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Study

Resource Efficiency Gains and Green Growth Perspectives in Moldova

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- The energy sector in Moldova faces several problems: strong dependence on energy imports, out-dated technology and high historical debts. For further development, access to the trans-European electricity grid and gas pipelines is necessary.

- In order to advance green growth in Moldova, measures need to be taken to raise public awareness of environmental topics and the transparent use of public financial resources, to promote and display best practice cases and to develop special financial solutions for environment-friendly production. There are still many obstacles for a green economy: the national market for efficient technologies remains small, the overall economic situation is still fragile, energy efficiency measures are often stigmatised as a luxury. The social aspect of energy prices is a problem as well as a reluctance to take responsibility for political action.

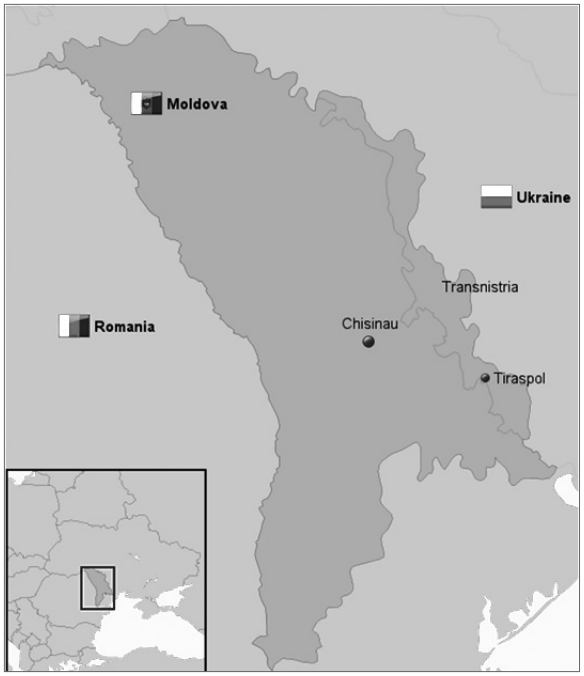
- Although CO_2 emissions in Moldova have dramatically declined over the past decade, the main potential for green growth is still the improvement of energy efficiency and energy saving. Further potential sectors for green growth are renewable energy, agriculture and the food industry.

Content

1. Current situation

Moldova is a landlocked country in Eastern Europe. It is located between Romania in the west and Ukraine in the east and therefore borders the European Union. Not only because of its geographic location, but also because of its cultural heritage the country is divided in its political intentions between seeking closer relations with the EU and historical communion with Russia and eastern partners. Furthermore, internal political weaknesses create obstacles to sustainable economic development.

Figure 1: Map of Moldovia



Source: stepmap.de

Another barrier is the still unsolved conflict concerning Transnistrian territories. Formally, they are considered Moldovan, but the economic and legislative standards are different. The Transnistrian government focuses only on cooperation with Russia, whereas the national government is open to several options, especially cooperation with the European Union.

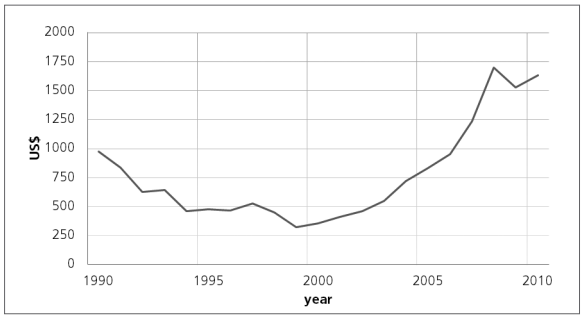
1.1 Economy

According to the World Bank, Moldova is the poorest country in Europe (Worldbank, 2012), even Iraq and the Philippines have a higher GDP. Average GDP per capita is around USD 1,630 per year, by far the lowest in the region. An overview of the development of the GDP since independence from the Soviet Union in 1990 is presented in Figure 2.

After the political changes in 1990 GDP decreased dramatically, from around USD 1,000 to roughly one third. Since 2000 it has increased slowly, reaching its maximum in 2008 before the global financial crisis hit, although its influence on Moldovan incomes was minor.

The country is in an economically challenging phase and still has to overcome some remnants of its Soviet heritage.

Figure 2: GDP per capita in US$ between 1990 and 2010



Source: World Bank

The main sector generating income is, according to CIA estimations for 2010, the service sector with 63.8 per cent; industry accounts for 20 per cent and agriculture for 16.3 per cent (CIA, 2012). Compared to the European Union the income generated in industry and the service sector is a bit lower and the income from agriculture a bit higher. This indicates that Moldova is strongly dependent on agriculture. Data on the labour force underline this: 40.6 per cent of the labour force works in agriculture, 16 per cent in industry and 43.3 per cent in service sector (CIA, 2012). These numbers also show the inefficiency that characterises agriculture: four out of ten Moldovans work in agriculture, but the sector produces only one-fifth of GDP.

According to official statistics the unemployment rate is 5.3 per cent (National Office for Statistics of the Republic of Moldova, 2012), which is very low. The av-

erage monthly salary in 2011 was 3,145 lei, a 5.8 per cent increase on 2010. The lowest average income was obtained in agriculture, the highest in real estate, communication and finance. Moldova has a good primary education system, the literacy rate is 98 per cent and 93 per cent of the population complete primary education; enrolment in secondary education is only 80 per cent, however. This points to weaknesses in the education system regarding professional training and higher education (Worldbank, 2012). Both genders are equally represented throughout the education system.

Moldova's external trade balance is highly negative. Coverage of imports by exports is 40 per cent (National Office for Statistics of the Republic of Moldova, 2012). Exported goods include food, textiles and machinery, imported goods comprise mineral products and fuel, machinery and equipment, chemicals and textiles. Coal, oil and fuel and natural gas are imported almost 100 per cent, electricity imports account for 28.9 per cent of supply.

Natural resources are lignite, phosphorite, gypsum, arable land and limestone.

1.2 Consumption

As stated above, Moldova is highly dependent on imported energy sources. According to the International Energy Agency, only 4 per cent of the used energy sources originate in Moldova. This weakens national economic development as security of supply is strongly dependent on sources abroad and pricing negotiations.

