IS WIND POWER MORE EXPENSIVE?

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***Abstract* – The wind power and power produced from natural gas cost prices in the Moldova's market conditions are analysed. Towards the year 2008 these cost prices will be equal although natural gas subsidies will be the same and towards the year 2011 the wind power cost price will be lower with 25 %.**

***Keywords*:** *wind power, cost price, subsidies for natural gas.*

1. INTRODUCTION

Some specialists in power domain and decision makers in Moldova Republic (MR) reflect the opinion that renewable energy, particularly wind power, is more expensive than the energy produced by fossils fuels. So, it is wrongly concluded that utilization at a large scale of renewable sources of energy is a luxury that only developed country can afford. This opinion is rooted from the soviet period when the energy cost did not reflect real costs and the environment problems were treated superficially.

Starting with 2006, the era of cheap natural gas (NG) has come to end in MR: in the same year the natural gas cost delivered by Russia increased with 37,5 %, in 2007 with 212,5 %, and in 2011 it will increase with 325% in comparison to 2005. All the power stations use the natural gas and evidently the cost of the produced electric energy will increase.

In MR the prefeasibility studies concerning the renewable energies was made in [1-7]. The author of this paper tries to prove that in the new condition of the power market in MR, the cost price of the wind power produced by modern turbines becomes competitive with the power cost produced by power stations, which use NG. The estimation was made for three scenarios: the NG tariff is established by ANRE, it is accepted a minimal subsidised tariff for NG, it is accepted a minimal tariff without subsidies.

2. INVESTMENT COST AND THE WIND POWER COST PRICE IN THE EU-25 COUNTRIES

According the EU-25 statistics [8] the total cost per kW of installed wind power differs scientifically between countries, as exemplified in Figure 1. The cost per kW typically varies from approximately 900

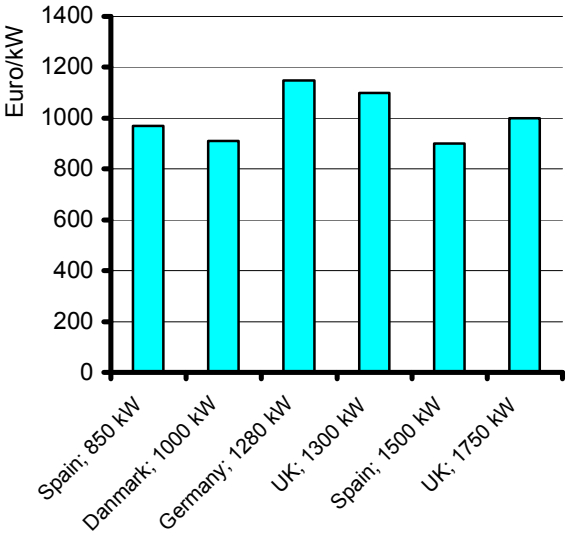

Figure 1: Total investment cost for different turbine sizes and countries of installation

to 1150 €/kW. This cost includes: turbines, foundation, electric installation, grid-connection, land, civil and road infrastructures, etc. For wind power cost price estimation in the MR we took in consideration the medium figure, namely 1000 €/kW.

The average wind power cost price in EU-25, taking into consideration the number of turbine working hours at the rated power, as a function of the average annual speed in the certain site and discount rate are presented in Figure 2 [8]. It is considered as a

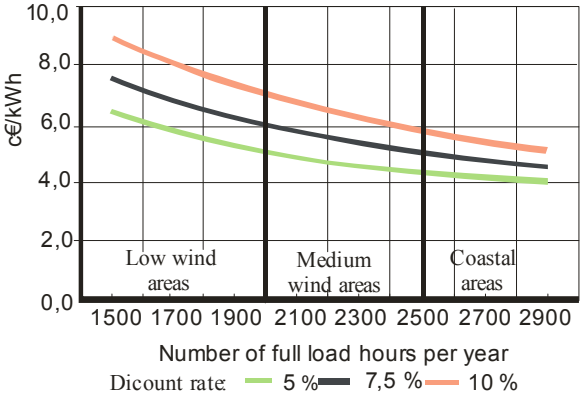

Figure 2. Wind power cost price in EU-25

coastal area sites if the average annual wind speed at the 50 m above the ground constitutes 6,9 m /s, respectively 6,3 m/s in certain site with an average wind potential and 5,4 m/s in low wind potential sites. The wind potential study was realized by the Technical University Centre „Energy plus", being based on historical wind data and recent measurements that have been done for a year at a 50 m high. The obtain data classify the southern part of MR as a higher than average potential site. The average wind velocity in this region constitutes 6,5 m/s at a 50 m high and the number of working hours of the turbine rated power will not be lower than 2300-2400 per year. From Figure 2 we can to conclude: the cost price of the wind power, produced by wind station placed in the South region of MR, based on statistics data from EU-25, frames between 0.045 and 0.060 €/kWh if the discount rate varies between 5 and 10 %. In addition, these data were verified for a wind station placed in Baurci region in the south of Moldova Republic.

