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## INCREASING INVESTMENT IN RENEWABLE ENERGY SOURCES IN THE REPUBLIC OF MOLDOVA

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**Abstract.** In recent years, Moldova has faced an energy crisis, both in terms of energy resource prices and the possibility of energy supply. There is a significant need for the development of domestic energy sources. This primarily concerns renewable energy sources (RES). This article examines the generation of electric power from RES in the Republic of Moldova, analyzes the changes in dynamics, determines the proportion of the total generated electric power in the Republic of Moldova, as well as in relation to the total purchased electric power. Let's determine how this intersects with investments in the energy sector and overall investments in the Republic of Moldova. Let's analyze how investments in the energy sector are changing by types of ownership. Let's also identify how the growth of renewable energy production intersects with the prices of purchased electricity in Moldova as a whole and from renewable energy suppliers. Let's determine the share of renewable energy sources (RES) in the perspective of 2025 according to the government-established capacity for purchasing electric power at a fixed price. Let's identify the opportunities, forecasts, and risks for the development of the renewable energy sector. As a result, investments in renewable energy sources represent a promising direction for Moldova. This strategy will allow the country to reduce its dependence on imported electricity, ultimately leading to lower electricity prices for consumers. Moreover, it will significantly improve the environmental situation within the nation. The development of the renewable energy sector will also create opportunities for growth in related economic fields, generate additional employment opportunities, and contribute to an increase in the Gross Domestic Product (GDP).

**Key words:** electricity, renewable energy, investments, energy prices, industry.

JEL: Q42, Q43, Q47.

### Introduction

Moldova does not have its own fossil fuel reserves and imports 96% of the required fuel, spending significant financial resources on this. (Быкова Е.В., 2013)

In the production of electricity and heat, not the most modern technologies are used and, for various reasons, not the most economical operating modes of the equipment.

Energy can be considered the artery for most sectors of the economy, and without its development it is difficult to imagine the development of the entire country's economy.

In recent times, there has been an energy crisis in the world and in the region, as well as in Moldova, associated with rising energy prices, as well as the risks of a shortage of energy resources in Moldova. This is largely due to external factors, as well as the lack of funding for the energy sector from the state and economic agents. The development of energy technologies largely determines the rate of economic growth and its sectoral structure in the long term, affecting the value of relative and absolute production costs in the country. At the same time, economic growth is an important factor in the dynamics of energy demand. Just four decades ago, growth in energy consumption approximately equal to the growth in GDP production was considered not only normal, but also a natural element of development. This was largely due to the low cost of oil and other energy sources. The fundamental factors for changing the situation in recent decades have been a significant increase in relative energy prices, problems associated with nuclear energy, and the concern of many countries with energy security issues; finally, the need to preserve the planet's climate. High prices and energy policy factors turned on the traditional mechanism for solving problems - technological, i.e., efficiency factor on the consumption side and the method of energy production. (Григорьев Л.М. et al. 2013)

As a result of the complex, contradictory effects of demand and prices, humanity finds itself in a transformation of the entire world energy sector. Of course, the irreversibility of investments in long-term energy assets slows down all these processes, but the flow of inventions and commercially viable investments in new technologies is becoming abundantly clear.

With all the difficulties of the current situation in the world, world GDP, according to the IMF forecast, will grow by 3.2% in 2023, which also indicates a further increase in demand for energy. (Наталья Коровлева, 2022)

In the context of rising prices and demand for energy resources globally and also in the Republic of Moldova, there is a need to study the necessity of investing in Moldova's energy sector. Investments in the energy sector can significantly accelerate the development of a significant number of sectors of the national economy and lead to growth in the country's GDP.

Investments in the energy sector will lead to GDP growth directly as the formation of additional enterprises or production facilities, will lead to lower prices for energy resources due to increased competition among suppliers, will lead to a reduction in consumption due to technology, and this will make it possible to reduce the cost of manufactured products.

### **Research methodology**

In recent years, due to the risk of a shortage of electricity, as well as a complete cessation of supplies and, accordingly, rising prices for energy resources, there is an urgent need to increase electricity production in Moldova, primarily from renewable energy sources. To do this, we will study the production of electricity from renewable energy sources, changes in dynamics, determining the ratio to the total electricity produced in the Republic of Moldova, as well as in relation to the total purchased electricity. Let's determine the already commissioned renewable electricity capacities in

Moldova. We will also determine how this intersects with investments in the energy sector and overall investments in the Republic of Moldova. Let us determine how investments in the energy sector change by type of ownership.

