ECONOMIC- AND- FORECAST INDEXES OF WIND POWER PLANTS IN AZERBAIJAN REPUBLIC

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ABSTRACT

This work is devoted to technical and economic forecast of powerful wind power plants (WPP) using possibility in Apsheron peninsula conditions of Azerbaijan **r**epublic.

Keywords: forecast, powerful, economic indexes, wind power plant,

I. INTRODUCTION

The analysis of wind power modes in researched time interval (12 months) is adduced, the basis for positive solution of powerful WPPs' utilization in Apsheron peninsula is given. The appropriate tables on calculated wind speeds and also possible electric power outputs by four types of powerful foreign WPPs in researched zone are given.

The summarized data according to economic indexes' calculations of 25 mW capacity wind power parks on the basis of submitted WPPs of five types are presented in paper, the conclusions and specific recommendations for their using are given.

II. MAIN TEXT

The measurements of 10-minutes average wind power parameters were carried out within 12 months, and according to them the hourly, daily, monthly and yearly average wind speeds were calculated.

These calculations' data (at 40 m height) are shown in table 1. The obtained data analysis allows to draw a conclusion, that the yearly average wind speed in Apsheron is equal to 8 m/s, and monthly average wind speeds vary within 6,5- 9 m/s range in spring and summer time and 7,6- 8,9 m/s within autumn and winter time, herewith during a month the calm doesn't exceed half of a day.

The approximation of passport power performances of five powerful WPPs of Nordex N- 54 1000 kW, Nordex N- 60 1300 kW, Enercon E-66 1500 kW, Tacke TW-1,5, Vestas V66/1,65 mW types [1] by 4- order polynomials was carried out, and by them and with using the hourly average wind speeds the generated by these WPPs supposed electric power output for each of 12 months was calculated, and then the supposed yearly average electric power output was determined subject to delivered to each specific WPP mast's height.

The obtained data of above mentioned WPPs' supposed electric power output are presented in table 2.

The obtained calculation results allow to draw a conclusion, that aforesaid WPPs' utilization supposed to be essentially efficient in Apsheron peninsula conditions of Azerbaijan **r**epublic.

There is also considered the case in the paper, that on the basis of using of wind power parks with 25 mW total capacity, composed of above mentioned WPPs, their total economic estimated indexes are presented under given conditions [3].

Allowing for that in world practice the investments cost for WPP installation varies within a range of 1100-1700 US$/kW [2], the economic calculations were carried out for three different possible costs of 1 kW installed power:

a) 1100 US$; b) 1400 US$; c) 1700 US$

and also for electric power cost in Azerbaijan equal to 2.7 cent/kW.

The calculations were also carried out subject to obtained from gas fuel saving the additional profit for two variants of its 1000 m^3 cost equal to 110 $ and 250 $. The pay-back periods of considered parks were determined. The obtained results of aforesaid wind power parks are shown in table 3.

III. CONCLUSIONS AND RECOMMENDATIONS

From the analysis of wind power parks' estimated economic indexes of 25 mW supposed power (table 3), created on the basis of different types of powerful foreign WPPs it is seen, that it needs to set additionally, what criterion must be taken as dominated one- to reduce investment cost and unit WPPs' quantity or pay- back period. If to issue from the first criterion, in this case the preferable variant is the park, created on the basis of WPP of Vestas V66/1,65 mW type, and if to issue from the second criterion the preferable one is the park, based on WPPs of Enercon E-66 1500 kW or Tacke TW- 1,5, which with the equal investment cost have the near economic indexes.

REFERENCES

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3. Yearly report of “Alternative power sources” laboratory, Azerbaijan Research Institute of Energetics and Energy Design, 2004. (in Russian)