3. COST PRICE OF THE WIND POWER PRODUCED BY THE WIND STATION PLACED IN THE SOUTHERN REGION OF MR

A simplified method of economic analysis of wind power production with flux of money discounting was used [9,10]. At the beginning, we'll determine wind power quantity which will be produced by selected wind turbine type V90-2000 with the power rate of 2000 kW, tower high of 80 m and rotor diameter of 90 m.

The eventual wind power station will be placed on the hill between Baurci and Congaz villages. The calculation result is presented in Figure 3. There were used measurement data made in Baurci site with a duration of 12 month (Figure 3 up) and the historical data for a period of 10 years from the meteorological station Ciadir – Lunga (Figure 3 down). Lower annual

power production was accepted, i.e. $6{,}381 \times 10^6$ kWh/year. If a turbine availability factor is equal with 0,95, will obtain $EE_t = 0{,}95 \cdot 6{,}381 \cdot 10^6 = 6{,}062 \cdot 10^6$ kWh/year.

Other initial data and calculus results are presented below and in the Table 1:

- Installed wind power station capacity, $P_i = 20$ MW;
- The number of the installed turbines, $n_t = 10$;
- Project life duration, $T = 20$ years;
- The annually power production, $EE = EE_t \cdot n_t = 60{,}62 \cdot 10^6$ kWh/year;
- The number of years over which the investment in the wind farm is to be recovered n=12 years;
- Specific investment, $I_s = 1000$ €/kW;
- Total initial investment, $I = P_i \cdot I_s = 20\,000 \cdot 1000 = 20 \cdot 10^6$ €;
- Discount rate, $i = 5{,}0$ %, 7,5 %, 10,0 %;
- Specific cost of operation and maintenance, $C_{SOM} = 0{,}01$ €/kWh [1];
- Annual total cost of operation and maintenance, $C_{OM} = C_{SOM} \cdot EE \cdot n_t =$
- $= 0{,}01 \cdot 6{,}062 \cdot 10^6 \cdot 10 = 0{,}61 \cdot 10^6$ €/an;

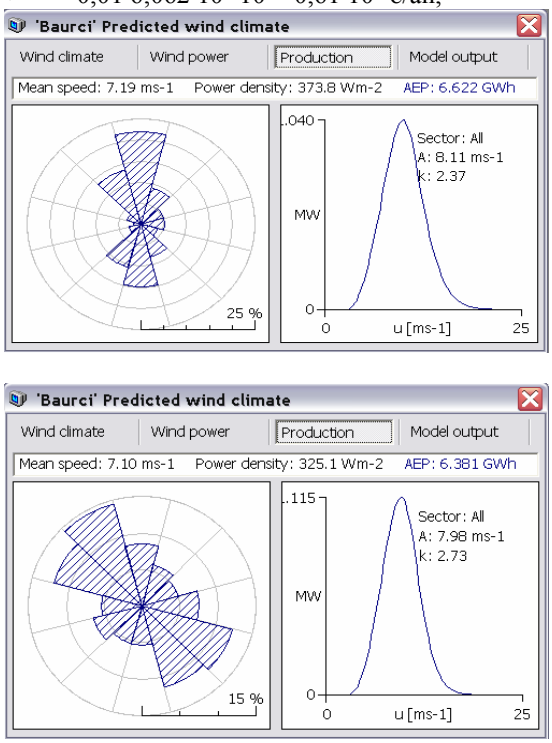

Figure 3. Wind power prediction

Indicator	Discount rate, i, %		
	5,0	7,5	10,0
Capital recovery factor $R = \frac{i}{1-(1+i)^{-n}}$	0,113	0,129	0,147
Uniform Discount factor $F_A = \frac{1-(1+i)^{-T}}{i}$	12,432	10,194	8,514
Discounted investment and loan cost $C_{IA} = I \cdot R \cdot F_A$, €	$28{,}2 \cdot 10^6$	$26{,}3 \cdot 10^6$	$25{,}0 \cdot 10^6$
O & M discounted cost, $C_{OMA} = C_{OM} \cdot F_A$, €	$7{,}6 \cdot 10^6$	$6{,}2 \cdot 10^6$	$5{,}2 \cdot 10^6$
Discounted total cost $CTA = C_{IA} + C_{OMA}$, €	$35{,}8 \cdot 10^6$	$32{,}5 \cdot 10^6$	$30{,}2 \cdot 10^6$
Wind power cost price $CEE = \frac{CTA}{F_A \cdot EE}$, €	0,047	0,053	0,059