The energy sector in Moldova faces several problems: strong dependence on the import of natural gas, oil and oil products, outdated technology for the generation and distribution of electricity and high historical debts. Furthermore, many district heating systems work inefficiently and are badly maintained.

The accumulated gas debts require long-term solutions. Legislation in November 2008 cancelled intercompany debts and in early 2010 the Concept on Energy Sector Restructuring was adopted. The World Bank is helping to resolve these issues. In order to mitigate the rapidly rising prices for imported gas, GoM is attempting to renegotiate the gas transit fees with Gazprom. The accumulation of debts is mainly due to the right bank of the Dnjestru regions.

Because of historical developments, Moldova's energy supply is only partly connected with other countries, mainly Ukraine and Russia. In recent years the development of grid connections to Romania have been in focus: at the moment, an electricity route to the Romanian border is under construction.

For further development, access to the trans-European electricity grid and gas pipelines is necessary. This points to the urgency of establishing regulations to facilitate market liberalisation and international competitiveness.

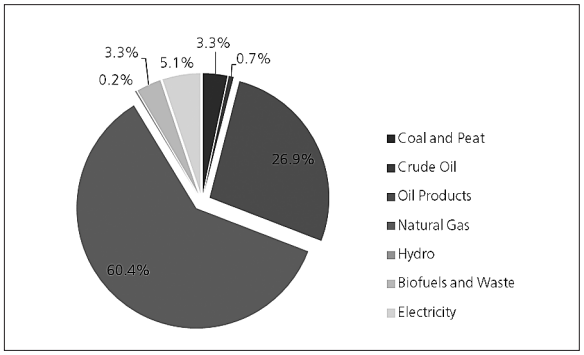
Energy intensity in Moldova is 1.24, meaning that 1.24 tonnes of oil equivalent are used to produce USD[1] 1,000 of GDP. This is more than seven times the energy used in the EU to produce the same amount of GDP. The Moldovan energy mix generates CO_2 emissions in the amount of 2.91 kg CO_2/USD (EU 0.38 kg CO_2/USD) (International Energy Agency, 2012). This also demonstrates the high potential for energy efficiency measures and climate neutral development.

The major sources of energy are natural gas (60 per cent) and oil and oil products (26.8 per cent). Moldova has no exploitable resources in either. Coal and electricity are also imported, the only locally available resources are waste and biodegradable matter and some small sources for hydropower. Almost no use is made of renewable sources of energy; at most, there is only small private consumption.

In Figure 3 total energy supply by source of energy is displayed. The biggest share is that of natural gas, provided by the Russian natural gas monopolist Gazprom. In recent years natural gas prices have increased dramatically. At the beginning of 2010, the official price per 1000 m³ of natural gas was 3,592 lei; after a number of increases the current tariff is 5,044 lei (since September 2011). This makes an increase of 40 per cent since the beginning of 2010. This price increase is one step towards cutting Moldova's accumulated debt with Gazprom. It can be assumed that in the near future even higher prices are necessary to reduce the debt. Part of imported natural gas is used for electricity production and district heating, so that gas prices also influence electricity prices.

1. USD standardised for the year 2000.

Figure 3: Total primary energy supply by source



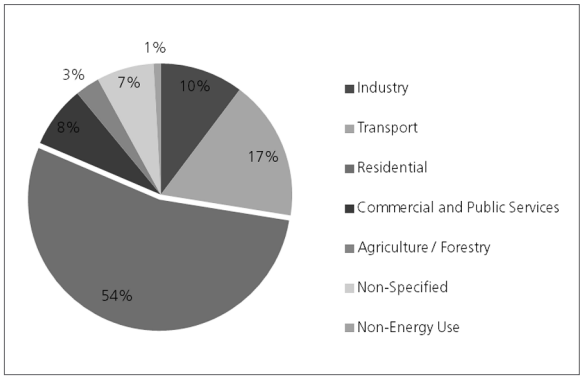
Source: International Energy Agency Statistics, 2012

Dependence on Russia is also very high with regard to oil, as most imports of oil originate from there. The prices for oil products increased by 25 per cent between 2009 and 2010 (National Regulatory Agency , 2012). The main oil products are gasoline and diesel for transportation.

Imported coal is used mainly for the production of electricity. Moldova has minor lignite resources, which were exploited during Soviet times, but at the beginning of the 1990s exploitation ceased due to the high costs.

Figure 4 illustrates energy consumption by sector. More than half of all energy is used in the residential sector, mostly as electricity and gas for heating; district heating is also part of this.

Figure 4: Energy consumption by sector



Source: International Energy Agency Statistics, 2012

As the residential sector is by far the biggest consumer, the potential for efficiency measures is largest there too. Many residential buildings were constructed during Soviet times or even earlier. Efficiency measures were not an issue. Therefore, most buildings have neither insulated walls, nor insulated roofs or modern efficient double glazed windows and doors. The same applies to electricity usage. In some cases electricity is used for additional heating.

In the transport sector, efficiency has not yet been promoted; for example, many cars and trucks would not meet EU requirements concerning dust concentration in exhausts. Public transportation is based on trolley buses or minibuses with diesel engines. In Chisinau the public transport company modernised a proportion of its bus park in 2011. Mini-buses also operate as public transport for medium distances throughout the country.

Access to water is possible in the whole country, however in rural areas that often means an unprotected well in the neighbourhood. Good and healthy water quality cannot be guaranteed in all areas. According to official data 90 per cent of the water supply is consumed in urban areas by industry and households; 89 per cent of sewage is treated conventionally (National Office for Statistics of the Republic of Moldova, 2012). These numbers reflect only urban areas; in rural areas, household connection to the public water supply is not possible (58.8 per cent of the population live in rural areas (Worldbank, 2012)). Many of the rural population have to use wells and springs for their water supply. Sewage treatment is also not common in rural regions throughout Moldova.

