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The Determination of Dominant Wind Speed to Increase Efficiency of Wind Energy in Manisa Province

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ABSTRACT

Renewable energy resources is seen as an important source with an increasing interest all over the world in covering the energy requirement owing to the fact that the envoronmental problems increase every other day and the fossile energy sources gradually decrease. The wind energy comes on the top of these energy resources whose usage and technology develop most quickl among these renewable energy resources.

In this study, it has been aimed to determine the most dominant direction of the wind to be able to benefit from the wind energy most effectively in Manisa. It is of vital importance to determine it in terms of locating the tribune in the right direction.In Manisa, the measurement of wind speed and direction for a year has been done and 8760 winds' blowing direction and speed have been determined. These data has been typed in Excel computer program. Making use of this program, these 8760 winds have also been assessed according to how many different directions and for how long duration they have winded. It has also been evaluated that in which direction winds have overwhelmingly blown registering it in Excel medium and a rose wind has been provided indicating the dominant wind direction. As a result of the researches, the dominant wind direction has been found as North-Northeast and East-Southeast. In Manisa, it was arrived as consensus that when the system is being established it should be paid attention that the direction of the dominant winds should be in an open area to be able to utilise productively the Wind Tribunes.

1 INTRODUCTION

Renewable energy resources are seen as an important source with an increasing interest all over the world in covering the energy requirement owing to the fact that the environmental problems increase every other day and the fossile energy sources gradually decrease (Özerdem, 2003). For this very reason, developing countries including Turkey do have to invest more in energy so as to reach the level of industrialized countries. In this respect, the environmental pollution on the local and global levels caused as a result of the energy production from the conventional power stations and understanding their relationships with the global warming have made renewable energy resources which cause almost %0 emission a significant alternative (Kose and Ozgur, 2003).

Seeing that Turkey has huge amounts of rich renewable energy resources, this potential should be seen as a solution to the highly posibble energy problems in the future. Today, the wind energy comes on the top of these energy resources whose usage and technology develop most quickly among these renewable energy resources (Kose, 2004). Despite the fact that Turkey is a very rich country in terms of potential wind energy resources, it is obvious that the sector in our country is rather underdeveloped when it comes to the consumption of wind energy. The sector should be refreshed and encouraged to contribute more to the economy and technical standarts should be constituted (Tavman and Onder, 2001).

Although the methods related to the studies focused on the specifications of the potential of wind energy in Turkey and the current infrastructures go in a parallel direction with the world. These studies progress at a slow pace, since we do lack a proper policy concerning the renewable energy resources. Therefore, a practical energy policy should be employed for our country which has the potential and realistic goals should be marked. The countries which use their national resources more properly in terms of technology will be taking part in more dynamic positions. The matter of making advantages of the usage of renewable energy resources, especially the wind energy can be seen as the top of the steps required to reach the said dynamic positions (Bayrakcı and Delikanli, 2007).

2 MATERIALS AND METHODS

2.1. Wind Formation

In the atmosphere which can be identified as a thermal machine which gains its required egerny from the sun, the air masses which have thermal potential differences move from a colder and higher presure area to to a warmer and lower pressure area. The air mass movement in this natural phenomenon in which the thermal energy transforms into a kinetic energy is called winds (Ozdamar, 2001).

The areas where the winds are meteorologically and topographically dense can be classified as;

1. The areas where change of pressure is high
2. The valleys where rain falls are in a parallel course with constant winds
3. High, plain hills and plateaux
4. The low-inclined valleys which receive constant winds
5. The summits and peaks which are under the effect of powerful wind areas
6. The coastlines which have geostrophic winds and high change of temperature

While the air, lands and seas warm up in one section of the world, they cool down in the other section. These warming and cooling progress periodically owing to the Earth's daily rotation. As a result of this, wind currents come into being in the geographical areas of the world whose structural characteristics are distinctive (Aydin, 2008).

2.2. Wind Calculations

In order to be able to make correct calculations in a measuring station, the locations of the equipments within the measuring stations and the distance between them are crucial (Ozgur, 2006). These equipments consist of measuring poles, sensors and data storage units. In measuring stations, the ideal height of the upper anemometer should be 30 meters above the ground and 20 meters above the lower anemometer. The direction control apparatus should be placed 1.5 meters lower than the upper anemometer (Sen, 2003).

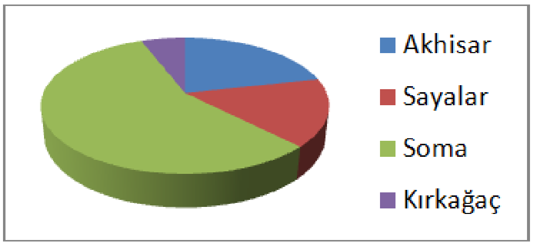
In order to design, plan and operate the wind energy systems, it is crucial to know all the characteristics of the winds in detail. Long lasting reliable data are necessitated so as to determine the positioning of turbines and the potential of wind energy (Nogay and Taskin, 2000). Wind velocity calculations are the most significant and crucial measurings for determining the annul energy savings, stabilizing the performance and investing the sources of winds (Ackerman and Soder, 2002). In order to benefit from the wind energy efficiently, the detailed reports of the wind characteristics should be provided in a particular location. In order to determine the wind potential of a specific zone, the calculations of the zone mentioned should be provided at least for a whole year. However, A larger period than a year will provide you with more accurate assessments.

