.

This report is structured in four chapters. The first provides introductory information on the country background and the RRA process. The second chapter highlights the main features of the energy sector from both a technical and legal perspective. In particular, it indicates the role that energy efficiency and renewable energy play in the government's agenda and in the national strategy to ensure sustainable development. The third chapter is dedicated to the renewable energy sector, with a focus on potential, current applications, legal framework and financing. The final chapter provides a set of recommendations – identified by stakeholders involved in the RRA process – that address the most important challenges of the renewable energy market in the Republic of Moldova.

Box 1. **IRENA's South East Europe Initiative**

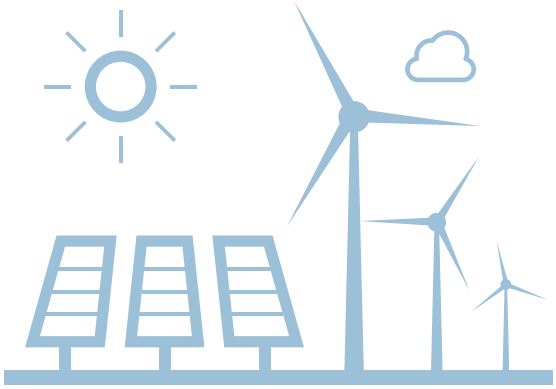
As part of IRENA's increasing engagement with South East Europe, the High-Level Meeting on Renewable Energy in South East Europe took place in Abu Dhabi, in January 2017.

The meeting served as a platform to discuss the opportunities and challenges in expanding the share of renewable energy in the region's energy mix. It built on the region-wide consultation process undertaken in 2016, including a regional consultation workshop organised in collaboration with the Ministry of Energy of Romania, and gathered representatives from the governments of the region, as well as other, key regional stakeholders.

The meeting resulted in the issuance of the Abu Dhabi Communique on Accelerating the Uptake of Renewables in South East Europe by the Heads of Delegation in attendance, which lays out the foundations for IRENA's engagement in the region. This has the goal of supporting the creation of more conducive frameworks for renewable energy investment. As agreed at the meeting, the priority areas for collaboration with IRENA shall include, amongst others: mapping renewable energy resources; renewable energy planning; strengthened enabling frameworks; the socio-economic benefits of renewables; integration of variable renewable energy sources; and renewable energy financing.

Figure 2. High-Level Meeting on Renewable Energy in South East Europe, 2017

From left to right: H.E. Mirko Šarović, Minister of Foreign Trade and Economic Relations, Bosnia and Herzegovina; Mr. Adnan Z. Amin, Director-General of IRENA; Mr. Dominique Ristori, Director General for Energy, European Commission.



Solar PV application in Chisinau
Photograph: Ministry of Economy and Infrastructure

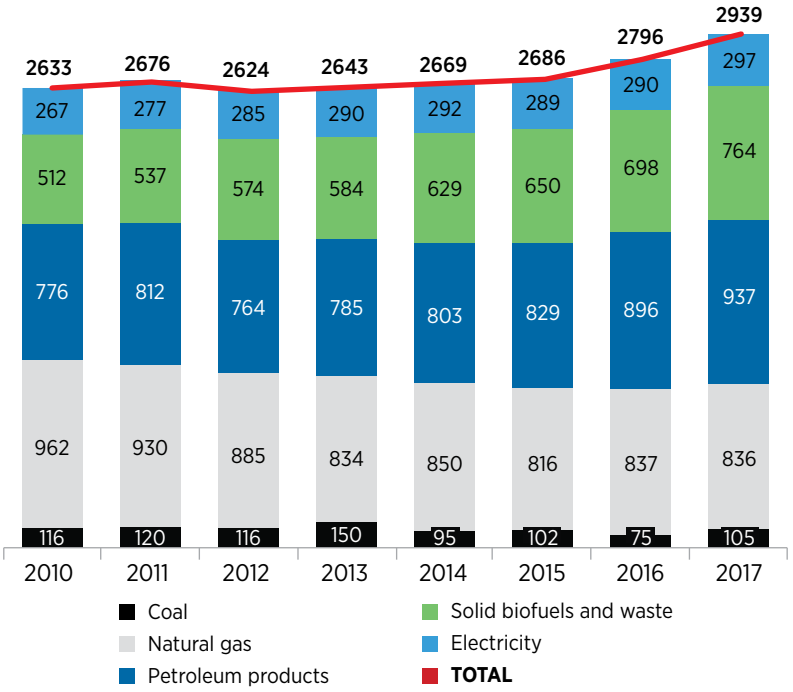
Energy context

2.1 Energy supply and demand

The total primary energy supply of the Republic of Moldova increased by an average of 1-2% annually during 2010-2017, reaching 2 939 kilotonnes of oil equivalent (ktoe) (see Figure 3) by the end of the period. The consumption of fossil fuels (coal and natural gas) decreased gradually during this time, while the shares of electricity and biomass continued to grow. The country also experienced rising use of petroleum products, increasing 17.2%, from 776 ktoe in 2010 to 937 ktoe in 2017 (NBS, 2018).

Final energy consumption in 2017 was 2 671 ktoe, equivalent to roughly 90% of the primary energy supply[2] (see Figure 4). The residential sector consumes the largest share of final energy, at 50%, while the industrial sector consumes just 8%, as industry does not play a significant role in the country.

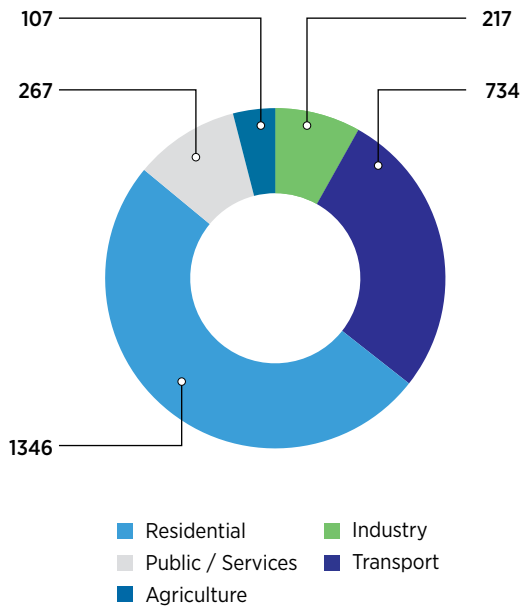
Figure 3. Total primary energy supply over the 2010-2017 period (ktoe)



Source: NBS (2018)

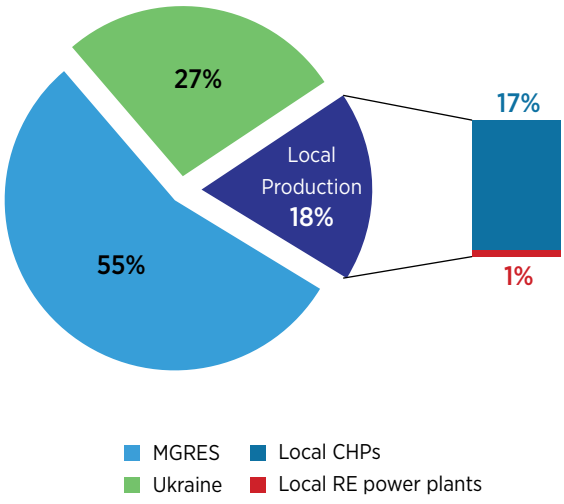
2 This high ratio is a result of the lack of industry that would use energy for further purposes. In countries that have such a sector in place, those losses reach up to 20-25% of primary energy.

Figure 4. Final energy consumption in 2017, by sector



Source: NBS (2018)

Figure 5. Electricity generation in 2017, by source



Source: ANRE (2018)

The Republic of Moldova is poorly endowed with fossil fuel energy resources and is highly dependent on imported energy, in the form of natural gas, petroleum products and electricity. Almost 70% of the primary energy supply – 2 012 ktoe of the total 2 939 ktoe – is imported from neighbouring countries. Thus, the country is vulnerable to risks related to energy supply disruption.

Nearly the entire volume of natural gas is imported from the Russian Federation (from Gazprom). About 44% of this fuel is used to generate electricity and heat, while 28% is used in the residential sector. Natural gas consumption has decreased over the last decade: by 2017, it had declined by 13% of 2010 levels, or 30% of 2005 levels (NBS, 2012 and NBS, 2018). Meanwhile, imports of petroleum products increased in 2017 to 809 272 tonnes, of which 70% was diesel, 21% was gasoline, and 9% was liquefied petroleum gas. The supply of petroleum products is more diversified, however, with imports coming mainly from Romania, the Russian Federation and Belarus (ANRE, 2018).

Of the 3.7 billion kilowatt-hours (kWh) of electricity used in 2017, only 18% was generated domestically, mainly by local combined heat and power (CHP) plants, a non-pumped hydropower plant, and other small-scale renewable energy installations (see Figure 5). The rest of the electricity was imported from Ukraine (27.2%) and purchased from MGRES (54.8%), a power plant located in Cuciurgan (see footnote 1).

2.2 Legal and regulatory framework

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, the *acquis communautaire*. Since then all governmental efforts have been focused on aligning the national legal framework for energy with that of the EU. As a result, competition and market principles have been introduced, especially in the natural gas and electricity fields, with the objective of unbundling vertically integrated entities and introducing liberalised market principles.

The above-mentioned reforms have had a positive impact on the quality of services provided to final consumers and businesses and are expected to enhance the investment environment and attractiveness of the country as a whole. Between

2016 and 2019, the Republic of Moldova improved its ranking on the World Bank's Getting Electricity Indicator from 97th to 81st and its ranking on the Doing Business Indicator from 52nd to 47th (WB, 2018a).

The energy legal framework includes the following laws:

- **The Law on Electricity** (Law No. 107 of 27.05.2016) ensures liberalisation of the electricity market and transposes all principles and rules of the EU's Third Energy Package. In particular, the law clearly sets the rules for businesses in the power field, especially regarding mandatory requirements in unbundling. In addition, this law ensures that all final customers are eligible to buy electricity from any generator or supplier – although as yet no one has exercised the right to switch providers.

- **The Law on Natural Gas** (Law No. 108 of 27.05.2016) introduces similar rules for liberalisation of the natural gas market. In particular, it sets out the unbundling requirements and envisaged derogation for the Moldovagaz JSC and its subsidiary companies, owned by Gazprom.

- **The Law on Energy** (Law No. 174 of 21.09.2017) provides a set of rules for all operators in the energy field, as well as for end-users of energy resources. It also consolidates the independence, authority and transparency of the National Energy Regulatory Agency (ANRE). The law establishes all the mechanisms and principles regarding the functioning of the ANRE, including: appointment and mandate of a director; budget formation and related financial management principles; and other provisions aimed at creating a healthy and favourable environment within the energy sector, focused both on attracting investment and on the supply of reliable, qualitative and affordable services to end-users.

- **The Law on Energy Efficiency**[3] (Law No. 139 of 19.07.2018) consolidates the national institutional framework capacities for implementing energy efficiency policies and developing relevant financing mechanisms. The law also enables active participation by third parties, as it provides a necessary framework for energy performance contracts (via energy services companies, or ESCOs) and allows private investment in the public sector. The law contains the following pillars: implementation of the concept of energy efficiency obligation schemes; strengthening the exemplary role of public buildings; introduction of the obligation for large companies to perform obligatory energy audits; popularisation of sustainable public procurement; and promotion of energy performance contracts as market-driven funding instruments for energy efficiency measures.

- **The Law on the Promotion of the Use of Energy from Renewable Sources** (Law No. 10 of 26.02.2016), in force since March 2018, comes with new support mechanisms for renewable energy investments. These include: feed-in tariffs; net metering; and tenders (see Section 3.2). At the same time, to ensure local energy autonomy and achieve the goal of distributed energy generation, the law supports the development of small-scale, community-promoted renewable energy projects. Moreover, it provides: an obligation by the central electricity supplier to purchase renewable electricity; guaranteed and non-discriminatory access to the grid; and priority dispatch.

  While the government's efforts have focused mostly on the use of renewables in the power sector, the law also introduces the possibility of importing mixed petroleum products. This would be as a first step in enabling the use of liquid biofuels, while working towards achieving the target of 10% renewable energy use in transport by 2020. In 2018, the government launched a comprehensive exercise to assess the costs and efforts related to reaching the target, in parallel with developing the required legislation on sustainability criteria for biofuels.

3 In addition, the Law on Labelling of Energy-related Products (Law No. 44 of 27.03.2014) and the Law on Eco-design for Energy-related Products (Law No. 151 of 17.07.2014) aim to create an environment to enable lower energy consumption.

2.3 Energy development plans

Approved in December 2018, the **Moldova 2030 National Development Strategy** establishes the country's long-term sectoral priorities and is aimed at enhancing the quality of citizens' lives. The strategy's goal is to bring the focus of public policy onto people's problems, interests and aspirations.

The document includes four pillars of sustainable development: a sustainable and inclusive economy; human and social capital; honest and efficient institutions; and a sound environment. In this context, ten sustainable development goals have been established at the national level, including: the guaranteeing of a quality education; the ensuring of efficient governance; the enhancement of people's access to infrastructure; and the improvement of labour conditions.