Concerning quantity and treatment/recycling of waste almost no data are available. In 2010, 2.36 million m³ of domestic waste were collected (National Office for Statistics of the Republic of Moldova, 2012). The amount of hazardous waste was 1,125 tonnes in 2009 (UNData, 2012). Further treatment is not documented. As there are only a small number of waste treatment facilities, it can be assumed that almost all the waste is dumped without prior treatment. However, there are some local collection points for glass or cardboard. Deposit systems for bottles or cans are lacking, however. In summer 2011 special dump boxes for plastic bottles were introduced in Chisinau.

Greenhouse gas emissions in Moldova were 1.31 tonnes of CO_2 per capita in 2008 (UNData, 2012). This is very low, due to the low level of industrialisation. Estimates of greenhouse gas emissions vary widely, depending on the

organisation publishing them. According to the Moldovan authorities (Ministry of Environment and Natural Ressources, 2009) in 2005 the figure was 11883 Gg CO_2 eq. (= 11.9 million metric tonnes of , while UNData (UNData, 2012) speaks of 4.9 million metric tonnes of CO_2.

1.3 Legislation

Moldova has several codes of law referring to land, subsoil, water and forest. Furthermore, several laws deal with protected areas and environmental protection in general, while others are more specific, dealing, for example, with air pollution or waste and waste disposal. A detailed list of all laws and secondary legislation can be found on the website of the Ministry of the Environment of the Republic of Moldova (Ministry of Environment of Republic of Moldova, 2012).

International agreements have set up the basic foundations for the structure and operation of the various segments of the Moldovan energy market and climate relevant legislation. More specifically, on 17 December 1994 the Republic of Moldova signed the Energy Charter Treaty, which was ratified on 10 June 1996 and entered into force on 16 April 1996. Moreover, in April 2009 negotiations were concluded on the Energy Community Treaty and in December 2009 the Energy Community Ministerial Council approved Moldova's accession to the Energy Community. On 23 December 2009, the Moldovan Parliament passed Law No. 117-XVIII on Accession to the Energy Community Treaty of the Republic of Moldova.

Following the enactment of new gas and electricity laws by the Moldovan Parliament in December 2009, the Accession Protocol was signed in March 2010 and on 1 May 2010 the Republic of Moldova became the eighth full member of the Energy Community. As part of its obligations pursuant to its membership, the Republic of Moldova is required to ensure compliance with the EU legislation pertaining to the Energy Community and to meet the deadlines laid down in the Accession Protocol and the 2009 Law on Accession to the Energy Community Treaty.

The Republic of Moldova signed the United Nations Framework Convention on Climate Change (UNFCCC) on 9 June 1995 and ratified the Kyoto Protocol on 22 April 2003. Moldova has submitted its Second National Communication Report to the UNFCCC, which contains information on national circumstances, priorities and envisaged steps, such as mitigation measures to implement the Convention. A national climate strategy is also in the process of preparation, while significant steps have been taken to facilitate the work of the National Commission on implementation of the UNFCCC and the Kyoto Protocol. Moldova is also in the process of developing Clean Development Mechanisms (CDM) projects and to date four such projects have been registered at the United Nations. Moreover, the country associated itself with the Copenhagen Accord and has provided information to the UNFCCC on actions that it plans to implement (Pitsas, 2011).

As in the case of other aspects of energy the first legislation is already in place. Secondary legislation and bylaws are partly enacted.

Primary legislation already in place includes the following:

- Law on natural gas
- Law on electric energy
- Law for completion and modification of a set of legislative acts for the consolidation of the institutional capacities of the National Agency for Energy Regulation
- Law on energy efficiency
- Law on renewable sources of energy

However, the targets of the Energy Community Treaty have still not been met in full. Secondary legislation and normative acts are less developed. However, institutional capacities are weak. Capacity and institutional development are desperately needed.

In 2007, the Government of Moldova approved the Energy Strategy until 2020, which lays down the directions of development for the energy sector, identifies the main actions, the parties in charge and financial sources, and also sets the 20 per cent energy efficiency improvement target till 2020.

The main direction of Moldova's energy strategy is to enhance security of its energy supplies and to ensure quality

and affordable energy supply to all consumers. The main strategic objectives towards achieving this goal are:

- diversification of the country's primary energy sources, suppliers and supply routes;
- improvement of energy efficiency;
- development of local energy resources, with emphasis on renewable energy sources.

The first of the above objectives implies, among other things, integration of the country's energy system in the European system. In addition, meeting all strategic objectives requires attracting investment from both international financing institutions and private entities into the energy sector. To achieve these aims, the state must create a stable, legal, regulatory and economic climate conducive to private investment and in line with European rules and conditions.

In this context, joining the Energy Community Treaty and the Union for the Coordination of Transmission of Electricity as a full member represents a strategic commitment for Moldova. To join these bodies, a number of technical as well as legal and organisational requirements should be met, to which the Republic of Moldova must commit itself. Foremost among these requirements is the transposition of the entire energy *acquis communautaire* into Moldovan law, a process that is ongoing.

1.4 Government Organisations

Moldova's state energy institutions have been undergoing substantial restructuring since 2000. Initially, the industry and energy fields were coordinated by one ministry. In 2001, as a result of a restructuring process, two separate ministries were created and in 2005 they merged again under the roof of the Ministry of Industry and Infrastructure. In 2008, the latter was dissolved and the Ministry of Economy and Commerce took over responsibility for the energy sector.

- *The Ministry of the Economy* (MoE) is in charge of developing and implementing energy policy in the Republic of Moldova. The main tasks consist of developing strategies and state policies such as the Energy Strategy 2020. Implementation of measures for ensuring energy security is another priority of the MoE. It is also responsible for the development, coordination and implementation of legal and normative acts in this area.

- *The Ministry of the Environment* (MoEN) is in charge of development policies and strategies in the field of environmental protection and economic utilisation of the natural resources. On behalf of the Government of the Republic of Moldova, MoEN is responsible for implementing international environmental treaties to which the Republic of Moldova is a Party (including the UNFCCC, signed by the Republic of Moldova on 12 June 1992, ratified by the Parliament on 16 March 1995, as well as the Kyoto Protocol, ratified by the Republic of Moldova on 13 February 2003). Representatives of MoEN and subordinate institutions also perform the function of the GEF Political and Operational Focal Points, as well as UNFCCC Focal Point.