Wind speeds calculation

Table1

Days	Dayly average wind speeds											
	1999 year									2000 year		
	April	May	June	July	August	September	October	November	December	January	February	March
1	6.97	5.71	7.81	6.67	3.45	5.45	5.05	9.59	8.53	6.1	9.03	7.11
2	9.61	5.11	11.9	3.75	7.19	5.6	3.34	5.95	11.67	6.74	6.95	7.23
3	5.94	8.85	5.21	4.08	6.17	14.76	2.15	3.69	5.83	3.69	11.3	5.66
4	7.36	6.77	7.8	9.92	3.22	14.21	2.98	2.4	15.17	8.32	10.53	7.82
5	6.08	12.84	9.71	8.45	9.04	6.45	3.99	8.11	10.68	11.12	11.22	5.39
6	13.39	8.89	4.65	4.62	13.3	6.71	8.03	7.79	14.23	11.76	5.22	10.23
7	8.23	14.05	6.13	5.67	17.3	2.57	4.54	3.86	9.16	11.62	13.7	15.7
8	4.56	11.66	5.56	7.42	11.5	3.82	4.01	6.49	8.88	6.15	4.23	13.26
9	4.56	5.54	3.48	4.39	9.1	3.49	5.34	14.18	12.94	4.96	9.26	4.34
10	4.54	3.29	4.03	3.79	6.33	12.11	7.89	16.32	10.99	4.32	7.09	13.51
11	4.93	3.36	4.38	4.67	7.61	6.97	9.23	6.06	12.32	4.62	5.02	12.44
12	10.29	10.54	10.55	13.68	5.98	6.66	10.88	6.86	5.92	5.97	10.15	10.4
13	4.67	7.18	11.81	5.71	10.57	5.58	6.17	8.74	4.41	3.7	6.21	8.95
14	10.74	13.58	11.84	4.58	11.23	6.74	8.71	11.43	2.66	1.82	6.75	11.79
15	4.19	6.03	15.44	4.74	6.49	8.69	10.43	7.07	5.54	3.76	10.28	5.9
16	4.92	9.02	6.77	6.46	7.66	12.19	14.13	13.67	9.43	4	9.19	9.64
17	6.24	6.93	4.1	3.02	5.17	10.07	7.87	11.55	9	7.15	8.45	11.97
18	4.4	14.2	4.86	4.88	7	4.41	10.8	3.29	5.09	14.5	4.93	9.62
19	7.79	7.15	3.31	6.67	6.35	8.29	11.83	9.98	8.82	17.17	10.71	12.28
20	11.32	13.38	5.07	9.71	8.23	12.27	4.11	10.98	7.03	8.54	10.44	10.75
21	4.16	4.93	10.36	11.79	5.02	11.3	6.65	4.64	14.27	11.58	8.51	11.02
22	7.34	6.08	11.54	14.14	3.19	13.09	10.7	5.96	8.3	14.49	12.63	12.36
23	8.17	6.73	5.82	13.5	3.33	6.43	9.85	4.04	16.22	11.67	7.69	8.92
24	3.44	7.81	5.64	12.05	6.71	6.4	7.15	13.19	6.23	7.74	14.71	6.34
25	4.8	7.05	7.49	7.77	14.38	3.06	9.62	8.69	5.71	16.33	6.92	6.45
25	2.95	5.33	5.49	8.45	11.69	3.93	6.39	9.28	6.36	15.61	6.71	8.03
27	4.11	10.29	6.38	5.51	12.72	2.82	9.84	11.45	5.97	12.65	8.66	11.59
28	5.03	9.64	9.18	6.18	11.95	8.21	13.42	4.43	16.73	7.51	15.17	6.54
29	6.84	8.89	7.34	7.89	13.36	9.41	5.71	8.4	9.27	2.05		6.43
30	10.64	8.23	5.63	5.2	10.58	8.58	2.66	6.84	9.92	10.09		7.25
31		13.18		6.03	5.15		7.5		7.84	8.44		3.22
Monthly average wind speed	6.61	8.46	7.31	7.14	8.42	7.68	7.45	8.16	9.20	8.52	8.99	9.10
Yearly average wind speed	8.09											

WPP's power output for 1999-2000 wind speeds data (kWh)

Table 2

Year, month		WPPs' types				
		Nordex N-54 1000 kW	Nordex N-60 1300kW	Tacke TW 1.5	Vestas V66/1.65mW	Enercon E-66 1500 kW
Height		70 м	60 м	67 м	67 м	66 м
1999	April	218718.27	271153.56	331839.69	336487.13	345799.47
	May	348673.25	492408.75	535435.81	541710.56	547118.94
	June	275113.00	338446.41	424022.00	423054.69	433686.34
	July	264203.66	326656.66	403439.00	407349.25	416125.81
	August	359324.03	441510.59	555250.31	557133.38	564469.69
	September	308554.31	378352.16	476773.97	476146.28	486320.00
	October	293906.06	362162.06	452256.06	454955.19	464024.59
	November	304324.38	375208.34	465327.28	473017.13	479064.38
	December	396045.66	488649.16	607012.69	621640.38	621935.19
2000	January	337699.94	418063.59	514514.69	531403.13	532923.13
	February	365344.44	448821.19	560400.31	567958.88	571635.00
	March	394847.75	484906.16	606699.38	613969.44	618785.44
Total for 12 months:		3867700.75	4827578.63	5933038.19	6004892.44	6081953.98

Total economic performance of wind power parks with following types of WPPs:

Table 3

WPP's type: / Name of position:				Nordex N-54 1000 kW	Nordex N-60 1300kW	Tacke TW 1.5	Vestas V66/1.65mW	Enercon E-66 1500 kW
Quantity				25	19	17	15	17
Total installed capacity, mW				25	24.7	25.5	24.75	25.5
Masts height, m				70	60	80	78	84
Pay- back period (years)	Variant (a) 1100			11.7	12.2	10.9	11.9	10.5
		Gas cost ($/1000 m^3)	110	5.9	6.1	5.1	6.0	5.3
			250	3.6	3.8	3.06	3.7	3.25
	Variant (b) 1400			14.9	15.5	13.9	15.2	13.4
		Gas cost ($/1000 m^3)	110	8.6	7.8	6.5	7.6	6.8
			250	4.6	4.8	3.9	4.7	4.1
	Variant (c) 1700			18.1	18.8	16.9	18.5	16.3
		Gas cost ($/1000 m^3)	110	9.1	9.4	7.9	9.2	8.2
			250	5.6	5.9	4.7	5.7	5.0
Investment costs, million $				27.5 35.0 42.5	27.2 34.5 42.0	28.05 35.7 43.4	27.2 34.7 42.1	28.05 35.7 43.4