The **Energy Strategy of the Republic of Moldova until 2030** ("The Energy Strategy"), adopted in 2012, indicates three main strategic objectives (see Figure 6).

The first objective relates to enhancing the security of energy supply, mainly by strengthening interconnections with Romania and, implicitly, with other EU countries. The most important infrastructure development projects are outlined in Section 2.4.

The second objective refers mainly to approximation of the legal framework with the EU acquis, which includes transposition and implementation of the Third Energy Package. The most important pillars of the package – ensuring the prerequisites for market liberalisation – have already been introduced to the national legal system.

The third objective aims to ensure sustainable development of the Republic of Moldova by, among other methods, promoting energy efficiency and renewable energy. In this context, as a Contracting Party of the Energy Community, the country has transposed EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources, which establishes a conducive framework for the production and promotion of energy from these sources. In particular, it introduces:

- A requirement for the whole EU to reach a share of at least 20% for renewable energy in its gross final energy consumption by 2020.
- An obligation for all EU members (and subsequently Contracting Parties of the Energy Community) to fulfil their national targets for renewables and to develop National Renewable Energy Action Plans that set out ways to achieve their respective commitments.
- A mandatory sub-target of a 10% share for renewables in transport, for all countries in question, by 2020.
- Sustainability criteria for biofuels to ensure that they are produced in a sustainable and environmentally friendly manner.

In 2012, within the framework of the Energy Community, the Republic of Moldova pledged to achieve a 17% share for renewables in gross final energy consumption by 2020. It also developed the National Renewable Energy Action Plan (NREAP) for the 2013-2020 period that envisages a set of legal, technical and analytical measures to ensure achievement of the target.[4] In addition, in the energy efficiency field, the National Energy Efficiency Program 2011-2020 and two National Energy Efficiency Action Plans (NEEAP 2013-2015 and 2016-2018) were elaborated, with the objective of achieving a total of 167 ktoe of energy savings by 2020.

Figure 6. Objectives of the Energy Strategy until 2030

4 The document is under revision – as of December 2018.

At the same time, the country remains committed to the objectives of the Paris Agreement and submitted its Nationally Determined Contribution in June 2017 (UNFCCC, 2017). The country has an economy-wide, unconditional target of reducing national greenhouse gas emissions to 64-67% below the 1990 level by 2030. The reduction commitment could be increased up to 78% below the 1990 level, conditional on a global agreement addressing some important issues. These include low-cost financial resources, technology transfer and technical co-operation, accessible to all at a scale commensurate to the challenge of global climate change.

In addition, the Ministry of Agriculture, Regional Development and Environment has developed two instruments of strategic planning, with associated action plans, aimed at implementing the above-mentioned commitments: The Climate Change Adaptation Strategy by 2020; and the Low Emission Development Strategy of the Republic of Moldova until 2030. Both documents emphasise the crucial role of energy efficiency and renewable energy in reaching the climate-related goal at the national level.

2.4 Power system[5]

Domestic power production in the Republic of Moldova typically covers less than 20% of demand and is provided by local CHP stations, a non-pumped hydropower plant, and other small-scale renewable energy installations. In this context, a central electricity supplier[6] was recently established to purchase electricity generated by the above-mentioned producers and to sell it to eligible customers and suppliers.

At present, two actors dominate the market and supply electricity, with tariffs approved by ANRE. These are: FCC Gas Natural Fenosa Furnizare Energie LLC (GNFFE), created as a result of the unbundling of the distribution of supply activities by FCC RED Union Fenosa JSC; and JSC Furnizarea Energiei Electrice Nord, created as a result of the unbundling of the distribution of supply activities by JSC RED Nord and JSC RED Nord-Vest.

Both companies also act as suppliers of last resort in their respective supply areas. In addition, 20 other registered independent electricity suppliers, licensed by ANRE, are entitled to provide electricity at non-regulated tariffs. As of November 2018, however, no contracts with these suppliers had been recorded. This was due to their lack of credibility and financial strength, along with favourable conditions for electricity importation from Ukraine.

In 2017, the Republic of Moldova purchased 55% of its electricity from MGRES[7] and imported 27% from Ukraine (via JSC Energocom). These two entities were selected in a tender for annual procurement of electricity organised by the Ministry of Economy and Infrastructure.

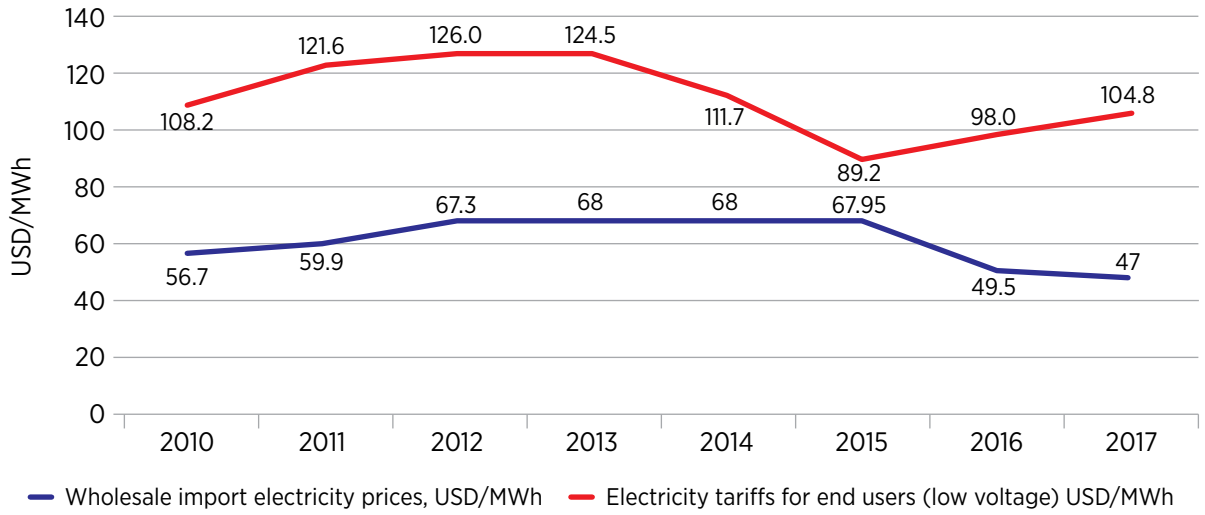
The trading of electricity in the Republic of Moldova is based on bilateral contracts, since a power exchange expected to be established only after several years. The regulator is notified of contracts concluded by the above-mentioned suppliers, at regulated tariffs, to ensure that all final customer demand is met at the lowest possible cost. Furthermore, agreements involving electricity imports are subject to examination by ANRE and Moldelectrica, the transmission system operator, to ensure their technical feasibility. Figure 7 provides an overview of wholesale import electricity prices and electricity tariffs for end users (low voltage).

5 Two electricity market participants from the Transnistrian region requested and obtained licences from ANRE: MGRES for electricity production and Energokapital JSC for supply of electricity. This allowed them to generate electricity and to supply it to Moldovan final customers.

6 Energocom has been mandated for three years, until 1 January 2021.

7 MGRES, built during 1964-1982, is the biggest generation capacity located in Transnistria. It has an installed capacity of 2 520 MW, with coal accounting for 1 600 MW, natural gas for 500 MW and heavy fuel oil for 420 MW. It can be switched to natural gas with an available capacity of approximately 1 700 MW. It is currently owned and operated by Inter RAO EES Corporation.

Figure 7. Wholesale import electricity prices and electricity tariffs for end users



Source: Based on ANRE (2018) and ANRE (2016)

Power generation

Domestic power generation capacity amounts to 383 megawatts[8] (MW) and is produced mainly by gas-burning CHP plants, which account for 86% of total installed capacity (see Figure 8 and Table 1) (MoEI, 2017).

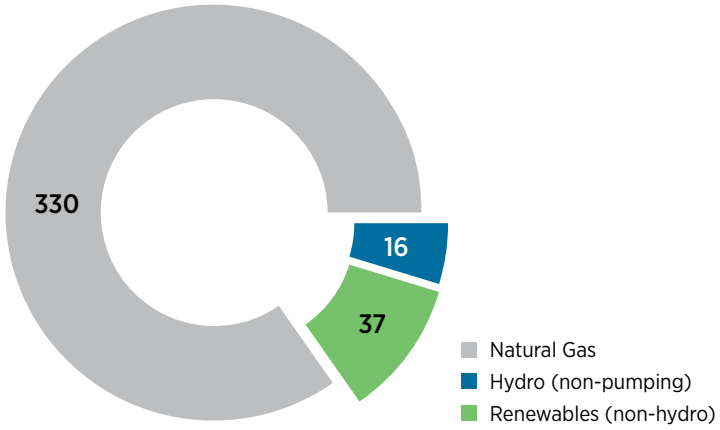
In the winter season, the typical load variation of the Moldovan power system (the right bank of the Dniester River only) ranges between a minimal base load of 330-370 MW and a maximum peak load of 700-760 MW, while in the summer season it ranges from a minimum of 260 MW to a maximum of 610 MW (MoEI, 2017). The maximum load for both banks of the Dniester River can reach up to 1100 MW (Moldelectrica, 2018).

Because of its deficient generation capacity and peculiar power system (heat-demand driven CHP plants and small-scale hydropower plants with vulnerable hydrology) the Republic of Moldova has no plants that can provide primary, secondary and tertiary reserves. As a consequence, it must rely on Ukraine, for frequency control as well. Although MGRES could provide some additional reserves, such an agreement has not been concluded so far.

Solar water heaters, "Povestea" kindergarten in Nisporeni
Photograph: UNDP Moldova

8 Seven additional sugar mill-owned CHP plants with a total installed capacity of 98 MW are available for a limited period of time during the year. In addition, two power plants are based in Transnistria: MGRES, with total installed capacity of 2 520 MW and HPP Dubasari, with an installed capacity of 48 MW.

Figure 8. Domestic generation capacity in 2017, by fuel



Source: Based on MoEI (2017) and MoEI (2018a)

Table 1. Overview of the domestic power generation infrastructure in the Republic of Moldova

Power plant name	Date of construction	Installed capacity	Available capacity	Fuel used
1. Termoelectrica JSC				
CET - 2 (CHP) in Chisinau	1976-1980	240 MWe	210 MWe	natural gas
CET - 1 (CHP) in Chisinau	1951-1961	66 MWe	40 MWe	natural gas
2. JSC CET-Nord (CHP), Balti*	1956-1970	24 MWe	24 MWe	natural gas
3. Costești hydropower plant	1978	16 MW	16 MW	hydro
4. Non-hydro renewable energy power plants	2009-2018	37 MW	37 MW	
Total		**383 MW**	**327 MW**	

Note: *An additional capacity of 13.4 MW of internal combustion engines powered by natural gas is to be installed and commissioned at the beginning of 2019.
Source: Based on MoEI (2017) and MoEI (2018a)

Grid infrastructure

The existing Moldovan power grid infrastructure was mainly built during Soviet times, as part of a jointly optimised system with the Soviet Union and the neighbouring countries of Bulgaria, Hungary and Romania. After the dissolution of the Soviet Union, all countries in the region redesigned their electricity systems. While Bulgaria, Hungary and Romania decided to synchronise their networks with the Western system (former UCTE, currently ENTSO-E), the Republic of Moldova and Ukraine joined the Eastern system (IPS).

Despite strong links between ex-Soviet republics and their western neighbours, electricity exchange between the two systems is only feasible in "island mode", or via expensive back-to-back converter stations. As the smallest country in the region, the Republic of Moldova was affected significantly by the dismantling of the region's electricity system and consequently has inherited a poorly maintained and unsustainable power network.

In particular, because the country suffers from insufficient power generation capacity, it uses its interconnections with Ukraine to ensure the necessary system reserves and balancing energy. This includes seven 330 kilovolt (kV) lines and 11 110 kV lines (see Figure 9).

The high-voltage interconnection between the Republic of Moldova and Romania consists of the 400 kV Vulcanesti-Isaccea overhead line and four 110 kV lines; however, due to a lack of synchronisation, these are used only in exceptional cases. Because the local system is isolated from ENTSO-E, it demonstrates major operational limitations that affect the energy security of the Republic of Moldova and hinder the operational stability of the system and the possibilities for power exchange. Thus, a feasibility study has been conducted on interconnecting the energy systems of the Republic of Moldova and Romania by installing back-to-back stations (asynchronous interconnection) (see Box 2). This scenario makes it possible to maintain both the interconnection with Ukraine, as well as energy exchanges with Romania.

At the same time, the Energy Strategy 2030 envisages plans to strengthen bidirectional transmission connections between the IPS/UPS and ENTSO-E systems, enabling the Republic of Moldova to become a power transit country. Interconnection projects with the EU internal power market through new power lines, as well as the enhancement of internal networks, are considered essential both for supply security and for social welfare. In addition, interconnection with the ENTSO-E system is expected to enable increased competitiveness that will lead to more affordable energy prices.

In this context, the Moldovan and Ukrainian governments are synchronising their energy agendas, especially those related to the interconnection of their national power systems with the ENTSO-E grid. In this regard, in June 2017, the transmission system operators of both countries signed a Memorandum of Understanding with ENTSO-E confirming their intention.