Further government agencies involved in energy policy in the Republic of Moldova are:

- *The National Agency for Energy Regulation* (ANRE) was established in 1997 as an independent authority to support the introduction of market mechanisms in the energy sector, while protecting the interests of consumers and investors. It issues licenses, regulates fuel and power prices and establishes energy pricing principles and calculation methodology.

- *The Agency for Energy Efficiency (AEE).* The National Agency for Energy Conservation (NAEC) was established in 1994, although as a result of restructuring its activities ceased in 2006. Next year, in July 2007, the Agency was relaunched and renamed the Agency for Energy Efficiency. The legal framework that ensures the basis for its activity consists of the following legal acts:
  - Law No. 160 on Renewable Energy Sources of 12 July 2007;
  - Law No. 142 on Energy Efficiency from 3 September 2010.

Tasked with stimulating investment in energy efficiency and renewables, the Agency offers technical and financial support to public institutions willing to increase the energy performance of their buildings. However, in the long run, an independent financial institution will be created (Energy Efficiency Fund) to respond to the increasing demand of public and private entities to increase the energy performance of their buildings and/or to make

use of renewable energy sources by implementing relevant feasible technologies. According to the MoE work plan for 2012, it is expected to have the fund set up by the end of the current year.

- *The Climate Change Office* of the Ministry of the Environment is focused mainly on climate change issues and environmental projects. The main area of activity of the Climate Change Office is the elaboration, promotion and implementation of national policy on climate change. Priority fields on climate change issues promoted by the Climate Change Office are related to reducing greenhouse gases (GHG) and adaptation to new climate conditions. Furthermore, the Climate Change Office is the national contact point for the Clean Development Mechanism of the Kyoto Protocol.

1.5 Energy-related Organisations

- The *Academy of Sciences of Moldova (ASM).* The Academy, established in 1946, is the main scientific organisation of the Republic of Moldova and coordinates research in all areas of science and technology, including energy.
  - *Institute of Power Engineering of the ASM* is a scientific organisation which performs research works in the field of power end electrical engineering. The main directions of research include: energy security and efficiency of functioning of the power complex of the Republic of Moldova; new technical decisions concerning construction of electric transmission and distribution lines and the equipment for managing regimes of smart energy networks; new methods of calculation of transients and stationary modes of operation in non-uniform circuits (lines) with distributed and lumped parameters; efficient use of electricity and heat; installations and systems for energy conversion from renewable sources. Together with the Ministry of the Economy the Institute of Power Engineering of the ASM is responsible for developing the Energy Strategy 2020.
  - *Coordination Council for the Use of Renewable Energy* is an inter-ministerial entity established by Prime Ministerial Order No. 0919-25 as of 1 January 2006. The Council's task is to promote energy efficiency and renewables in the Republic of Moldova. The Commission is presided over by the President of the Academy of Sciences and includes representatives from key ministries, such as Economy, Construction, Agriculture and Environment, as well as other organisations.
  - *Agency for Innovation and Technology Transfer (AITT)* of the ASM was created by the Supreme Council of the ASM in order to coordinate, motivate and implement the mechanisms of innovation activity and technology transfer.

- *The Carbon Financing Office* was established to strengthen institutional capacity for implementing Law No. 29-XV of 13 February 2003 on the Republic of Moldova's accession to the Kyoto Protocol and for CDM implementation. The objectives of the Carbon Financing Office included the development, monitoring and implementation of new CDM projects.

1.6 Energy Market Framework

The Republic of Moldova is very much dependent on imported primary energy resources (around 96 per cent) and partially on imported electricity. There are no major indigenous resources of fossil fuels and hydro power. The electricity produced locally is insufficient and the excess demand is compensated by imports from neighbouring Romania and Ukraine. In order to lower dependence on imports more active use of renewable energy sources as well as an increase in energy efficiency are essential for Moldova.

Power Sector

Power transmission and dispatch is organised by one state-owned company; there are three distribution companies on the market, four separate generation capacities and 17 suppliers. Prior to the establishment of ANRE a process of unbundling the power sector took place in 1997. The legal, functional and accounting unbundling resulted in the creation of a separate state-owned enterprise that serves as the TSO (Transmission System Operator), provides transmission services and is forbidden to engage in any supply activities. The TSO, MOLDELECTRICA, is a state-owned company that manages the assets of the power transmission system and the dispatch centre. There are three distribution companies, one of which is owned by an international energy group from Spain, Union Fenosa.

Full opening up of the market occurred in March 2005. The wholesale power market is based on a number of bilateral contracts among distribution companies, customers, generators and other power suppliers (traders).

Gas Sector

The gas sector consists of MOLDOVAGAZ, which is a corporate entity owned (50 per cent + 1 golden share) by Gazprom, 35.3 per cent by the government of Moldova, 13.4 per cent by Transnistria and 1.3 per cent by individual shareholders. MOLDOVAGAZ also owns the entire transmission and most of the distribution network in Moldova and acts as the supplier for most customers, an insignificant number being served by some small distributors. Virtually all gas is imported from Russia. The Gas Market Rules were adopted by ANRE in 2005 and they designate MOLDOVAGAZ as the system operator, mandate bilateral contracts, identify the rights and obligations of the dispatch centre and specify that ANRE is the body empowered to resolve disputes arising from application of the market rules. They include no unbundling of MOLDOVAGAZ, nor do they include provisions on Third Party Access or storage.

1.7 NGOs

The technical and financial assistance granted to the energy sector has a long standing tradition in Moldova. It started together with the declaration of independence. The first steps in promoting energy efficiency and renewable energy principles and technologies were taken with the support of different international development actors. They were implemented by local organisations with the required knowledge and skills in the field. Nevertheless, capacity building at national level is still of major interest for all actors and a crucial issue for overall sectoral development. In this sense, only a few organisations can be presented as active and professional in the field.

ProEnRe is an NGO working on the promotion of renewable energy sources in Moldova. Closely related to the Technical University, it conducts research studies on renewable energy sources; lobbying and conducting prefeasibility studies on solar and wind energy projects are also core elements of the organisation's activity.