### Research results

**Table 1. Amount of electricity produced from renewable energy sources in thousand kWh, excluding the waterworks in Costesti**

Type of RES	Amount of electricity produced, thousand. KWh						
	2016	2017	2018	2019	2020	2021	2022
Solar energy(photovoltaic)	1 311	1 509	1 457	1 437	3 275	7 764	30 297
Biogas	14 030	21 576	27 961	28 748	27 793	32 239	23 567
Wind energy	2 477	7 066	21 968	36 915	50 138	76 310	142 373
Hydroelectrics		38	279	330	147	239	96
<b>Total</b>	<b>17 818</b>	<b>30 189</b>	<b>51 665</b>	<b>67 430</b>	<b>81 353</b>	<b>116 552</b>	<b>196 333</b>

**Source:** prepared by authors based on data from [the](#) National Energy Regulatory Agency.

According to Table 1, we see an annual increase in electricity production from renewable energy sources. Wind energy takes the largest share in electricity production. In second place is solar energy. Wind in the total electricity produced amounted to 65.5% in 2021 and 72.5% in 2022, and solar 6.6% in 2021 and 15.4% in 2022. That is, the share of solar energy is growing due to the limited possibilities for installing wind turbines, as well as their significant cost. Solar installations are easier to install on buildings or structures.

**Table 2. Dynamics of growth of electricity produced from renewable energy sources in % excluding the waterworks in Costesti**

Type of RES	2017	2018	2019	2020	2021	2022
Solar energy(photovoltaic)	15,10%	-3,45%	-1,37%	127,91%	137,07%	290,22%
Biogas	53,78%	29,59%	2,81%	-3,32%	16,00%	-26,90%
Wind energy	185,26%	210,90%	68,04%	35,82%	52,20%	86,57%
Hydroelectrics		634,21%	18,28%	-55,45%	62,59%	-59,83%
<b>Total</b>	<b>69,43%</b>	<b>71,14%</b>	<b>30,51%</b>	<b>20,65%</b>	<b>43,27%</b>	<b>68,45%</b>

**Source:** prepared by authors based on data from [the](#) National Energy Regulatory Agency.

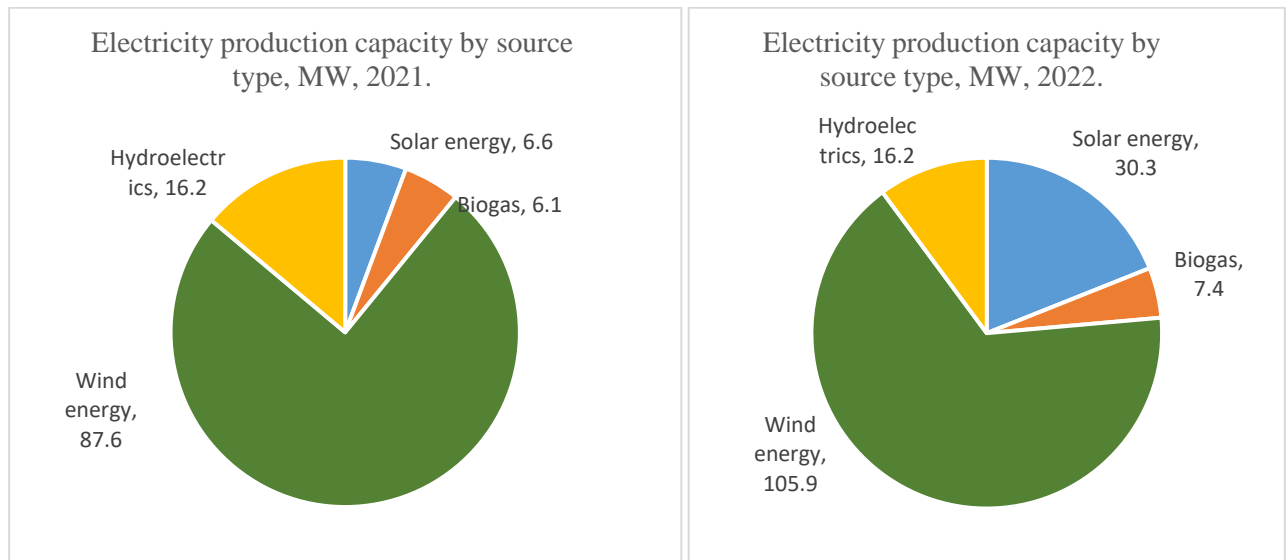
According to Table 2, we see that in the last two years there has been a significant increase in electricity production. For 2022 it amounted to 68.45%. The greatest growth was achieved by solar energy in 2022 compared to 2021 by 290.22%, and wind energy by 86.6%.