Figure 9. Electricity network and power generation facilities in the Republic of Moldova

Source: WB (2015)
Disclaimer: Boundaries and names shown on this map do not imply any official endorsement or acceptance by IRENA.

Box 2. Asynchronous interconnection with Romania

A feasibility study was performed on interconnecting the energy systems of the Republic of Moldova and Romania by installing back-to-back stations (asynchronous interconnection). This approach makes it possible to maintain both interconnection with Ukraine as well as energy exchanges with Romania.

In this context, the following scenarios were analysed (see Figure 10):

1. A back-to-back station with up to 600 MW of capacity at Vulcănești and construction of the Isaccea-Vulcănești-Chisinau overhead line, estimated at EUR 270 million (No. 1 in the figure).

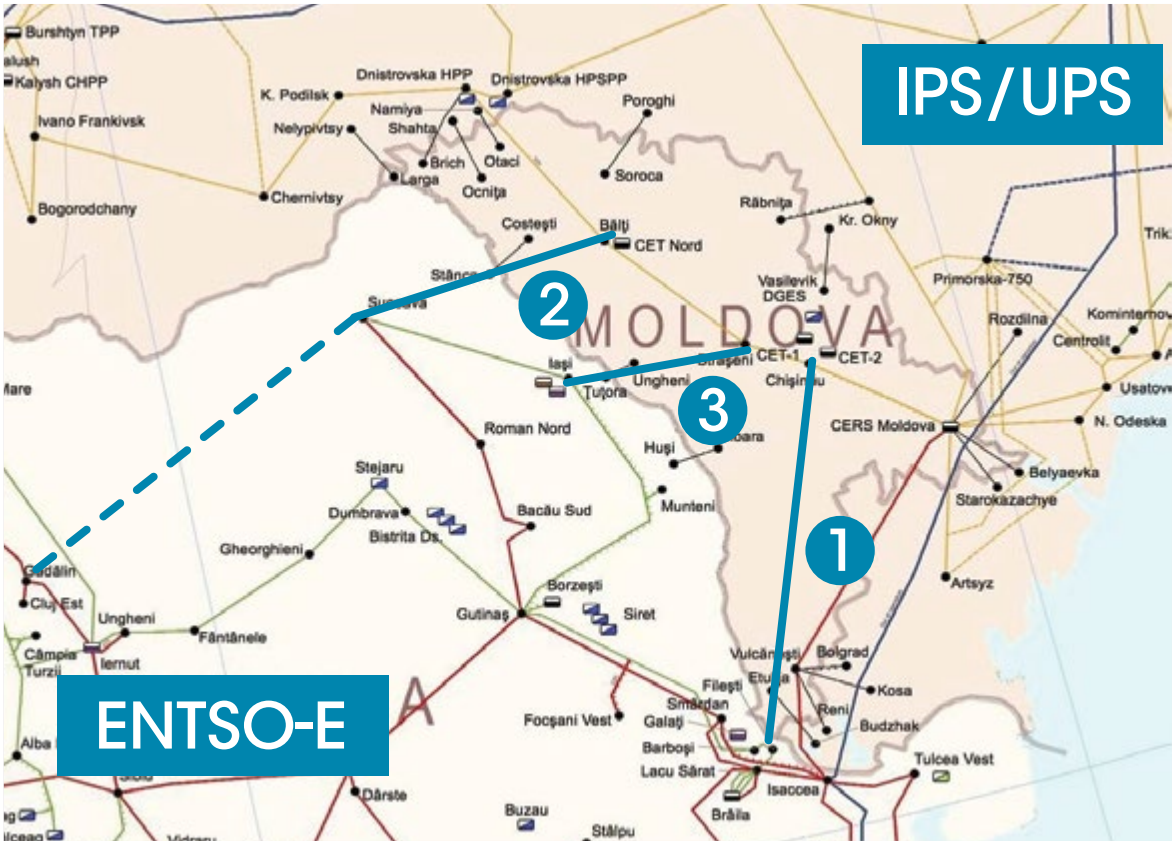
2. A back-to-back station with 300 MW capacity at Balti station and construction of the 400 kV Balti-Suceava overhead line, estimated at EUR 130 million (No. 2 in the figure).

3. A back-to-back station with 300 MW capacity and construction of the 400 kV Straseni-Ungheni-Iasi overhead line. An investment budget is not elaborated, as a connection point with Romania has not been determined yet (No. 3 in the figure).

The feasibility study concluded that the most feasible and suitable is option 1, the Isaccea-Vulcănești-Chisinau overhead line.

Once finalised, the project is expected to increase diversification of the electricity market in the country, enable future integration with the ENTSO-E system and positively influence the increased uptake of renewable energy capacities.

Figure 10. Potential power interconnections of the Republic of Moldova with ENTSO-E



Source: MoEI (2018b)
Disclaimer: Boundaries and names shown on this map do not imply any official endorsement or acceptance by IRENA.

2.5 Organisational structure of the energy sector

Below is a list of the most important actors involved in governing the energy sector.

The Ministry of Economy and Infrastructure is responsible for administration of the energy sector, as well as for elaboration and implementation of the necessary measures to ensure the energy security of the country. In particular, the ministry develops energy-related policies, strategies, normative acts and sector programmes and project concepts.[9] In addition, the ministry leads international collaboration in the energy field, including, but not limited to, the supply of strategic energy resources, attraction of foreign investment, and facilitation of power interconnections.

The Energy Efficiency Agency provides support to the Ministry of Economy and Infrastructure in implementing energy efficiency and renewable energy policies. Its mission is to: manage all activities in the energy efficiency and renewable energy sectors; ensure the continuation of country-wide efforts to reach the objectives stemming from national strategies and programmes; and guarantee timely and proper implementation of legislation related to energy efficiency and renewable energy. Moreover, following institutional reform in 2018, the agency has absorbed the Energy Efficiency Fund. As a result, it also is responsible for providing financial support to the sector – in part through funds allocated from the state budget, but also through additional resources to be fundraised on local, regional and international financial markets.

The National Energy Regulatory Agency (ANRE) is an independent regulatory authority, directly subordinated to parliament. It is responsible primarily for the introduction of market regulatory mechanisms that protect the interests of both consumers and investors. In particular, the agency:

- Supervises compliance with laws and regulations in the energy field.
- Promotes and ensures fair competition and efficient operation of energy markets, monitoring the level and effectiveness of market opening, as well as competition, in the wholesale and retail energy markets.
- Issues licences for activities in the energy market and monitors compliance with licensing conditions.
- Monitors the investment plans of system operators.
- Sets and approves standards and requirements for distribution, transmission and supply activities.
- Approves tariffs with the objective of considering the interests of both producers and customers.
- Supervises customers' rights and protections.

The Competition Council aims to ensure the supremacy of competitiveness principles in the energy market, in line with the provisions of the Law on Competition (Law no. 183 of 11.07.2012), as well as the relevant legislation on electricity and natural gas.

Moldelectrica, a state-owned enterprise, performs the functions of a transmission system operator and manages the internal electricity transmission network, including the operation of 4 699 km of 400 kV, 330 kV, 110 kV and 35 kV transmission lines. In August 2018, the government strengthened ownership independence through the adoption of Decision no. 806/2018, with the objective of advancing the unbundling process. In a next step, transmission system operators will be further certified by the regulator to prove compliance with unbundling-related requirements.

The state-owned RED Nord[10] and privately owned RED Union Fenosa perform the functions of distribution system operators (MoEI, 2017).

9 For example, project concepts for development of the power sector, refurbishment of domestic CHP plants, implementation of energy efficiency measures in the residential sector, etc.

10 JSC RED Nord absorbed another state-owned distribution system operator, JSC RED Nord-Vest, in 2017.

Biogas plant in Drochia
Photograph: Energy Efficiency Agency

Renewable energy development

3.1 Renewable energy resources and applications

The Republic of Moldova has vast technical potential for renewable energy. Yet, deployment has been limited so far, with the exception of the use of biomass in the heating sector. Indeed, although renewable energy has developed rapidly worldwide over the past decade and is the most cost-competitive solution in an increasing number of countries (see Box 3), this trend has not yet been observed in the Republic of Moldova.

In 2017, the share of renewables in the Republic of Moldova's gross final energy consumption was 27.8%. Biomass provides 98% of this share and is used mainly in the heating sector (NBS, 2018). This high contribution to the energy mix was identified only recently, however, by the retroactive revision of biomass household consumption data for 2010-2016. Efforts by the National Bureau of Statistics, the United Nations Development Programme (UNDP) and the Energy Community Secretariat to improve the statistical record led to an apparent 10-fold increase in consumption figures, from 67 ktoe in 2009 to 678 ktoe in 2016 (UNDP and ECS, 2016). This revised share of renewables is well above the national target of 17% by 2020, which was established in 2012, based on the energy situation in 2009. At that time, the share of renewables was 11.9%.[11]

Table 2 presents the evolution of renewable energy use in three sectors – electricity, transport, and heating and cooling – taking into account the revised data for 2010 - 2016.

11 Based on an analysis of the Energy Community Secretariat. The national sources, *e.g.* the Moldovan Energy Efficiency Agency, indicated significantly lower share.

Box 3. The business case for renewables

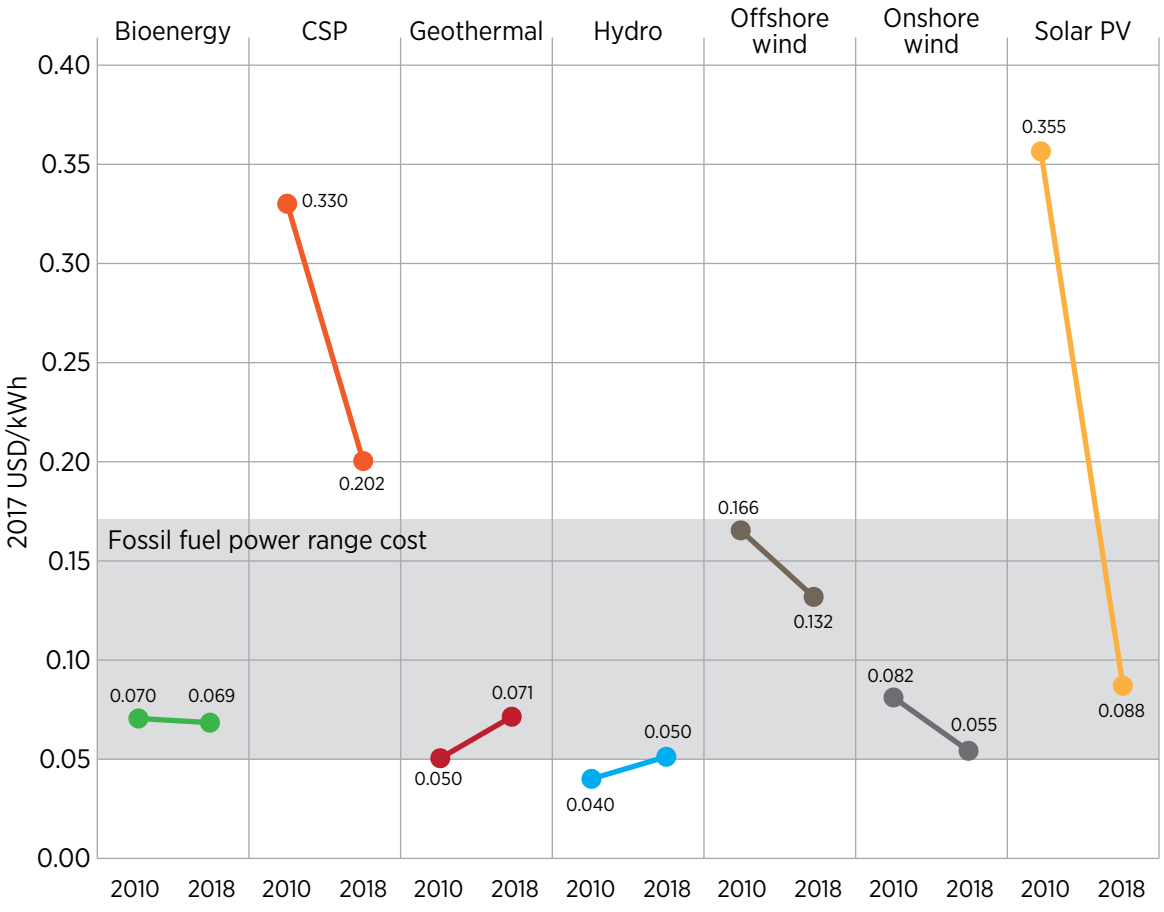
Renewables have grown at unprecedented rates over the past decade, with new records being set each year. An increasing number of countries have committed to those developments, too. In 2016, at least 176 countries had renewable energy targets (IRENA, IEA and REN21, 2018).

The most spectacular changes have occurred in the power sector, where, since 2012, renewables have outpaced conventional fuels in annual new global capacity additions in electricity production (IRENA, 2018a).

By the end of 2017, the global installed capacity of renewables amounted to 2 179 gigawatts (GW), representing more than 29% of the world's total power generating capacity. The bulk of this renewable capacity was from hydropower (53%), followed by wind power (23%) and solar power – mostly solar photovoltaics (PV), at almost 18%. Between 2010 and 2017, the global installed capacity of solar PV increased almost ten-fold and onshore wind almost three-fold (IRENA, 2018a).