The Alliance for Energy Efficiency and Renewables (AEER) is a Moldovan NGO founded on 14 May 2007 as a follow-up of the MUNEE programme implemented by the Alliance to Save Energy (an USA NGO), under a US-AID Project implemented during 2001–2007. The goal of AEER is to contribute to the promotion of strategies and policies in the field of energy efficiency (EE), renewable energy resources (RES) and environmental protection.

The Institute for Development and Social Initiatives (IDIS Viitorul) is an independent think-tank and member of several national and international public policy networks. Its main fields of economic research include energy policy. IDIS Viitorul has conducted an assessment of public policy in the gas sector and provided support to Chisinau Municipality in the sustainable provision of heating services.

1.8 National Strategies

In the Priorities for Medium Term Development Report (Rethink Moldova) prepared for the Consultative Group meeting in Brussels dated 24 March 2010 the Government presented its strategic view for achieving its five-pillar reform priorities: European integration, economic recovery, rule of law, administrative and fiscal decentralisation and reunification of the country.

The following statement was formulated as the official position of the government of Moldova[2]: »The Republic of Moldova needs growth for development. Achieving policy objectives in education, public health, social protection and other sectors depend upon how well the country is performing in economic terms. In light of the economic downturn, the model through which growth is a function of high consumption rates in turn fuelled by remittances from abroad has proven unsustainable. The vision of our Government is to re-establish a growth path and at the same time, ensure export and investment led growth. Economic growth is the key factor that enables us to fight poverty and promote human development in a sustainable manner.«

The government's reform programme has the following strategic priorities:

2. Source: http://www.gov.md/doc.php?l=en&id=2774&idc=447

- Infrastructure: rehabilitation and modernisation of infrastructure, including municipal services;

- Energy: focus on energy efficiency, rehabilitation of existing assets and further investments in the sector;

- Industry and agribusiness: focus on creation, expansion, restructuring and modernisation of export-oriented enterprises;

- Financial sector: priorities include support for financial sector development by providing debt and equity financing to both existing and new clients with a view to improving access to funding and expanding the range of financial products;

- SME support programme: Access to credit has always been difficult for SMEs. The government responded with a variety of policy instruments aimed at facilitating access to finance:
  - Interest rate subsidy or partial guarantee of credits provided to SMEs through the state Guarantee Fund managed by the Organisation for the Development of Small and Medium-sized Enterprises;
  - Concessional loans through the National Programme for the Economic Empowerment of Young People (NPEEY);
  - Matching grants for invested remittances (PARE 1+1);
  - Matching grants for implementation of ISO certification;
  - Setting up a network of business incubators and strengthening existing ones to provide SME support infrastructure, to improve SME viability and to encourage more innovation and the introduction of new technologies and know-how, which should result in growing state revenues;
  - Stepping-up procurement of equipment for the creation of small industries in rural areas (pursuant to the mechanism used by the Implementation Unit of the grant provided by the government of Japan).

The development strategy of the Republic of Moldova's energy complex has the following main objectives: finalising the privatisation process and establishing the power market, promoting energy efficiency and energy conservation and ensuring state energy security and environmental protection. The *Energy Strategy* was approved in 2007 and has been developed for the period until 2020. It deals with objectives, measures and activities oriented towards a more efficient, competitive and reliable national energy industry, while ensuring the country's energy security, the upgrading of energy-related infrastructure, improved energy efficiency and the utilisation of renewable energy sources, and its integration into the European energy market. The fundamental principles are based on the following:

- energy supply systems oriented towards serving the needs of the customer;

- improvement of the security of energy supply;

- improvement of energy efficiency;

- increased use of renewable energy sources;

- acceptable environmental impact at the local, regional and global (climate change) levels;

- energy systems that include distributed generation sources;

- selection and implementation of energy technologies based on criteria related to energy efficiency, operational security and environmental impact ;

- reasonable tariffs and the development of a favourable investment climate;

- supporting research and development in the field of new and efficient energy technologies;

- enhancing Moldova's role as an important transit country for electricity and gas.

The National Development Strategy of the Republic of Moldova for 2012–2020, a project under development, is being designed to articulate a vision of cohesive long-term and sustainable economic growth, based on a diagnostic study of constraints to growth. In this regard, it will complement the sectoral approach and outline the objectives that should be achieved for the entire governance period. The draft proposed for public consultation identified the following priorities:

- Aligning the education system to labour market needs in order to enhance labour productivity and increase employment in the economy.

- Public investment in the national and local road infrastructure in order to reduce transportation costs and increase speed of access.

- Reducing financing costs by increasing competition in the financial sector and developing risk management tools.

- Improving the business climate by streamlining the regulatory framework and applying information technologies in public services for businesses and citizens.

- Reducing energy consumption by increasing energy efficiency and using renewable energy sources.

- Financial sustainability of the pension system in order to ensure an appropriate rate of wage replacement.

- Increasing the quality and efficiency of justice and fighting corruption in order to ensure equity for all citizens.

2. Potential

2.1 Carbon Dioxide Emissions

The most important greenhouse gas in the atmosphere is water vapour (H_2O), responsible for approximately two-thirds of the total greenhouse effect. The content of water in the atmosphere is determined by the cycle of water in nature: expressed more simply, as the difference between evaporation and precipitation. Carbon dioxide (CO_2) has a 30 per cent share in the greenhouse effect, while methane (CH_4), nitrous oxide (N_2O) and ozone (O_3) together account for 3 per cent. There are other photochemical active gases, such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) (including substances such as propane, butane and ethane), which influence the formation and destruction of ozone in the atmosphere in the presence of solar rays (ultraviolet radiation) and are considered to be ozone precursors in the troposphere.

Carbon dioxide (CO_2) emissions in Moldova have dramatically declined over the past decade, since Moldova gained its independence. In particular, CO_2 emissions from the use of coal have dropped to almost nothing, while CO_2 emissions from petroleum have dropped to less than 15 per cent of the emissions level of 1992. A summary of CO_2 emissions is shown in Table 2 (on next page.