**Table 3. Installed capacity for electricity production from RES in MW**

Renewable Energy Capacity,MW"	2020	2021	2022
Solar energy	4,3	6,6	30,3
Biogas	6,1	6,1	7,4
Wind energy	44,1	87,6	105,9
Hydroelectrics	16,2	16,2	16,2
<b>Total</b>	<b>70,7</b>	<b>116,5</b>	<b>159,8</b>
<i>Growth in % compared to the previous year</i>		64,78%	37,17%

**Source:** prepared by authors based on data from [the](#) National Energy Regulatory Agency.

The presented table shows that the growth rate in increasing renewable energy capacities in 2022 is lower than in 2021. This is mainly reflected in Wind Energy, where the growth in 2021 was 98.6%, whereas in 2022, it was 20.9%. Biogas increased by 21.3% in 2022, while Solar Energy, which saw a 53.5% increase in 2021, experienced a remarkable surge of 359% in 2022. Which suggests that significant investment has been observed in solar energy production.



**Figure 1. Diagram of distribution of electricity production capacity by source type in MW for 2021 and 2022**

**Source:** prepared by authors based on data from [the](#) National Energy Regulatory Agency.

According to Figure 1, we see that the largest share in the production of electricity from renewable energy sources is Wind energy. So in 2021 it amounted to 87.6 MW or 75.2% of the total capacity, and in 2022 105.9 MW or 66.3%. Solar energy has significantly expanded its share from 6.6 MW or 5.7% in 2021 to 30.3 MW or 19% in 2022.

**Table 4. Electricity production in Moldova by generation source, million kWh**

Indicators	2018	2019	2020	2021	2022
<b>Electricity production total, million. kWh</b>	<b>804,2</b>	<b>801,1</b>	<b>851,4</b>	<b>984,7</b>	<b>851,1</b>
incl:CET Termoelectrica,CET-Nord	705,0	659,7	721,5	797,9	611,6
Waterworks Costesti	44	64	47	68	41
Solar energy(photovoltaic)	1,5	1,4	3,3	7,8	30,3
Biogas	28,0	28,7	27,8	32,2	23,6
Wind energy	22,0	36,9	50,1	76,3	142,4
Hydroelectrics	0,3	0,3	0,1	0,2	0,1
Other	3,5	9,5	1,8	2,7	1,6

**Source:** prepared by authors based on data from [the](#) National Energy Regulatory Agency.

According to Table 4, we observe that the maximum volume of electricity production in Moldova over the past five years was reached in 2021 and amounted to 984.7 million kWh. The growth was due to an increase in production from thermal power plants; compared to 2020, the increase in production from thermal power plants was 10.6%, then in 2022 the decrease was 23.3%. This was due to both repair work at the thermal power plant and increased gas prices.

**Table 5. Structure of electricity production in Moldova by generation sources, in%**

Indicators	2018	2019	2020	2021	2022
<b>Electricity production in %</b>	<b>100,00%</b>	<b>100,00%</b>	<b>100,00%</b>	<b>100,00%</b>	<b>100,00%</b>
incl:CET Termoelectrica,CET-Nord	87,67%	82,35%	84,74%	81,03%	71,86%
Waterworks Costesti	5,43%	8,04%	5,49%	6,85%	4,87%
Solar energy(photovoltaic)	0,19%	0,18%	0,38%	0,79%	3,56%
Biogas	3,49%	3,59%	3,26%	3,27%	2,78%
Wind energy	2,74%	4,61%	5,89%	7,75%	16,74%
Hydroelectrics	0,04%	0,04%	0,02%	0,02%	0,01%
Other	0,44%	1,18%	0,22%	0,28%	0,19%

**Source:** prepared by authors based on data from [the](#) National Energy Regulatory Agency.

Table 5 shows us that the share of thermal power plants in electricity production in Moldova, although it occupies the maximum value, is decreasing over the years from 87.7% in 2018 to 71.9% in 2022. At the same time, the share of renewable energy sources continuously grew from 12.3% in 2018 to 28.1% in 2022. Also, the largest share of renewable energy sources in production was wind energy, which increased from 2.74% in 2018 to 16.74% in 2022.