Thus, the business case for renewables today is stronger than ever, with many technologies achieving spectacular cost reductions. Indeed, the average costs of utility-scale solar PV and onshore wind declined by 73% and 22%, respectively, between 2010 and 2017 (IRENA, 2018b).

Figure 11. Global levelised cost of electricity from utility-scale renewable power generation technologies, 2010-2018



Source: IRENA (2019)

Table 2. Share of renewable energy in gross final energy consumption, by sector (%)

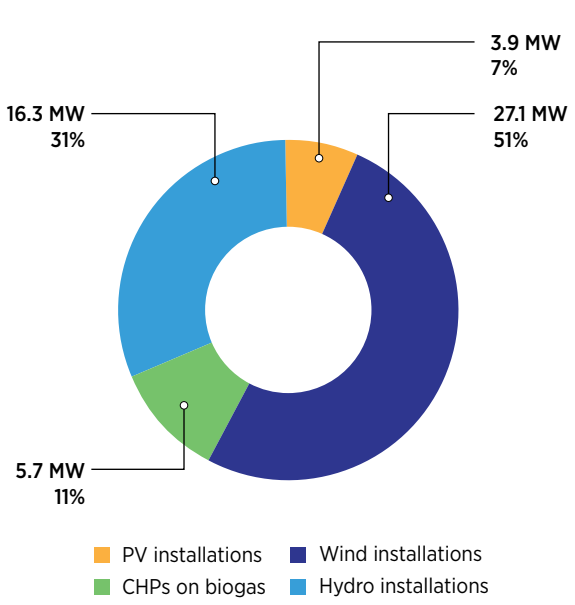
Year	2010	2011	2012	2013	2014	2015	2016	2017	Target
Electricity	6.9	4.4	4.0	1.7	1.9	2.0	2.0	2.2	10
Heating and cooling	34.4	36.1	39.0	39.9	43.6	44.5	45.5	46.1	27
Transport	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	10
Total renewable energy	**21.3**	**22.0**	**24.3**	**24.4**	**26.1**	**26.2**	**26.9**	**27.8**	17

Source: MoEI (2018c)

In the power sector, the most-used renewable energy technology is wind, with an installed capacity of 27 MW, followed by CHP using biogas and almost 4 MW of solar PV (see Figure 12). The Republic of Moldova also has one, 16 MW hydropower plant, constructed in the late 1970s.

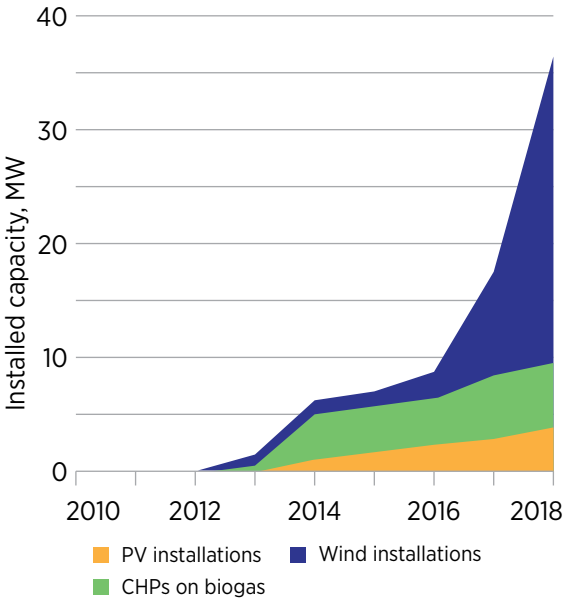
The deployment of non hydro renewables had been growing slowly since 2012, but it accelerated greatly in 2016 (see Figure 13). This was due to investors seeking to obtain support before the new law on the promotion of the use of energy from renewable sources came into force in March 2018.

Figure 12. Installed renewable energy capacity, by source (as of March 2018)



Source: MoEI (2018d)

Figure 13. Dynamics of renewable energy growth



Source: MoEI (2018d)

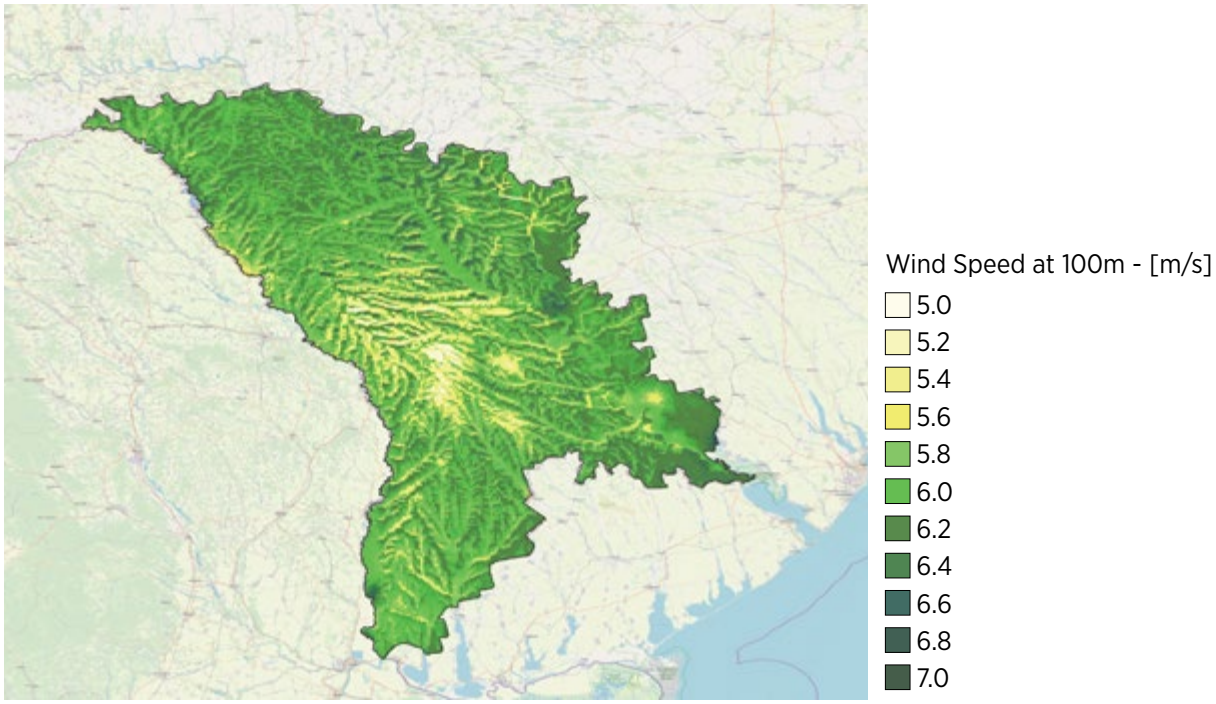

Photograph: Shutterstock

Wind

Wind is the most abundant renewable energy source in the Republic of Moldova, with almost the entire country offering technically suitable locations for wind power investments (see Figure 14). Moreover, as identified in the 2017 IRENA report, *Cost-competitive renewable power generation: Potential across South East Europe*, wind can provide up to 21 GW of power capacity, much of which could be deployed with the levelised cost of electricity (LCOE) below 90 EUR/MWh. This is the level up to which the potential is considered by the report to be cost-competitive (see Box 4) (IRENA *et al.*, 2017).

With 27 MW currently installed, wind is the most widely used renewable energy technology in the Moldovan power sector. This is based exclusively on second-hand turbines imported from European countries. With a new support regime (see Section 3.2), up to 100 MW of new wind capacity is expected in the coming years. Further developments are also considered for industry self-consumption purposes.

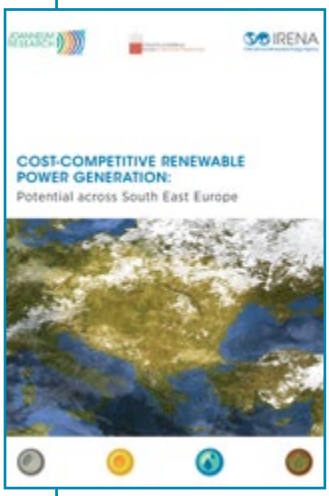
Figure 14. Wind potential in the Republic of Moldova



Source: IRENA, Global Atlas; map data: Risø DTU (2018); base map: OpenStreetMap (2018). Available at: http://irena.masdar.ac.ae/?map=103
Disclaimer: Boundaries and names shown on this map do not imply any official endorsement or acceptance by IRENA.

Photograph: Shutterstock

Box 4. Cost-competitive solar PV and wind potential in South East Europe

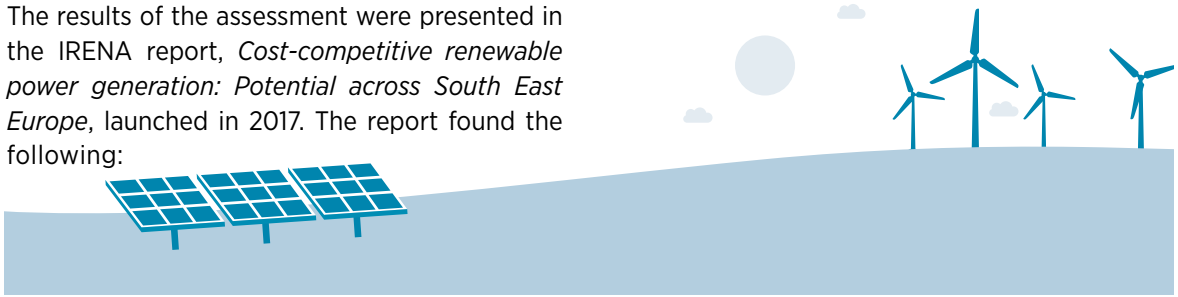


IRENA's Global Atlas is the largest initiative to assess renewable energy potential on a global scale. The platform hosts over 2 000 renewable energy maps, covering solar, wind, bioenergy, geothermal and marine energy, including several high resolution maps.

In 2016, the tool was used to conduct a suitability analysis and to map investment opportunities for wind and solar PV in South East Europe. Six dimensions were taken into account to identify these areas: resource intensity, distance to power grids, population density, land cover, topography and altitude, and protected areas.

The results of the assessment were presented in the IRENA report, *Cost-competitive renewable power generation: Potential across South East Europe*, launched in 2017. The report found the following:

- Vast technical renewable energy potential exists in the region, amounting to 739 GW. Wind energy is the most abundant resource in the region, with an overall technical potential of over 532 GW, more than four times that for solar PV.
- 126.9 GW of the region's overall renewable energy potential could be implemented in a cost-competitive way today. This is almost 17% of the identified technical potential and is also 15 times higher than the 8.2 GW of planned total capacity additions required by National Renewable Energy Action Plans from 2016 until 2020.
- The additional cost-competitive potential could be even higher (above 290 GW), if low-cost capital was available. In total, by 2030, the additional cost-competitive potential of solar PV and wind will equal 620 GW.



Note: The study covers: Contracting Parties of the Energy Community (Albania, Bosnia and Herzegovina, Kosovo*, Montenegro, the Republic of Moldova, Serbia, the former Yugoslav Republic of Macedonia, and Ukraine); and member states of the European Union (Bulgaria, Croatia, Romania and Slovenia).
Note that this designation of Kosovo* is without prejudice to positions on status and in line with the United Nations Security Council Resolution 1244 (1999).

Bioenergy

The Republic of Moldova is known as an agricultural country with a significant biomass potential. Thus, bioenergy is the most popular renewable energy source in the country and remains a priority for the government. Almost all biomass is used in a traditional manner, though – as firewood and agricultural waste, typically consumed for heating purposes, especially in rural communities.

In 2010, the annual potential of solid biomass was assessed at 21 042 terajoules, or 503 ktoe (UNDP, 2010). This figure, sufficient to cover 18% of national energy needs, no longer seems to be accurate. In 2017, the consumption of biomass totalled 733 ktoe (NBS, 2018).

Pellets and briquettes – burned in highly efficient boilers or stoves – represent just 3% to 5% of biomass use, according to the Energy Efficiency Agency. At the same time, limited developments have occurred in the power sector, with less than 6 MW of bioenergy capacity installed so far. Actions towards promoting the use of liquid biofuels in transport were also only initiated recently.

Box 5. Republic of Moldova Energy and Biomass Project

Over the last decade many development partners supported the Moldovan authorities in replacing coal- and gas fired boilers, as well as basic stoves, with biomass heating units that burn straw, pellets, briquettes and firewood.

One of the most important projects in this regard was the Energy and Biomass Project, financed by the European Commission and implemented by UNDP. This aimed to increase the use of energy from biomass sources and laid the basis for establishing functional markets for biomass technologies. Furthermore, it envisaged the creation of jobs and value-added chains at the local and regional levels through the supply of biomass fuel and technologies (UNDP 2018a, UNDP 2018b).

With a total budget exceeding USD 28 million, within its first phase (2011-2014) and second phase (2015-2018), the project provided support for the installation of biomass-based heating systems in more than 250 buildings – mostly schools, kindergartens and medical facilities. Moreover, almost 1000 small residential boilers were installed thanks to subsidies for renewable energy heating. Overall, the installed capacity of equipment during this period was 41.2 megawatts-thermal.