The energy sector includes emissions resulting from electricity and heat production activities, and fuel combustion for energy generation purposes. This sector has the biggest share in CO_2 emissions and it is approximately three times higher than the emissions generated by the transport sector and more than 10 times higher than the emissions generated by industry. There are several reasons for this, one of the most important being the equipment age of approximately 20–45 years. The installed equipment is of Russian production made at the Barnaul, Belgorod and Taganrog factories between 1951 and 1995. According to the specific fuel consumption level, technologies used in the Republic of Moldova are not as efficient as similar ones used in the rest of the world (for example, the nominal efficiency of the local CHPs is half that of modern installations).

Table 1: International comparison of installed power generation units and their fuel consumption

Installed power of the condensing energy units	**Specific consumption of fuel, g.c.e./kWh**
Russian Federation:	
200 MW	338–350
Germany (Siemens):	
450 MW	254
Republic of Moldova	
200 MW	380–420

Compared to European efficiency levels with regard to energy production, Moldova is far behind the leaders: with existing technologies a minimum 10 per cent improvement in Moldova's power regeneration capacity may bring considerable benefits in terms of reducing CO_2 emissions.

In addition, economic and structural reforms have resulted in a substantial reduction of industrial production, which in turn has resulted in a reduction of energy consumption. The energy efficiency of the industrial sector is low and obsolete technologies and equipment used within some industrial enterprises together with the recession affecting the Moldovan economy led to a declining trend with regard to CO_2 emissions.

The same situation may be observed in the residential

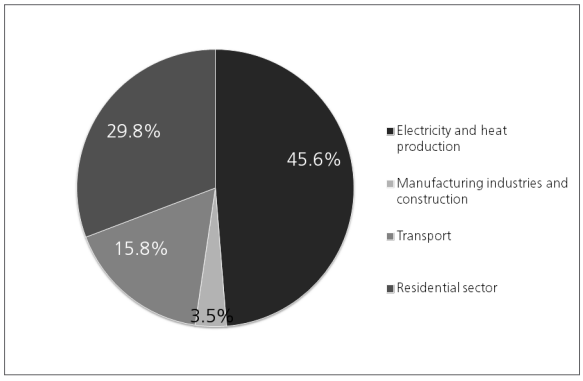
Table 2: CO_2 emissions from source in Moldova between 1990 and 2009

CO_2 emissions source	**Liquid fuel consumption** (Kt)*	**Solid fuel consumption** (kt)	**Residential, commercial & public buildings** (million metric tonnes)**	**Electricity and heat production, total** (million metric tonnes)	**Manufacturing industries and construction** (million metric tonnes)	**Other sectors** (million metric tonnes)	**CO_2 emissions from transport** (million metric tonnes)
1990	n/a	n/a	0.89	13.5	2.03	11.4	2.39
1991	n/a	n/a	0.92	12.5	2.14	6.48	2.25
1992	20972	4012	1.76	12.98	1.19	1.52	2.18
1993	15629	3990	2.48	9.77	1.25	1.37	1.38
1994	12090	3700	2.39	7.29	0.99	1.18	1.16
1995	11192	2248	2.54	5.24	0.98	1.09	1.06
1996	11522	1984	1.65	7.22	0.69	0.72	1.15
1997	7099	997	1.8	6.65	0.72	0.65	0.97
1998	6271	983	1.6	6.06	0.6	0.53	0.73
1999	4503	447	1.44	4.64	0.46	0.35	0.51
2000	3513	367	1.21	4.02	0.49	0.25	0.5
2001	3715	260	1.25	4.52	0.5	0.27	0.49
2002	3968	279	1.37	3.78	0.52	0.33	0.71
2003	4290	337	1.61	4.01	0.56	0.3	0.84
2004	4554	319	2.03	3.73	0.65	0.27	0.83
2005	4895	286	2.04	3.98	0.69	0.27	0.89
2006	4994	345	1.83	3.78	0.6	0.26	0.95
2007	4686	169	1.73	3.86	0.6	0.24	1.07
2008	4774	326	1.66	3.37	0.69	0.31	1.04
2009	n/a	n/a	1.7	2.6	0.2	0.1	0.9

* Source: Carbon Dioxide Information Analysis Center, Environmental Sciences Devision, Oak Ridge National Laboratory, US
** Source: International Energy Agency, 2012. IEA electronic files on CO_2 emissions from fuel combustion.

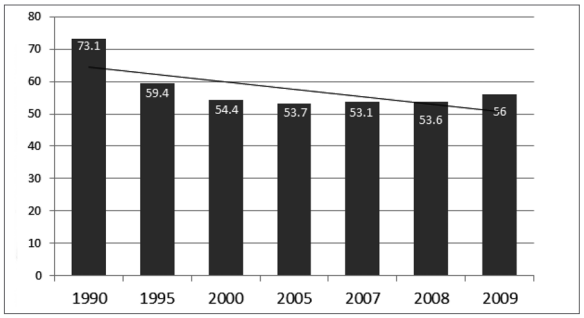
sector. As already mentioned, it is by far the biggest consumer of energy (54 per cent) and also a major source of CO_2 emissions (1.7 million tonnes of CO_2) (International Energy Agency Statistics, 2011). The trend of electricity and heat consumption in the residential sector is also decreasing, for several reasons. First, the low incomes of the population and delayed payments for delivered energy have led to a substantial reduction of electricity and heat production. As a consequence, the level of CO_2 emissions decreased. At the same time, the increasing prices for natural gas caused approximately 90 per cent of the households to use log wood for heating.

Figure 5: CO_2 emissions from fuel combustion by sector



Source: International Energy Agency Statistics, 2012

Figure 6: CO2 emissions / TPES, (tones of CO2/terajoule)



Source: International Energy Agency Statistics, 2012

District heating, one of the major sources of CO_2 emissions, has been progressively degraded since the 1990s. The old and inefficient heat production plants experience over 15 per cent losses in heat because of too long distribution lines. Official figures announced by the service provider claimed 19– 21 per cent, but it used to be higher (approximately 36 per cent). Reducing these losses remains a high priority in terms of prices and volumes of noxious gas emissions in the process of energy production. Besides this, another key issue in this context is energy efficiency regulation, including the energy performance of public and private buildings, required improvements, measurement and optimisation of heat demand. Because only 80 per cent of residential buildings are equipped with collective heat meters it is impossible to optimise heat demand as there are no incentives for households to reduce heating energy consumption.