**Table 6. Share of renewable energy sources in the total volume of purchased electricity in the Republic of Moldova, in%**

Indicators	2018	2019	2020	2021	2022
Amount of purchased electricity, thousand kWh	4178,8	4301,9	4269,8	4591,7	4512,9
Waterworks Costesti	1,05%	1,50%	1,09%	1,47%	0,92%
Solar energy(photovoltaic)	0,04%	0,03%	0,08%	0,17%	0,67%
Biogas	0,67%	0,67%	0,65%	0,70%	0,52%
Wind energy	0,53%	0,86%	1,17%	1,66%	3,16%
Hydroelectrics	0,01%	0,01%	0,00%	0,01%	0,00%
<b>Total RES in the structure of purchased electricity</b>	<b>2,29%</b>	<b>3,07%</b>	<b>3,00%</b>	<b>4,01%</b>	<b>5,27%</b>

**Source:** prepared by authors based on data from [the](#) National Energy Regulatory Agency.

According to Table 6, we see that RES occupy an insignificant weight in the structure of purchased electricity. This weight has more than doubled over the past 5 years from 2.29% in 2018 to 5.27% in 2022, but its share is very small in the overall structure of electricity needed by Moldova. The growth rate averages 1% per year. If current growth continues, it will take 5 years to reach the target of 10% of total electricity consumption.

**Table 7. Average prices for purchased electricity in Moldova and from renewable energy sources**

Indicators	Unit	2020	2021	2022
Average price of purchased electricity	lei/kWh	0,97	1,04	1,73
Fixed purchase price from solar energy	lei/kWh	1,88	1,88	1,8-1,97
Fixed purchase price from wind energy	lei/kWh	1,55	1,55	1,59-1,84
The ratio of solar energy procurement to the average acquired	%	193,2%	180,6%	104% -114%
The ratio of wind energy purchases to the average position	%	159,3%	148,9%	92% -106%

**Source:** prepared by authors based on data from [the](#) National Energy Regulatory Agency.

Looking at Table 7, we see that the average price of purchased electricity increased significantly from 1.04 lei per kW in 2021 to 1.73 lei in 2022. This was due to the energy crisis in the region and the country, which ultimately led to the purchase at more high prices from different suppliers. The fixed

purchase price of solar and wind energy has not undergone significant changes. Wind power purchases are almost equal to the national average purchases.

**Table 8. Main indicators of investment activity, million lei**

<b>Indicator name</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>
<b>Investments in long-term tangible assets</b>	<b>23 498,3</b>	<b>27 464,7</b>	<b>31 253,2</b>	<b>30 089,6</b>	<b>35 411,2</b>	<b>37 107,5</b>
<i>Growth in % compared to the previous year</i>		16,88%	13,79%	-3,72%	17,69%	4,79%
<b>Incl. production and provision of electricity and heat, gas and hot water; air conditioning</b>	<b>1 186,8</b>	<b>1 470,6</b>	<b>1 316,5</b>	<b>1 310,5</b>	<b>1 304,0</b>	<b>937,8</b>
<i>Growth in % compared to the previous year</i>		23,91%	-10,48%	-0,46%	-0,49%	-28,08%

**Source:** prepared by authors based on data from [the](#) National Bureau of Statistics

The table shows that the growth rate of investments in long-term tangible assets is steadily falling from 16.9% in 2018 to (-3.7%) in 2020 and increased in 2021 by 17.7% and 4.8% in 2022.

For the production and provision of electricity, heat, as well as gas and hot water, the growth rate of investment decreases even more significantly from 23.91% in 2018 to (-28.08%) in 2022.