In addition, the project resulted in:

- Promotion of the use of bioenergy and increased awareness and social acceptance.
- Vocational training for biomass boilers operators and foresters.
- Launch of the Biomass Energy Cluster and the Bioenergy Association.
- Creation of a web platform to connect biomass energy producers and consumers.
- Several companies assembling and manufacturing biomass boilers.
- Inauguration of public-private partnerships for the provision of bioenergy services.
- Accreditation of the first testing laboratory for the physical and chemical parameters of biofuels (see Figure 15).

Figure 15. The Solid Biofuel Laboratory at the State Agrarian University of the Republic of Moldova

Source: UNDP (2017)

The deployment of biomass continues to provide employment opportunities as well. Existing efforts are oriented towards strengthening the newly created industry of producing solid biofuels (briquettes and pellets), which already ensures about 400 new jobs in rural areas and had an assessed turnover of USD 6 million to USD 8 million in 2017. According to the Energy Efficiency Agency, this market is driven by 155 MW of heat-only boilers that run on biomass, with 67 MW installed in the public sector and approximately 88 MW in the residential sector.

The Ministry of Economy and Infrastructure also aims to promote the energy crop production industry. This priority stems from the fact that consumers prefer to use wood biofuels for energy, instead of less efficient straw and other residues, even though the country's level of forest cover is only about 12%.

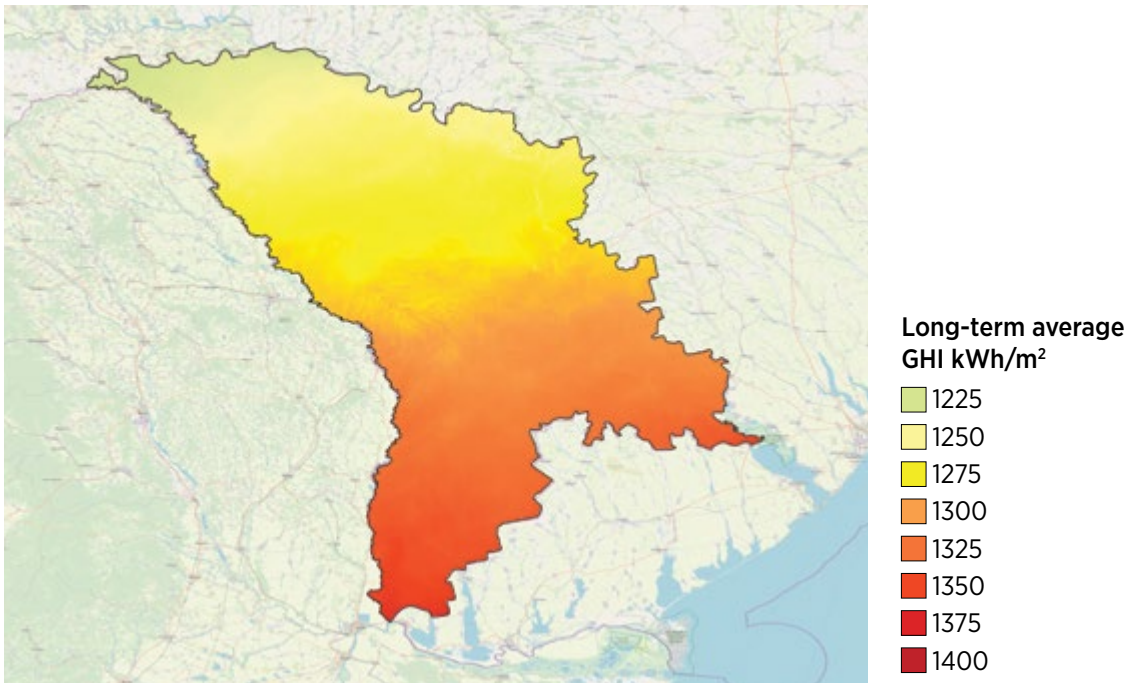
Solar

The Republic of Moldova has experienced limited development of solar PV in recent years. Only 50-plus small projects, mostly rooftop solar, have been implemented during the last five years, with a cumulative capacity of almost 4 MW. Solar PV could provide up to 4.5 GW of capacity, however, more than 20% of which (1 GW) was considered already cost-competitive in 2016. This meant that it had an LCOE below 90 EUR/MWh, if attractive financial conditions were provided.[12] The other 80% would become cost-competitive by 2030 (IRENA *et al.*, 2017).

The public sector remains the leader in using solar energy for hot water production. Through the Energy and Biomass Project (see Box 5), 30 public institutions benefited from the installation of solar water heaters, with these complementing existing biomass boilers. Another 15 projects in the public sector were financially supported by the Energy Efficiency Fund.

Installing solar water heaters, especially in public institutions with high hot water demand, such as hospitals and kindergartens, proved to provide cost savings; thus, the public sector plays an exemplary role in promoting wider exploitation of solar heating potential.

Figure 16. Global horizontal irradiation in the Republic of Moldova



Source: IRENA, Global Atlas; map data: World Bank S map (2018); base map: OpenStreetMap (2018). Available at: http://irena.masdar.ac.ae/?map=3103.
Disclaimer: Boundaries and names shown on this map do not imply any official endorsement or acceptance by IRENA.

12 Weighted average cost of capital (WACC) = 8%

Hydropower

Despite its large number of rivers, the Republic of Moldova has only one reservoir hydropower facility, a 16 MW plant located in Costesti on the Prut River, the second most important river in the country. In addition, 254 kilowatts (kW) of small hydropower installations are in operation (ANRE, 2017).

The best areas for development are located in the Dniester, Prut and Danube river basins, with the country's total potential estimated at 3.36 terawatt-hours per year (Ceban, 2015). As envisaged by the Energy Strategy 2020, some mini-hydro stations, totalling 1.2 MW in capacity, were planned for the Raut River, close to the village of Tribujeni in the Orhei district (UNECE, 2009).

Geothermal

The geothermal energy resource potential of the Republic of Moldova has been poorly investigated, with no comprehensive quantified estimate existing. Nevertheless, the country has significant availability of low enthalpy geothermal potential, especially in the southern part of the country, which could be widely used by heat pumps. The government's focus on this technology is limited, with no actions envisaged in the National Action Plan for Renewable Energy. The Energy Efficiency Agency, however, has identified four operational geothermal installations, with a total installed capacity of 142 kW (EEA, 2016).

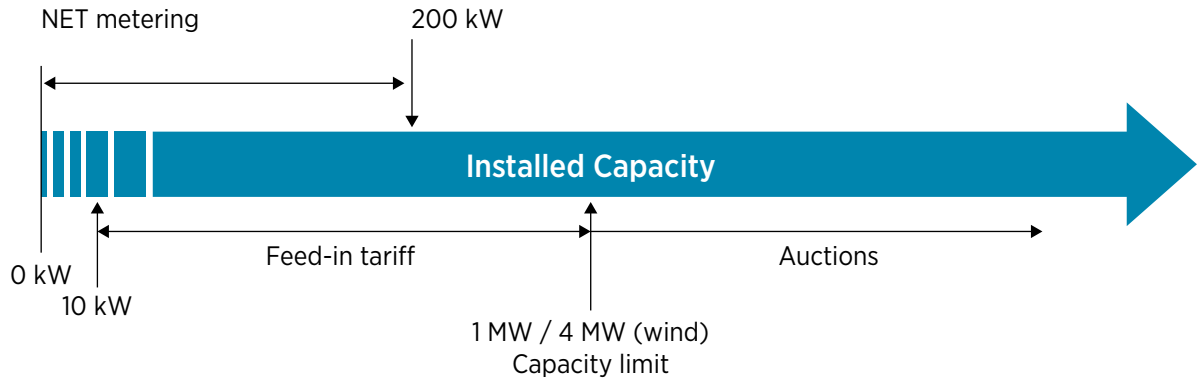
3.2. Renewable energy support mechanisms in the power sector

Until March 2018, power generation from renewable sources was supported by the Renewable Energy Law of 2007 (No. 160-XVI of 12.07.2007). The law envisaged the cost-plus principle.[13] Under this, ANRE issued a tariff for 15 years – based on the actual eligible costs incurred – only after the investments had been made. In addition, the regulator had the right to adjust the tariff to regional benchmarks, if they were lower. This approach was not sufficient to attract investments in the sector and was therefore revised.

The Law on the Promotion of the use of Energy from Renewable Sources (Law No. 10 of 26.02.2016), came into effect in March 2018 in the form of a tariff-based scheme and net metering. The law also provided the necessary guarantees for investments, including: non-discriminatory grid connection; priority dispatch; and an obligation for the central electricity supplier to purchase all-renewable-generated electricity for 15 years. In addition, the new market-based scheme promotes competition among investors, as it envisages auctions for projects above 4 MW in the case of wind and 1 MW for other technologies. At the same time, the law supports the development of small-scale, community-promoted renewable energy projects.

Figure 17 represents the support mechanisms under the 2016 law.

Figure 17. Graphic representation of the support mechanisms in the Republic of Moldova



Source: MoEI (2018a)

13 Tariffs are calculated based on project costs plus a relevant return.

Net metering and community-based projects

Net metering has been introduced to encourage project owners who cover their own electricity consumption with small, renewable-based generation units of up to 200 kW capacity. Any excess, calculated in a one-year accounting period, can be sold on at the average wholesale market price.

In addition, the Ministry of Economy and Infrastructure and the Energy Efficiency Agency are extensively promoting the concept of renewable energy projects driven by local communities, in order to increase the use of distributed generation. Despite ongoing efforts to promote the concept of community self-sufficiency, mainly by sharing European best practices, the country has not yet experienced any such developments.

Feed-in tariffs

Administratively set feed-in tariffs for small installations (those with capacities below 4 MW in the case of wind and 1 MW for other technologies) will be issued by ANRE using a first come first served principle. In 2017, ANRE approved a methodology (Decision No. 375 of 28.09.2017) for determining those tariffs but some of its elements are subject to revision.[14] The total capacity of those projects benefitting from feed-in tariffs is assumed to be 55 MW.

Auctions (competitively set tariffs)

The introduction of capacity auctions, tentatively scheduled for 2019, is considered the most important change in the renewable energy sector.

As presented in Table 3, the government aims to organise technology-specific tenders for a total capacity of 113 MW, which will guarantee fixed tariffs for 15 years. The scheme has been designed in line with the EU Guidelines on state aid for environmental protection and energy for 2014-2020, which are mandatory for the Contracting Parties of the Energy Community. In addition, IRENA, the Energy Community Secretariat and the European Bank for Reconstruction and Development (EBRD) have jointly developed Guidelines for Contracting Parties of the Energy Community, which provide insights in this regard (see Box 6).

Table 3. RE capacity quotas under the new supporting scheme

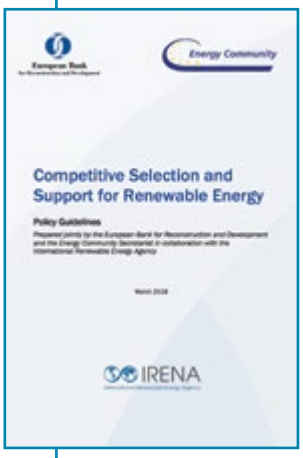
#	Type of technology	Quotas (MW)		Threshold for small installations
		Classic feed-in tariff	Auctions	
1	Wind	20	80	4
2	Solar PV	15	25	1
3	Biogas installations	12	8	1
4	CHP installations (on solid biomass)	5	–	1
5	Small hydro	3	–	1
	TOTAL	**55**	**113**	**–**

Source: Based on Government Decision no. 689 of 11.07.2018

14 It also sets out a methodology for determining ceiling prices for auctions.

Source: MoEI (2018c)

Box 6. Policy Guidelines on Competitive Selection and Support for Renewable Energy

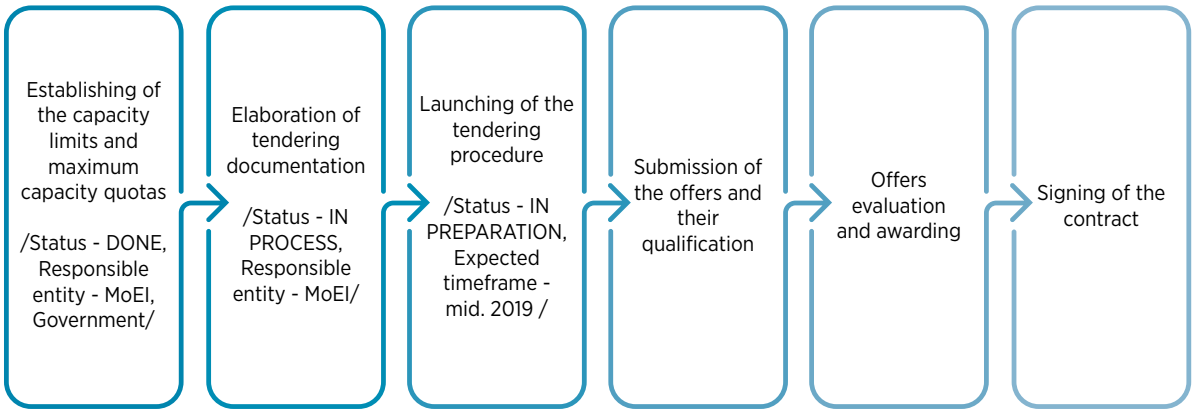


In March 2018, the Policy Guidelines on Competitive Selection and Support for Renewable Energy were prepared jointly by the EBRD and the Energy Community Secretariat, in collaboration with IRENA (ERBD *et al.*, 2018).