According to the Energy Strategy of the Republic of Moldova up to 2020, it is estimated that well-planned and concerted implementation of an energy efficiency programme in Moldova could reduce the financial impact of the energy sector on GDP by 1.6–1.7 per cent per year. According to the Ministry of the Economy one euro invested today in improving energy performance in the residential, energy, industrial and agricultural sectors will save four euros after 2020.

2.2 Climate Change Mitigation and Adaptation

As shown above, a large part of the Moldovan population is dependent on income generated in agriculture. Climate change affects agriculture very strongly and therefore has a major influence on economic development. The rural population in particular is vulnerable to change. Studies show a direct connection between increased risk of natural disaster and migration to cities. This in turn decreases productivity in agriculture unless investments balance this effect.

The development of mitigation strategies must consider the interdependencies of all natural processes. To take one example: often heavy precipitation occurs as a result of climate change. This leads to floods in endangered areas and increases soil erosion. Also, the quality of the soil and its capacity for growing certain crops might be influenced. Furthermore, water quality and accessibility need to be ensured. Needless to say, for a single risk event several mitigation measures in different environmental departments are necessary. Such measures also need to be discussed and implemented within the framework of an interdisciplinary approach. To develop a sustainable system of mitigation measures the sectors of energy supply, transportation, residential and commercial buildings, industry, agriculture, forestry and waste management must be examined.

For Moldova there should be a particular emphasis on energy supply, the building sector and waste management, as short- and medium-term mitigation needs are most urgent there. Bearing in mind actual energy consumption and an estimated increase in consumption because of economic development the most cost effective and sustainable measurements can be taken in the energy supply and building sectors. Enhancing energy efficiency in buildings has proved to generate win-win situations for all involved parties:

- For the residents of modernised buildings the amount of income that must spent on energy will decrease.
- For the owner investments can be covered through higher rentals (for owner-occupiers the short payback periods of most investments will be a good incentive).
- For producers/construction companies a new source of income stimulates economic growth.
- For society in general a healthy environment boosts health and living standards (for example, improving air quality reduces asthmatic disease).

- For industry and the economy in general more energy is available at reasonable prices, which again supports economic development and growth.

Most current efforts concerning adaptation to climate change are based on international projects, for example, the UNDP Biomass Project.

2.3 National Emission Reduction Targets (All Sectors)

In 1992, Moldova joined an international treaty, the United Nations Framework Convention on Climate Change, to consider cooperatively what they could do to limit average global temperature increases and the resulting climate change, and to cope with whatever impacts were, by then, inevitable. At the very heart of the response to climate change, however, lies the need to reduce emissions. In 2010, governments agreed that emissions need to be reduced so that global temperature increases are limited to below 2 degrees Celsius.

On this basis, the Moldovan Ministry of the Environment addressed a letter of association to the Copenhagen Accord in which a reduction of no less than 25 per cent of the base year (1990) level national GHG emissions should be achieved by 2020 through implementation of global economic mechanisms focused on climate change mitigation, in accordance with the Convention's principles and provisions (Appendix II - Nationally appropriate mitigation actions of developing country Parties, 2012)

2.4 Sectors for Green Growth

Moldova has opportunities for green growth, especially with regard to energy savings (including housing), renewable energy, agriculture and the food industry. Opportunities exist for the introduction of integrated permitting (including technology-based requirements and best available techniques) and for increased application of economic and market instruments. There are also good opportunities in changing the consumption patterns of both the public sector (green procurement) and households.

Agriculture is the biggest sector in the Moldovan economy and it has major potential for green growth. Some practical steps towards achieving this improvement have already been taken. Organic production, for instance, expanded very rapidly in the period 2005 to 2009, with 35-fold growth. The main reasons for this growth are market demand and state policy. The area under organic production is today 1.94 per cent of total arable land and it has significant potential for extension. Over the past five years there has been positive growth in organic production and export of organic certified products: as of the end of 2009, 32,374 tonnes of organic products were exported, with a value of 580.7 million lei (34,6 million euros). This accounted for 11 per cent of total agriculture export value. The main certified and exported organic products are: wine, shelled walnuts, dried fruits, sunflower seeds, sunflower oil, soy seeds, wheat for animal fodder, lavender essential oil, beans and barley. The main market for Moldovan organic products is the EU, where the main importers are Austria, Germany, the Netherlands, Belgium, France, Italy, Greece, Spain, Portugal, Poland and Bulgaria.

The development of renewable energy resources (RES) is in its early stage in Moldova. In 2005, the share of renewables in energy consumption was 71.4 ktoe, just 3.6 per cent of the total primary energy supply. Currently, according to Ministry of the Economy estimations, the share of renewables is up to 5 per cent of total energy consumption. The estimated potential of renewables in Moldova is approximately 25.5 mtoe. An increase of energy consumption from renewables to 6 per cent will produce an annual reduction of CO_2 emissions of approximately 167–210,000 tonnes of CO_2 equivalent. A substantial part of this reduction can be cashed through CDM projects.

Table 3: RES potential of Moldova

Types of RES found in the Republic of Moldova	The theoretical Potential of RES, mtoe	Technical potential of RES, mtoe	The economic potential of RES, mtoe
Solar energy	12.00	1.20	0.90
Wind power	2.10	0.70	0.50
Biomass	1.00	0.50	0.40
Water power	0.45	0.30	0.20
Low-grade heat sources	9.50	0.95	0.65
Total	25.05	3.65	2.85

As already mentioned, energy intensity in Moldova is 1.24. The reduction of CO_2 emissions in the industrial and residential sectors is possible by applying environmental friendly and energy efficient technologies, as well as increasing the use of renewable sources of energy.