**Table 9. Main indicators of investment activity for the production and provision of electricity, heat, gas, and hot water, thousand lei**

<b>Indicator name</b>	<b>2020</b>	<b>2021</b>	<b>2022</b>	<b>Growth 2022/2021 in %</b>
<b>Production and supply of electricity and heat, gas and hot water; air conditioning</b>	<b>1 310 500,0</b>	<b>1 304 049,2</b>	<b>937 809,0</b>	<b>-28,1%</b>
<b>Incl. gas production; distribution of gaseous fuel through pipelines</b>	<b>105 848,6</b>	<b>173 087,9</b>	<b>125 721,6</b>	<b>-27,4%</b>
<b>Steam and conditioned air supply</b>	<b>401 265,4</b>	<b>447 425,5</b>	<b>157 688,6</b>	<b>-64,8%</b>
<b>Electricity production, transportation and distribution</b>	<b>803 367,3</b>	<b>683 535,8</b>	<b>654 398,8</b>	<b>-4,3%</b>
From which public property	458 817,7	399 311,7	343 655,5	-13,9%
Private property	28 721,4	25 613,8	65 765,7	156,8%
Foreign ownership	315 828,2	258 610,3	244 977,6	-5,3%

**Source:** prepared by authors based on data from [the](#) National Bureau of Statistics

As can be seen from the table, the largest drop was provided by the supply of steam and conditioned air - 64.8%

Production, transportation, and distribution of electricity in 2022 decreased by 4.3%.

The largest decrease was provided by public ownership 13.9%

At the same time, investments from the private sector increased by 156.8%. More than 2.5 times. At the same time, the share of the private sector in the production, transportation and distribution of

electricity is 10%. This share is not significant. Investments from the private sector are mainly investments in renewable energy sources.

### **Conclusions**

Investments are a crucial element of the economic development of a country. In this context, the economic policy of the Republic of Moldova for the medium and long terms should be oriented towards fostering investment growth and maintaining it at a high level. This is because investments determine the production capacities of the country in the future and contribute to its economic growth potential. In this regard, countries compete internationally for the influx of investments.

Having analyzed the information presented above, we observe that the production of electricity from renewable energy sources (RES) is actively developing, showing significant growth. However, the share in electricity production, and even more so in consumed electricity, is very modest. Consequently, there are risks of continued dependence on imported electricity and potential price fluctuations in the future.

The statement in the article "Хотите продавать зеленую энергию в сеть по гарантированной цене?" (Do you want to sell green energy to the grid at a guaranteed price?) indicates that the government has approved Resolution 401 dated December 8, 2021, concerning the approval of power limits, maximum power levels, and power categories in the field of electricity from renewable sources until 2025. For all technologies under the fixed tariff support scheme, a capacity limit of 235 MW has been approved.

Based on this, we conclude that by 2025 the capacity will increase by 1.47 times relative to the capacity in 2022. If we assume that electricity consumption remains at the current level, then the share of electricity produced from renewable sources will be just over 7.8%, which will also remain a very insignificant figure.

For many years, Moldova will continue to depend on electricity imports and the production from thermal power plants (TPPs), where the raw material for electricity production can significantly change depending on the market situation. We presume that the state inadequately invests in this sector and does not provide sufficient incentives for private investors. There are several constraints. The fixed tariff support scheme is limited in capacities, solar panels are mainly allowed on buildings and structures, wind power stations are restricted in installation locations, delivery methods, and connection to distribution networks. Biogas power stations require substantial financial investments, and the purchase tariffs from these power stations have not changed significantly. Meanwhile, the average electricity purchase price in the country has increased by more than 1.5 times.

Government support measures may include public-private partnerships, provision of government loans and guarantees, compensation for investment expenses, grant provision, tariff reductions, removal of bureaucratic barriers, simplification of administrative procedures for investors, tax relief, regulation, and commitment to purchasing generated capacities at fixed prices, streamlining investment procedures through the Internet, and support for e-commerce.

Nevertheless, all these constraints, increased delivery risks, and rising prices suggest that investments in the renewable energy sector are the most viable soon. In the existing conditions, experienced investors see new opportunities and promising directions for implementing investment projects.

To address issues related to economic growth, the adoption of new technologies, and ensuring production, a transformation of the state's investment policy is necessary. This transformation should be aimed at creating a favorable investment climate in Moldova. Such an approach will significantly increase the influx of investment resources into the economy and facilitate the realization of opportunities for economic growth.

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