Table 1. Calculus results of the wind power cost price

4. THE COST PRICE OF WIND POWER VIS-A-VIS TO ELECTRICITY PRODUCED FROM NATURAL GAS

In accordance with ANRE (National Agency for Energy Regulation) decision nr. 239 from 29th of February 2007 for Thermal Power Station (TPS) was

Year		2007	2008	2009	2010	2011
NG fixed tariff		**150**	**170**	**190**	**210**	**230**
Come in cost		170	193	215	238	260
Transport cost [11]		6,9	6,9	6,9	6,9	6,9
Subsidised minimal tarif		177	199	222	244	267
Delivered tariff for TPS+VAT, 5%		186	209	233	257	280
Subsidies	Historical debts payment: Budget law art.21	4,0	4,0	4,0	4,0	4,0
	Compensation for NG consumers: Budget law, appendix nr. 1	0,9	0,9	0,9	0,9	0,9
	Investment from public budget: Budget law, appendix nr.18	6,2	6,2	6,2	6,2	6,2
	VAT exemption: Fiscal Code, art. 96	27	30	33	37	40
Total subsidies		**38**	**41**	**44**	**48**	**51**
NG minimal tariff without subsidies		**215**	**240**	**266**	**292**	**318**

Table 2. Cost and tariff estimation for NG delivered to TPS, $ per 1000 m^3

established a tariff the NG of 150,4 $ per 1000 m^3. At the same time, NG cost at the MR border constitutes $170. Natural gas real tariff delivered to TPS is much bigger and should include the border gas cost, transport expenses, Moldova-Gas benefit, and subventions granted to this sector. In table 2 is presented NG minimal real tariff, estimated for 2007-2011 period with the following conditions:

- NG cost delivered by Gasprom Company will uniformly grow in 2007-2011 from 170 to 260 $ per 1000 m^3. It is accepted that the NG tariff will also grow uniformly;
- During the mentioned period the transport cost are constant and equal to those established by ANRE in 2007;
- The subventions for the NG are considered constant and equal to the same that were fixed in the year 2007;
- Exchange rate $/MDL – 1 : 13

Power cost price produced from NG was calculated with following initial data:

- NG specifically caloric power - 8000 kCal/m^3;
- Average annual efficiency of the NG conversion to electricity – 36 %;
- NG weight in the cost price in 2007 constitutes 84,5% and remains constant for the whole period;
- Exchange rate euro/dollars – 1:1,3

The calculations were done for three scenarios:

1. ANRE tariff for NG delivering to TPS is accepted;
2. Minimal NG subsidised tariff is accepted
3. Minimal NG tariff without subsidises is accepted.

The obtained results are included in the Table 3, cost price diagram interpretation is presented in Figure 4.

GN tariffs	Power form NG & wind power cost price				
	2007	2008	2009	2010	2011
ANRE tariff	4,08	4,63	5,17	5,70	6,25
Subsidised	5,04	5,69	6,33	6,97	7,61
Without subsidises	5,82	6,53	7,24	7,94	8,64
Wind power cost price	4,70				

Table 3. Cost price of power, c€/kWh

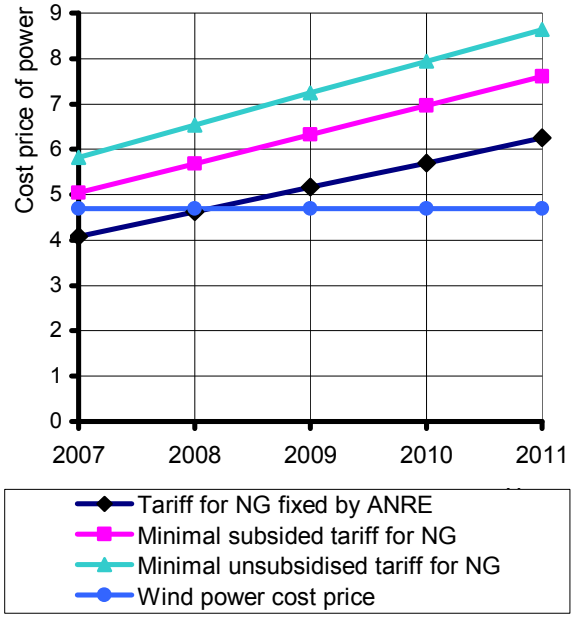

Figure 4. Power cost price estimation, c€/kWh

4. CONCLUSIONS

The answer to the question in the title of this work is negative. On the RM market wind power becomes more competitive with the energy produced from NG. In accordance with the first scenario (NG tariff is established by ANRE, which does not reflect real expanses) towards 2008 wind power cost price will be equal with the same produced from NG.

If we exclude existent subventions for NG, wind power cost price is lower with 21 % (year 2007), but towards 2011 will be lower with 46 %.

Acknowledgments

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