Because of the emergent character of the energy efficiency and renewables market there is a lot to be done by all market stakeholders and many obstacles to be overcome. This will definitely lead to a lower level of energy intensity and better energy efficiency on the part of both the industrial and the residential sectors. Some practical steps in this direction are being undertaken by the donor community and international development actors in the field. A considerable number of international institutions, such as the EU Delegation to Moldova, UNDP, UNIDO, SIDA, GIZ, USAID and the World Bank, and certain donor countries contributed and are implementing projects relevant to the development of the green economy. To provide some examples:

- European Commission: Socio-economic Benefits of Environmental Protection in ENP Policy Area, Water;
- Governance, Waste Governance, Air Quality Governance, Support with regard to the Kyoto Protocol;
- Implementation, Environmental Collaboration for the Black Sea, Budget Support Programme;
- UNDP and European Commission: Energy and Biomass Project;
- UNIDO: National Cleaner Production Programme;
- CDM: nine projects (mainly energy efficiency and biomass).

2.5 Available Products and Services and Technology Development

In Moldova the market for international and national investors in green technologies is fairly small. Many international companies thus do not have regular branches there, but only official distributors. Almost all of the products are imported and for this reason more expensive than in the company´s home market. Many of the big European companies offer products specially designed for GIS countries; such products have lower specifications than similar products in other countries. This allows these companies to distribute their products, but also to meet the lower price level Moldovan consumers are able to pay.

Special services such as energy contracting or freelance energy consultancy for companies or house owners are not yet available; trained energy managers are also currently lacking. There is no demand on the Moldovan market for such services, as government policy does not place much emphasis on this.

Financing for energy efficient production and buildings for commercial customers has been alleviated with the establishment of the Moldovan Sustainable Energy Financing Facility (MoSEFF), an EBRD initiative in cooperation with local partner banks. MoSEFF provides a credit line with special conditions for energy efficiency measures, combined with a grant system and international consultants and technical assistance.

The development of technologies in this area is weak, as financial support through companies or government is generally not possible.

2.6 Obstacles

As already mentioned, Moldova faces several problems with regard to energy efficiency and climate-friendly development. One of the biggest issues is the narrowness of the national market for efficient technologies. This makes the country unattractive to international investors and companies. Furthermore, convergence with European standards in the economy still has some way to go, which is likely to put off companies otherwise willing to invest.

Another obstacle is the fragile overall economic situation in the country. Energy efficiency measures and green development are still stigmatised as »luxury« investments. Once basic needs are fulfilled, however, such as a stable income, modern furniture and appliances in the home and a new car, priorities will shift towards environment-friendly technologies and investments. This applies to both private consumers and enterprises. Private companies in particular have to settle into the market before being in a position to reinvest money in more advanced technologies.

Social factors also constitute constraints on the development of green technologies. The government subsidises energy prices for socially vulnerable groups, meaning that up to a certain consumption of electricity or natural gas prices are below economically sustainable levels. This diminishes the benefits looked for by investing companies.

Some cultural obstacles also constrain implementation of necessary reforms. During Soviet times most of the decisions were taken in Moscow and the regional government had only limited influence on this. Democratic processes are thus having to be learned, together with taking responsibility and demanding political action from civil society. This process is ongoing and needs to be supported by international organisations specialising in such things.

2.7 International Activities

This section presents the most important international donor projects in the field of energy.

- World Bank Energy II Project: The funding for this project occurred in two steps. The first tranche of USD 35 million was approved in November 2003. A second tranche of USD 10 million was approved in January 2009. The objectives of the Second Energy Project for Moldova were to: (a) improve the security and reliability of the electricity transmission system and wholesale electricity supply and facilitate unimpeded commercial operation of the power system and (b) improve the availability, quality and efficiency of heating in selected buildings.

- EU Sector Budget Support: The foreseen budget is 40 million euros with a first fixed tranche of 13 million euros and two variable tranches to a maximum of 13 million and 14 million euros. The variable tranches will be subject to independent reviews of the implementation of the Policy Matrix in 2012 and 2013. A technical assistance package of around 2.6 million euros will be defined before the signing of the Financing Agreement. The main objective of the SPSP is to support the reform of the energy sector and to facilitate technical improvements in its operation. It will offer a flexible instrument to support GoM efforts towards further progress on the implementation of the Moldovan energy strategy and energy sector development. This will be achieved through support for intervention in the preparation and adoption of appropriate legislation, as set out in the policy matrix, as well as technical assistance and policy dialogue.

- UNDP Biomass burning project: The overall objective is to contribute to a more secure, competitive and sustainable energy production in the Republic of Moldova through targeted support to the most viable and readily available local source of renewable energy, namely biomass from agricultural waste. The projected cost is about 14 million euros.

- EBRD: The European Bank for Reconstruction and Development (EBRD) has recognised the increasing importance of energy efficiency and the key role it will play in the future of Europe. In September 2009 the first Moldovan Sustainable Energy Financing Facility (MoSEFF) was launched in order to support energy efficiency investments in Moldovan enterprises.

3. Conclusions and Recommendations

In order to gain sustainable success it is necessary to strengthen cross-sectoral approaches in Moldova, to cover the main targets as well as cross-cutting issues. Overall, civil society should be strengthened and take its responsibility for general national development. Only with government and society acting together can effective steps be taken. The current developments in Moldova illustrate the need for national reforms towards more environmental and climate-friendly development, and even further targeted international donor activities. Special emphasis should be laid on the proper implementation of policies and directives in combination with a functioning framework of governmental and society institutions. To achieve this, several steps are of particular importance:

- raising public awareness of environmental topics;

- transparent use of public financial resources (regardless of national or international source);

- promotion and display of best practices and working examples;

- explaining general economic principles to stimulate economic growth;

- developing special financial solutions for environment-friendly measures and making them amenable to the public.

Moldova has much more potential for renewable energies and green technologies than are being exploited at the moment. The potential for energy efficiency measures in all sectors is enormous; however, access is currently limited to the financially stronger parts of society.

About the author

Uta Schmieder is a meteorologist and very committed to the issue of climate change. She works as an international consultant in the field of renewable energy, energy efficiency and climate policy. Her solid work experience in South Eastern European countries has made a valuable contribution to various development projects in the area of energy efficiency.

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