Intended for countries of the Energy Community Treaty that are also EBRD countries of operation, these Guidelines build on IRENA's *Renewable Energy Auctions: A Guide to Design* (IRENA and CEM, 2015). They provide recommendations for governments in four areas of auction design: the competitive process framework; procurement choices; selection process choices; and the delivery mechanism for renewable energy support.

Guidelines are already being used in the policy work of the EBRD and the Energy Community Secretariat. In Albania and the former Yugoslav Republic of Macedonia, EBRD is using the guidelines to assist local authorities. In Ukraine, the guidelines are informing discussions on the policy framework for supporting renewables. In the Republic of Moldova, EBRD has recently initiated its efforts to support the country in designing renewable energy auctions for onshore wind and solar PV, including preparation of the required tender documentation.

Figure 18. Key steps in a tenders' development



Source: Based on Government Decision no. 690 of 11.07.2018

The recently approved regulation on tendering (Government Decision No. 690 of 11.07.2018) provides an initial framework for organising auctions that grant "eligible producer" status on large investors. This is done through the establishment of unequivocal, objective, transparent and non-discriminatory procedures, conditions and criteria.

Under the new regulation, development of the renewable energy auctions will be carried out in compliance with the steps presented in Figure 18. Additional tendering documentation and an auctions calendar are yet to be prepared by the national authorities.[15]

Auctions will be carried out by the Tendering Commission, which comprises representatives of: the Ministry of Economy and Infrastructure, the Ministry of Agriculture, Regional Development and Environment, the Agency of Land Relations and Cadastre, the Energy Efficiency Agency, and the Public Property Agency. Any bid that meets the pre-

15 As of December 2018.

qualification criteria presented in Figure 19, including bids put forward by foreign developers, is eligible to participate in the auctions. The criteria include issues related to land, financial credibility, technical credibility and connection to the grid. They have been established to ensure that only those with a genuine intention to implement the project are admitted to the procedure.

The selection procedure is to be held based on the lowest price criterion, provided that:

- This is below the ceiling price to be determined by ANRE.
- The proposed capacity is within the quota for each technology set out by the government (see Table 3).
- New equipment is to be used.[16]

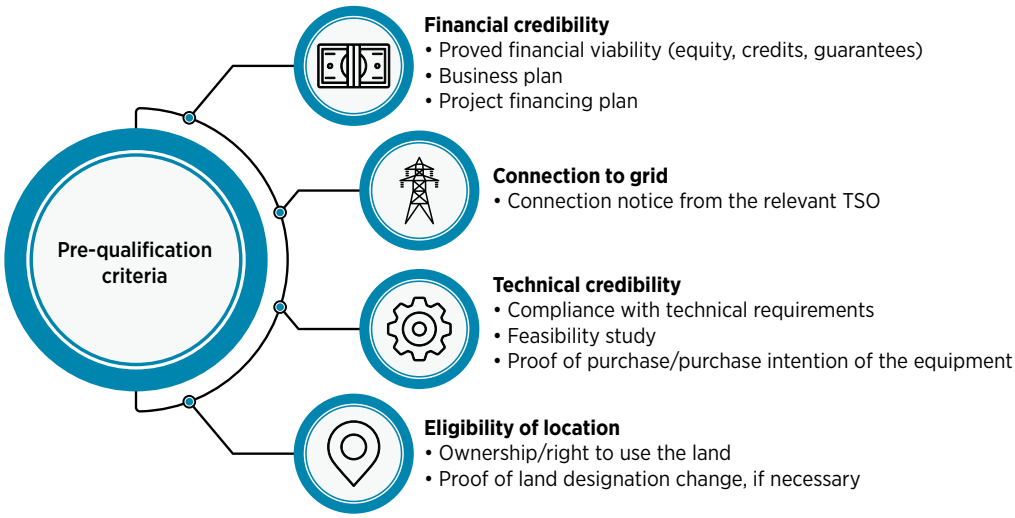
Moreover, potential investors are obliged to submit the proposal's guarantee together with the offer. This is specified in the tender documentation as a fixed amount per 1 kW of specific technology, equal to 0.2% of the capital investment cost used by ANRE in the methodology used to set the ceiling price. The proposal's guarantee shall be provided in the form of a guarantee letter provided by a financial institution.

An additional guarantee needs to be submitted to the Tendering Commission within 30 days by the winner of a tender to ensure delivery of the commissioned electricity. Such a guarantee, at a fixed amount per kW, is not to exceed 2% of the value of the capital investment cost used by ANRE in the methodology used to set the ceiling price. Once selected and granted with the status of eligible producer, an investor will have 36 months to finalise its power plant.

The key development steps for renewable energy projects/business in the Republic of Moldova are specified in Annex. Key development steps for renewable energy projects

In addition to the pre-qualification criteria, renewable energy investors must be aware that the total capacity of all the projects developed by an investor using the same technology will also be taken into account while issuing feed-in tariffs. If the total capacity exceeds the capacity threshold provided in Table 3, participation in a tender will be required in order to benefit from the support scheme. Similarly, in the case of increasing the capacity of an existing power plant, its cumulative capacity will be taken into account. Those rules also refer to an investor's spouse, relatives and affiliated persons (up to the second degree).

Figure 19. Pre-qualification criteria



Source: Based on Government Decision no. 690 of 11.07.2018

16 Manufactured no more than 48 months before the start-up of the power plant.

3.3. Financing of renewable energy

Most of the renewable energy projects in the Republic of Moldova were financed by multilateral development banks or bilateral development agencies, or were self-financed by the private sector. Examples of the first source of funding include the EBRD, the European Investment Bank (EIB), and the World Bank Group, while examples of the second include the Swedish International Development Cooperation Agency and the Japanese International Cooperation Agency (JICA). Private sector funding was used mainly in the case of biogas and solar.

While some of these partners provided grants for the financial products developed in collaboration with local commercial banks, others set up credit lines to support both renewables and energy efficiency. For example, the EBRD's financing tools, implemented together with BCR Chisinau, Moldova Agroindbank, Moldindconbank, ProCredit Bank and MobiasBanca, include:

- MoSEEFF – the Moldova Sustainable Energy Efficiency Financing Facility. With a total budget of EUR 42 million, this aimed to support the use of renewables by local enterprises. Solar was one of the focus areas, and a diverse range of projects was implemented through the programme, from a 100 kW rooftop power plant installed on an agriculture warehouse, to a 500 kW solar PV farm installed on the grounds of a carpet manufacturer.

- MoREEFF – the Moldova Residential Energy Efficiency Financing Facility. This had a total budget of EUR 35 million and targeted the residential sector during the period 2012-2017.

In addition, the Republic of Moldova is one of the beneficiaries of the Green Climate Fund (GCF) EBRD Sustainable Energy Financing Facilities programme. This is set to direct USD 1.4 billion to financing facilities with local financial institutions in Armenia, Egypt, Georgia, Jordan, the Republic of Moldova, Mongolia, Morocco, Serbia, Tajikistan

Planting the energy willow, Orhei Professional School, Orhei
Photograph: UNDP Moldova

and Tunisia, in order to support renewable energy, energy efficiency projects and climate adaption measures (GCF, 2017).

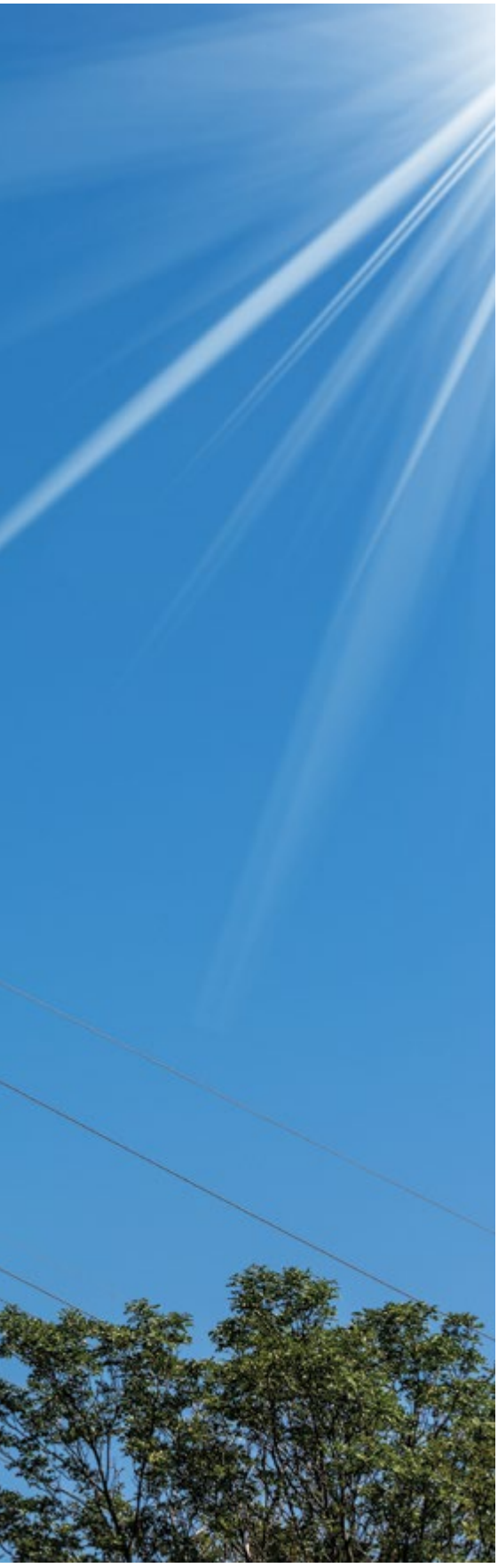
Meanwhile, the local financial sector still does not offer adequate financing options for renewables, with the exception of a few banks with foreign capital that have dedicated financial products for renewable energy projects.[17] The limited number of financial institutions open to this field results from the unavailability of low-cost capital and the high-risk perception of such projects. The lack of understanding of renewable energy technologies leads to the broad perception of renewables as being very innovative and prone to failure, which has led to high interest rates from capital providers.

The continuous involvement of international players, however, is expected to advance the uptake of renewable energy sources and to ensure that all investors, including small ones, that are interested in the new support mechanisms will be in a position to prove their financial credibility. Already, Moldelectrica has issued more than 30 connection permits with a cumulative capacity of about 1000 MW for new renewable energy projects.

Yet, the preparatory costs related to the pre-feasibility stage and permitting, amongst other factors, are considered to be at a level that can limit the appetite of investors for the Republic of Moldova. Thus, given the condition of the local financial sector, only larger companies have sufficient financial resources to initiate project development. Small and medium sized enterprises with scarce finances are exposed to a high risk of failure in the completion of a project. Some support is provided by the Energy Efficiency Fund and international financial institutions, but this is often insufficient to increase the participation of those entities in the renewable energy market.

17 Procredit, Mobiasbanca.

Wind turbine and transmission lines
Photograph: Shutterstock



Challenges and recommendations

Over the past few years, the Republic of Moldova has stepped up efforts towards developing renewable energy sources. The decade-long activities to develop the solid biofuel sector, as well as the recent adoption of the new support schemes for renewable electricity, have contributed greatly to the rising interest of the business community.

Additional efforts are necessary, however, to cement the foundations of the sector. The sections below outline the main challenges hindering more accelerated deployment of renewable energy and the corresponding recommended actions to address them. These have been identified via a multi-stakeholder consultative process along with the RRA implementation, described in detail in Chapter 1.

4.1 Long-term planning

The Republic of Moldova is poorly endowed with conventional energy resources and thus highly dependent on imported energy. Only around 25% of primary energy consumption is supplied through indigenous resources, with more than 98% of this biomass, used mostly for heating in rural areas.

As identified in the IRENA report, *Cost-competitive Renewable Power Generation: Potential across South East Europe* (IRENA *et al.*, 2017), the country has abundant renewable energy sources. With more than 27 GW of technically suitable potential, those resources could be widely deployed to help achieve two key objectives of the Energy Strategy by 2030: to ensure the security of energy supply; and the sustainability of the energy sector.

With the costs of renewables falling rapidly over the past decade, these technologies offer cost-competitive energy supply solutions in an increasing number of countries, worldwide. The trend is set to grow, too, as technological innovation continues to drive the next generation of cost declines.

Current efforts to raise renewable power capacity beyond the 2020 target also confirm the government's recognition of the importance of the ongoing energy transition, in enabling the country to improve its energy security. Additional policy and regulatory actions are required to solidify the role that renewable energy could play in addressing the key energy challenges in the country. In this context, the following recommended actions can be considered:

- **Adopt a renewable energy target for 2030**

  Since the renewable energy target of 17% by 2020 has already been overachieved, it neither provides long-term predictability, nor reflects the country's vision of energy sector development. The fact that the current share of renewables (27.8%) was reached mainly through the revision of biomass consumption data adds another level of uncertainty. Although the announced development of 168 MW of renewables capacity in the coming years has captured the interest of several investors, this could be considered a one-off boost to the market, rather than an element of a solid strategy.

  Therefore, the ongoing activities undertaken by the Ministry of Economy and Infrastructure, as well as the discussions within the Energy Community, are undertaken with a view towards agreeing on a new renewable energy target for 2030. IRENA's recently initiated regional REmap analysis for the countries of Central and Southeast Europe, including the Republic of Moldova, would contribute to these efforts and help identify cost-effective technology options for the deployment of renewables in the power and end-use sectors. The future long-term framework for renewables could also emphasise the important role that distributed generation across the country can play in consolidating the national power system.

- **Conduct a production cost modelling study**

  Renewables are becoming an increasingly cost-competitive source of energy in the Republic of Moldova and are poised to play a greater role in the national power system.

  From a technical perspective, some research studies indicate that the system could absorb around 1 GW of renewables – a level almost equal to the maximum load, which reaches 1100 MW (Gropa, 2017). The increased use of solar PV and wind technologies, however, would present a new challenge, as the country completely relies on Ukraine for balancing its generation. Thus, the country should carry out a production cost modelling study to determine any potential operational constraints that could result in the unavailability of sufficient power to meet demand.

  This study, including economic dispatch, would allow investigation of multiple scenarios for the generation mix, including those with higher shares of renewables, as well as any other policies and sensitivities. The modelling normally covers one year – with a higher time resolution to provide more insights on operational cost impacts – and aims to ensure that the system load is supplied entirely and most economically. The analysis would also address the issue of ancillary services and balancing, which are becoming increasingly important with the deployment of intermittent renewables and the increasing availability of distributed generation.

  The results could help build confidence among policy makers, system operators and investors, as well as identify the most cost-effective option for balancing the system. The study should consider the ongoing efforts to ensure interconnection and asynchronous operation with Romania, expected within the next four to five years, as well as the plans of the governments of the Republic of Moldova and Ukraine to ensure synchronous operation with ENTSO-E, in the long run.

  To support countries in assessments of power system flexibility, IRENA and the VTT Technical Research Centre of Finland Ltd. have developed the FlexTool. This analyses not only the traditional concept of flexibility (concerning, for example, flexible thermal and hydropower generation with high ramping capability and very low start-up time), but also other innovative technologies that enrich the concept of flexibility. These include flexible demand, energy storage and sector coupling. The FlexTool is capable both of analysing system operations using a time step that represents real-world challenges (an hour or less in the case of VRE variability) and of carrying out long-term analyses and proposing possible flexibility solutions in a hypothetical future system with high VRE penetration (IRENA, 2018c).

4.2 Regulatory environment for renewable power investments

Until March 2018, the development of renewable energy capacity in the power sector was supported by tariffs issued by ANRE. These were calculated for each individual project, after the investment was done, based on the actual eligible costs incurred. This lack of revenue predictability before the completion of a project, combined with the administrative and bureaucratic challenges reported by stakeholders, failed to ensure an attractive environment for significant uptake of renewables, over the last decade. Only 52 MW of renewable capacity had been installed by March 2018.

While the methodology developed by ANRE intended to ensure that investment costs are recovered through a tariff provided for 15 years, investors have questioned some of its assumptions. For instance, while the regulator assumed a capacity factor of 0.25 for wind, which is relevant for new turbines, almost all units imported by local owners could reach capacity factors of only 0.17—0.18. In consequence, discrepancies in cash flow projections between investors and ANRE led to dissatisfaction with the issued tariffs. Moreover, as raised by the business community, exclusion of some expenditures was not clearly justified.

With the recent introduction of the new support regime, ANRE will be responsible for setting feed-in tariffs for small-sized projects, up to 4 MW for wind and 1 MW for other renewable energy sources. In this context, the authorities can consider the following recommendations:

- **Strengthen the enabling regulatory framework**

  The Law on the Promotion of the use of Energy from Renewable Sources (Law No. 10 of 26.02.2016) has been in force since March 2018, although additional pieces of legislation are still under preparation to ensure smooth implementation of the support schemes. Clarity on all requirements and procedures to be followed needs to be ensured well in advance for both project developers and financial institutions. Successful efforts in this regard will guarantee confidence in the government as a reliable partner in the development of renewable energy projects and will maintain the interest of the investor community. In this context, the government is expected to:

1. Adopt essential secondary legislation,[18] including: on standard documentation for the tendering procedure; on eligible producer status confirmation (for small renewable electricity producers); and on grid connection, including provisions referring to the integration of renewables.

2. Implement the methodology used to calculate feed-in-tariffs and ceiling prices for tenders in a transparent manner. All key elements of the methodology should be made public, including investment cost per MW/technology, capacity factors, and operation and maintenance costs.

3. Ensure that all the elements of auction design, including standard documentation, are in line with the EU's 2014 Guidelines on State Aid for Environmental Protection and Energy and with international practices. A joint Policy Guidelines on Competitive Selection and Support for Renewable Energy, prepared by the Energy Community Secretariat and the EBRD, in collaboration with IRENA, provides insights in this regard (EBRD *et al.*, 2018). Among other aspects, issues need to be addressed in relation to: the technical and human capacity of a committee responsible for the administration of auctions; and the establishment of an effective dispute resolutions centre.

4. Facilitate the introduction of the net metering scheme for distributed renewable energy generation. Despite the legislative framework in place, the mechanism is not widely used, due to the lack of clear rules for distribution system operators, insufficient understanding of the mechanism among local commercial banks, and the structure of subsidised electricity prices.

18 As of December 2018. In addition, the recently approved regulation on tendering (Government Decision no. 690 of 11.07.2018) provides an initial framework for organising auctions that grants an "eligible producer" status to large investors through the establishment of unequivocal, objective, transparent and non-discriminatory procedures, conditions and criteria.

- **Streamline administrative procedures and facilitate their enforcement**

  The lack of effective co-ordination among different actors hinders the deployment of renewable energy in the country. As a result, the private sector highlights some procedures as too costly and lengthy, or even catalogues them as an administrative burden. To ensure better harmonisation, the Ministry of Economy and Infrastructure is advised to initiate a dialogue with the Ministry of Agriculture, Regional Development and Environment, the Ministry of Finance, and Moldelectrica to clarify and simplify such procedures. This effort could be part of the forthcoming revision of the National Renewable Energy Action Plan and the development of an integrated National Energy and Climate Plan, and may include the following aspects:

  1. Land use designation

  The national Land Code (Law No. 828-XII of 25.12.1991) envisages the use for agriculture purposes only of sites/land parcels with a Soil Potential Index exceeding 60 points.[19] As a consequence, most of the areas with abundant wind resources might not be available for the construction of renewable energy power plants, due to their status as agricultural land, despite the vast economic feasibility associated with the renewable energy business in such areas. Even with the presence of wind farms, however, land can fulfil other functions, such as agriculture: only some 10% of such land is occupied by wind power equipment, while the remaining 90% is available for grazing or cultivation. Moreover, a power plant could generate additional income for land owners and taxes for local municipalities.

  2. Environmental impact assessment

  The perception of stakeholders in the sector is that current procedures, in particular assessments of the social and environmental impacts of a new power plant, are too lengthy. The relevant national authorities are not seen as having sufficient capacity to issue permits in a timely manner. Therefore, strengthening capacity and optimising internal procedures, with the support of external technical assistance, if necessary, could ensure that the legally set time frame and other requirements are respected. In particular, efforts should be focused on the practical implementation of the provisions of the EU's Directive 2014/52/EU on the Assessment of the Effects of Certain Public and Private Projects on the Environment, adopted by the Republic of Moldova in October 2017, including the arrangements for early and effective opportunities for public participation (EnC, 2018).

  3. Taxation

  Incentives of a customs and fiscal nature are envisaged in the legislation,[20] to ensure additional support to wind and solar PV investments. These incentives include reduced customs fees at import, exemption from value-added tax on installation work and other inputs for renewable energy projects. Yet, some of the relevant provisions are considered unclear by both the investor community and the authorities responsible for implementation. In particular, specific technologies and sizes of projects are not treated in a coherent way. For example, a project with only one wind turbine does not correspond to the "wind park" definition, according to the interpretation of the Moldovan Fiscal Service. Thus, a univocal understanding of those provisions has to be ensured, either by amendment of the legislation, or by elaboration of a fiscal practice to be followed by the national fiscal authorities. Furthermore, any future changes in tax legislation should be introduced with a sufficient *vacatio legis*[21] to enable adaptation of the business models used by investments already under development.

19 The Soil Potential Index, or SPI, is a calculation which rates soil on a scale of 0-100 points based on its capability to produce crops. For example, a rating of 10 would indicate a soil poorly suited to growing crops, while a rating of 95 would mean top quality soil with virtually no impediment to crop production.

20 Law No 172 of 25.07.2014 on the Approval of the Combined Nomenclature of Goods and The Fiscal Code of the Republic of Moldova, No. 1163 of 24.04.1997.

21 Latin, meaning "absence of law". Refers to the period of time between a law's promulgation and it taking effect.

4. Grid connection permits

Approximately 1 GW of renewable energy projects, mostly wind, have received grid connection permits in the last few years, with the transmission system operator now refusing to issue such permits to additional investors, due to concerns about grid stability. In fact, however, only projects awarded in the upcoming auctions are likely to be implemented. As a result, an increased volume of issued permits, even exceeding 1 GW, would not necessarily affect stability of the grid. As a permit is required to take part in forthcoming renewable energy auctions, the approach of Moldelectrica appears to be to limit future competition to the investors already present in the Republic of Moldova. The credibility and the outcome of the auctions could therefore be severely undermined and, thus, a solution should be found to enable the issuance of grid connection permits to new potential renewables investors.

4.3 Bioenergy

The Republic of Moldova is an agricultural country with significant biomass potential, with bioenergy contributing greatly to the achievement of the current 27.8% share of renewables in gross final energy consumption. Almost all biomass is firewood and agricultural waste, used in a traditional manner. When combined with the widespread use of inefficient technologies and the illegal cutting of firewood, this constitutes a challenge for policy makers, as the level of forest cover is very low, at only about 12%.

At the same time, national stakeholders increasingly recognise that marginal and depleted lands represent a potential for energy crop plantations. A comprehensive assessment of total bioenergy potential, including that related to energy crops, has not been developed. The only estimation provided so far has identified limited energy potential from agricultural residues.

Over the last decade, the country has intensified its efforts to develop a bioenergy sector and market, with a focus on solid biofuels. With the assistance of development partners, many coal- and gas fired boilers, as well as inefficient stoves, have been replaced by biomass heating units burning straw, pellets, briquettes and firewood. Nevertheless, the sector requires further effort to ensure co-ordination and allocation of resources, in order to develop a proper market that would facilitate communication between suppliers of raw material and producers of fuels. The currently existing trade and information portals created within the framework of the UNDP Energy and Biomass project have not been sufficient to establish an effective market with stable demand and supply sources. A comprehensive approach to the bioenergy sector, including biofuels, has never been developed. In this context, several key steps are recommended:

- **Develop a strategy for the bioenergy sector**

  With limited availability of wooden biomass, the country needs to manage the sector in a sustainable manner. A deep and comprehensive inventory of all forest areas, as well as marginal and depleted lands, could be established to ensure an accurate estimation of the biomass potential that could constitute a basis for a country-wide programme for the use of solid biofuels.

  In particular, the potential for the cultivation of energy crops can be further considered. With an estimated 38 000 hectares available for growing both woody and herbaceous biomass, the Republic of Moldova could develop the local raw material industry in a short period of time. The strategy, however, would need to be based on a detailed analysis, determining the most promising energy crops, the most feasible locations within the country, and the types of soil where the crops have the highest yields.

  In addition, the strategy could address many of the challenges that the energy crop sector currently faces, including land conversion issues, land suitability and the availability of financial support. In this context, the government could analyse the opportunity to revise the relevant legislation with the objective of increasing the role of local public authorities in promoting the bioenergy sector, including energy crops. As the owners of a vast amount

of land, those authorities could strengthen their commitment to developing the local industry and would benefit from locally harvested, cost-competitive heating resources; public institutions in more than 250 communities in the country use biomass boilers for heating purposes. More common use of public-private partnerships and inter-municipal co-operation would also facilitate development of this sector.

Finally, the programme should build on a comprehensive assessment, providing clarity on the most suitable technology for each potential group of beneficiaries. As raised by stakeholders, due to a large diversity of raw material, as well as different consumption profiles, there is a lack of understanding of the available options. Some failures to match beneficiary and technology have turned out to be costly in the past. Thus, the analysis should consider: all types of properties; different groups of beneficiaries; several technologies, such as organic Rankine cycle (ORC), pyrolysis, Stirling, and steam mini turbines; and different consumer profiles. This exercise will help determine different business models for using biomass as a sustainable alternative – including in district heating – and provide clear recommendations for implementation, based if possible, on successful pilots.

- **Encourage the use of and further develop the online platform for biomass trade**

  A major challenge for the sector is the lack of proper communication and exchange among actors in the biomass market, even though a dedicated online platform was recently launched. The limited use of this tool causes considerable disruption to the value chain, as suppliers of raw material and producers of fuel struggle to find effective communication channels – and as final beneficiaries face problems in identifying reliable sources of biomass fuel. The country is advised to actively promote the platform and to encourage potential users to increase trade in all types of biomass, taking into account factors such as price, quality, region of origin and transport. With the expected development of the energy crop industry, widespread use of such a tool is even more necessary.

  The online platform could also facilitate the market operation and entry of new fuel suppliers, including producers of agriculture residues and local public authorities, as well as enhance fuel price competition and supply liquidity. In addition, this platform can offer a source of information on the benefits stemming from the use of bioenergy and be a repository of available opportunities for local consumers to switch to this source of energy. This type of bridge between biomass producers and potential customers would contribute to more stable and increasing demand. Furthermore, the platform could be further developed based on best practices in biomass exchange platforms, including the experience of Lithuania in the development of the Baltpool biomass exchange (Energypost, 2017).

- **Identify an optimal pathway to increase the role of biofuels**

  The country has committed to reach a 10% share of renewables in the transport sector by 2020, but no actions have been taken so far to promote the use of liquid biofuels. At present, the widespread perception that the country lacks suitable areas to grow sugar cane and rapeseed continues to hinder development in this area. In addition, with no infrastructure in place to cultivate such crops, adaptation costs for the existing infrastructure would decrease the competitiveness of locally produced liquid biofuels against imports, opponents say.

  There is, however, a clear understanding of the need to find an adequate approach to ensure more sustainable use of energy sources in this sector. An assessment is therefore recommended, in order to identify an optimal pathway towards the use of biofuels in transport. The options currently under discussion include: full reliance on domestic production; import of bioethanol and biodiesel; or a combination of the two options, in light of the local production potential and price affordability. The results of the assessment could provide a clearer indication of the potential way forward for the biofuels sector.

4.4 Financing of renewables

Most of the existing renewable energy power plants in the Republic of Moldova were supported by financing lines and programmes launched by development partners. This is because local commercial banks are cautious about investing in this sector, due to their high-risk perception of renewable energy projects, partly owing to their limited understanding of the technology.

In addition, the country's financial and banking sector is comparatively small, with limited resources. Frequent problems in the financing sector, evidenced by the collapse of three large banks, have affected the banking sector's activities in general. Hence, scaling up renewable energy investment under the new policy support environment may be challenging, as the financial sector may have difficulty in providing funding for the investments needed to achieve a total capacity addition of 168 MW.

Cost of capital is critical for the financial viability of projects, yet, local commercial banks' products may not match the specific requirements of capital-intensive renewables projects, even though these banks are becoming highly interested in this sector. The loans offered tend to be short term and at a high interest rate. Further strengthening of the related regulatory framework, particularly in those areas that strongly affect the bankability of renewable energy projects, would increase financial institutions' confidence in the market.

- **Improve the bankability of renewable energy projects**

  Under the project financing scheme, renewable energy projects are considered bankable only when lenders are confident that the expected revenue stream of the project can ensure the repayment of the loan, as per the terms of the lending agreement. Despite recent efforts by the government, the current framework is not perceived as sufficient, as it seems to expose potential investors to several risks. Therefore, additional actions are required to improve the bankability of renewable energy projects, including:

  1. Enhancement of the templates of the key project documentation, including the power purchase agreement (PPA), to provide the guarantees and predictability necessary to the stakeholders involved. This would include, among others, the following essential elements: an obligation to offtake renewable electricity; balancing obligations and costs; liability for non-compliance; payment security instruments; the transfer of obligations to a new central supplier; liability for unplanned disconnection from the grid; arbitration clauses; and a stated duration for the agreement.

  2. Procedure for transparent assignment of the central electricity supplier, as the mandate of the current one is due to expire on 1 January 2021. In case of a change of the central supplier, a smooth transition needs to be ensured allowing the transfer of all obligations to the new entity without impeding existing PPAs. A change of the off-taker increases the actual and perceived risks faced by potential investors.

  3. Design a procedure for the transfer of all existing renewable energy producers to the support system, with this based on a contract for difference, which is envisaged to be implemented when the electricity market (day-ahead and intra-day markets) is declared liquid by the regulator.

- **Enhance the capacity of local banks to facilitate the financing of renewable energy projects**

  While large-scale renewable power plants can access the necessary financial resources from abroad – through the contributions of either foreign investors or international financial institutions – small-scale projects are limited to funding opportunities from the local financial market. The total cost of planned small-scale renewable energy projects to be supported through the feed-in tariff (for a total of 55 MW) has been assessed to amount to approximately EUR 50 million. Additional capacity could also be introduced through net metering projects of up to 200 kW. The availability of financing for such projects, however, may be obstructed

by the limited knowledge of the renewable energy sector and poor understanding of the support mechanisms among local lenders who appraise projects. Thus, technical support in, for example, developing bankable project proposals and in structured finance principles, including project finance, can increase the capacities of local commercial banks. This support could be facilitated by international financial institutions that are well placed to provide such technical assistance. In addition, aside from long-tenor concessional loans provided at below commercial rates to local financiers, international financial institutions, such as development finance institutions (DFIs), can utilise hybrid, on-lending and syndication structures to facilitate a more active involvement from local investors. Such structures include:

1. Mezzanine finance, whereby a DFI's claim is subordinated to senior debt (provided by the local financier), but still senior to equity claims on project cashflows.

2. On-lending structures, whereby DFIs can use their high credit rating to borrow internationally at low rates and then on-lend the funds to local financiers via credit lines, at lower rates than such financiers would otherwise face.

3. Syndications (or co-financing) with local financiers to help spread the risks and returns. This would also spread knowledge of renewable energy financial structuring among a wider group of capital providers. DFIs should be careful not to displace (*i.e.*, crowd out) the local private sector, or distort the market, but to instead act to crowd-in local investors and hence kick-start the local market.

Finally, public capital, including that provided by the DFIs, could be used to help de-risk or lower the risk of renewable energy projects. This would lower the cost of capital for renewables, via the provision of risk mitigation instruments. Such instruments could include: partial risk guarantees for uncertain grid access; credit guarantees to lower the power off-taker non-payment risk; liquidity facilities to bridge short-term cash flow problems; and currency hedging instruments, to name but a few.

4.5 Public awareness

Due to technological developments and rapidly falling costs, renewables are a viable energy choice for a growing number of countries, cities, companies and households. The deployment of renewable energy is also an effective tool to fuel economic growth, create new employment opportunities, enhance human welfare and contribute to a climate-safe future. Renewables are already a significant source of new employment, with renewable energy jobs standing today at 10.3 million, worldwide. Only a limited number of stakeholders in the Republic of Moldova, however, are aware of the socio-economic benefits that renewable energy can offer.

As the use of biomass for heating is perceived positively in the country and has allowed the development of a significant number of local businesses around this sector, the most advanced efforts to increase public awareness have occurred in the field of bioenergy. Nevertheless, more needs to be done to increase the public acceptance and use of renewable energy to facilitate its long-run development.

- **Develop a national communication strategy on renewable energy sources**

  Public awareness is necessary to influence political decisions on strategies for the country's future development. A national strategy is needed to raise awareness and boost understanding of renewable energy sources and their benefits across the Republic of Moldova. This would also help consumers make more informed decisions regarding energy supplies and benefit from the opportunities offered by the sector.

  The strategy should address several stakeholders, including state authorities, civil society, the banking community and donors. It could envisage necessary actions to ensure proper ways to disseminate the most up-to-date information on renewables and the ongoing energy transition (*e.g.*, a dedicated website, with translations of authoritative publications into local language). It could also improve the curriculum of schools and universities to reflect the growing role of renewables. At the same time, intensified government communication efforts on ongoing legislative changes would be beneficial for stakeholders. This is especially so for local financial institutions, as they prepare the relevant mechanism to finance renewable energy projects.

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Annex. Key development steps for renewable energy projects in the Republic of Moldova

No.	Renewable energy power plants with capacity of 5 MW and higher for public consumption and 20 MW and higher for internal use	Renewable energy power plants with capacity below 5 MW for public consumption and below 20 MW for internal use
	Key development steps	
1	**Establishing the business** Competent institution: Public Services Agency Other institutions involved: National Commission for Financial Market (only in the case of Joint Stock Companies), State Tax Service of the Republic of Moldova	
2	**Registration of property rights** Competent institution: Public Services Agency Other institutions involved: State Property Agency	
2.1	**Change of land destination from agricultural land to land for construction purposes** Competent institution: Government of Moldova or Local Public Administration Other institutions involved: Central or local public authorities, Design Institute for Territorial Planning, State Environmental Inspectorate of Moldova, General Inspectorate for Emergency Situations, National Public Health Agency, Public Services Agency	
3	**Urban Planning Certificate for Design Documentation** Competent institution: Local public authority Other institutions involved: National Public Health Agency, Agency for Environment (Protection), General Inspectorate for Emergency Situations, Design institute "Urbanproiect"[22] or "Chișinăuproiect"[23]	
3.1	**Technical conditions for connection to utility networks** Competent institution: All responsible utility companies (water supply and sewage, electrical, gas, heat, telecommunications distribution networks and other utilities) Other institutions involved: Local public authority	
3.2	**Networks Routing Plan** Competent institution: Local public authority Other institutions involved: Not applicable	
3.3	**Topographical study and geotechnical prospecting** Competent institution: Licensed institutions Other institutions involved: Not applicable	

22 For all localities except Chisinau city.

23 Only for Chisinau city.

No.	Renewable energy power plants with capacity of 5 MW and higher for public consumption and 20 MW and higher for internal use	Renewable energy power plants with capacity below 5 MW for public consumption and below 20 MW for internal use
	Key development steps	
3.4	**Environmental Permit/ Environmental Impact Assessment**[24] Competent institution: Agency for Environment (Protection) Other institutions involved: Not applicable	
4	**Detailed designing** Competent institution: Licensed institutions Other institutions involved: Not applicable	
4.1	**Detailed design verification and approval** Competent institution: Agency for Technical Supervision, chief architect from the local public authority and experts or institutions authorised for verification of design documentations Other institutions involved: State Environmental Inspectorate, National Public Health Agency	
5	**Construction authorisation** Competent institution: Local public authority Other institutions involved: Agency for Technical Supervision, Agency for Environment (Protection)	
6	**Obtaining the fixed price or fixed tariff**[25] Competent institution: Government of Moldova, ANRE Other institutions involved: Not applicable	
6.1	**Approval to build a new renewable energy power plant with capacity above 20 MW and increase in capacities above 20**[26] Competent institution: Government of Moldova, Ministry of Economy and Infrastructure Other institutions involved: Not applicable	Not applicable
7	**Communication of construction works launch** Competent institution: Agency for Technical Supervision Other institutions involved: Agency of Inspection and Restoration of Monuments	
8	**Power plant construction** Competent institution: Licensed company Other institutions involved: Not applicable	

24 Thermal power plants, industrial and heating boiler plants with capacity of 300 MW and above; complex hydrotechnical structures (ports, big dams and water storage facilities); industrial sewage and wastewater treatment facilities in urban and rural areas, with a discharge of 10,000 cubic metres per day and higher; waste treatment and incineration plants; any construction activity in river basins, within river and water basin protection areas; power transmission lines with a voltage level of 330 kV and higher, wind farms with a height bigger than 20m, etc.

25 The difference between "fixed tariffs" and "fixed prices" supporting schemes is being determined by the power plant capacity and capacity limits set by the Government through its decision no. 689 as of 11.07.2018

26 According to a MoEI initiative on amending national legislation related to power generation, launched in 2018, renewable energy project developers that won the tender receive the government approval mentioned at pt. 6.1 automatically (ex officio).

No.	Renewable energy power plants with capacity of 5 MW and higher for public consumption and 20 MW and higher for internal use	Renewable energy power plants with capacity below 5 MW for public consumption and below 20 MW for internal use
	Key development steps	
9	**Connection to power transmission or distribution network** Competent institution: Power transmission and/or distribution company Other institutions involved: Not applicable	
10	**Testing and acceptance** Competent institution: Beneficiary/Investor Other institutions involved: ANRE, Agency for Technical Supervision, National Public Health Agency, State Environmental Inspectorate, Power Transmission or Distribution Company, Local Public Authority, General Inspectorate for Emergency Situations, Designing Institution, Construction Licensed Company, National Bureau of Statistics, Territorial State Tax Inspectorate, Central Electricity Supplier	
11	**Power generation licence** Competent institution: ANRE Other institutions involved: Not applicable	Not applicable
11.1	**Signing of the electricity supply contract** Competent institution: Central Electricity Supplier Other institutions involved: Not applicable	
11.2	**Licence registration with the system operator**[27] Competent institution: Power transmission company Other institutions involved: Not applicable	Not applicable
12	**Entering into force of the electricity supply contract and into operational phase** Competent institution: Central Electricity Supplier Other institutions involved: Not applicable	

Source: MoEI (2018d)

27 Moldelectrica, which holds the license for electricity transmission and dispatch services in the Republic of Moldova.

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