2.3. The Situation of the Wind Energy in the Province of Manisa

The distribution of the wind stations among the districts in Manisa is displayed in the figure 1. According to this drawing, the total installed power had reached for 293.80 MW till the October of 2011 in Manisa.

In Turkey, since the January of 2011, 15 wind stations have been installed, reaching an overall of 72 in the whole country. Akres-Akhisar wind station in Bekirler village in Manisa-Akhisar formed by the

Best-Karesi Energy Company was opened in 11.09.2011. With the joining of 45 MW installed power in Akhisar into the overall cycle, the installed energy of Turkey has reached 1600 megawatts, while Turkey's investment has reached 1.6 billion Euros. Manisa forms almost %18.36 of Turkey with its 293.80 MW. And this is a very high proportion.



Toplam Kapasite	MW
Akhisar	55,80
Sayalar	34,20
Soma	178,20
Kırkağaç	25,60
Toplam	293,80

Fig. 1: The distrıbutıon of the wind stations among the distrıcts in Manisa

2.4. Measuring the Directions of Dominating Winds in Manisa

Measuring in which directions the winds are moving predominantly is a crucial matter in determining the locations of turbines. As a result of hourly measurements in Manisa for a year, the moving directions and velocity rates of 8760 winds have been stated. These measure rates obtained with the aid of Manisa Region Directorship of Meteorology have been exhibited in Excel and by using this software, it has been possible to determine how many hours, at what directions and velocity the winds have been blowing for a year. These results have been evaluated in Excel and the wind rose displayed in the drawing 'Figure 2' has been acquired. As a result of the wind measuring results conducted in Manisa, the dominating wind direction has been stated as (NNE) North East North and (ESE) East South East. It has been concluded that during the installation of the system, it would be more appropriate to pay attention to leaving this particular direction through which the wind velocity is predominant open in order to benefit more from the turbine.

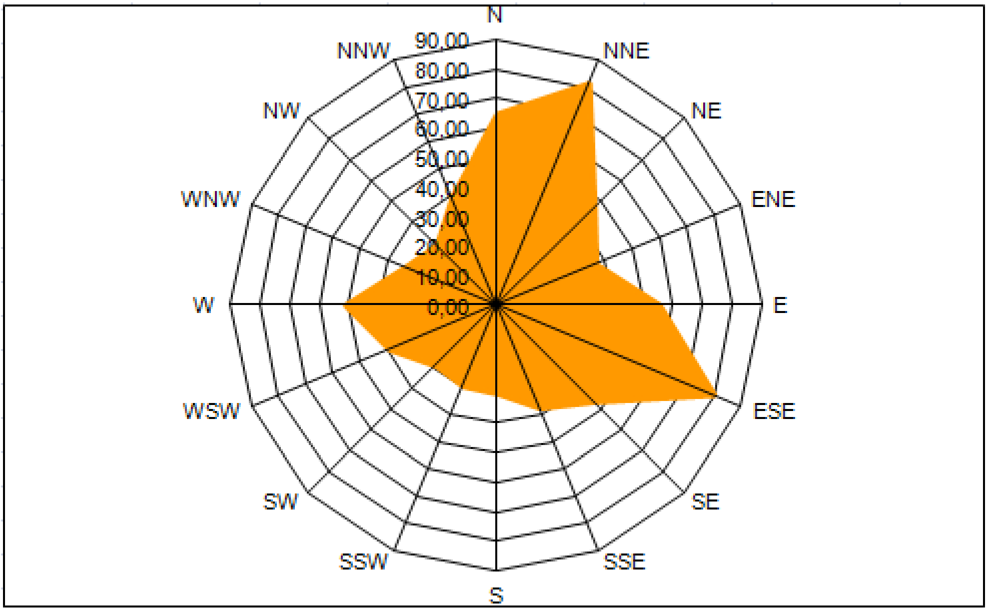


Fig. 2: Wind rose

By using the Excel program, it has also been found for how many hours, at what velocity and directions the winds blow in Manisa and with these results, the hourly wind scale displayed in drawing 'Table 1' and the graphical distribution of this scale are displayed in drawing 'Figure 3'.

Wind velocity (m/s)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
0 ≤ V < 1	154	117	45	80	69	43	66	86	126	96	174	107
1 ≤ V < 2	287	235	163	222	232	182	166	220	242	243	259	208
2 ≤ V < 3	147	171	184	196	171	133	128	132	144	158	139	159
3 ≤ V < 4	51	66	144	119	87	109	86	63	68	66	63	112
4 ≤ V < 5	34	37	104	61	61	75	84	58	42	52	38	70
5 ≤ V < 6	16	31	30	17	44	64	66	44	33	55	17	33
6 ≤ V < 7	10	28	36	6	38	48	42	42	22	28	13	19
7 ≤ V < 8	13	24	15	8	19	24	44	40	22	20	5	4
8 ≤ V < 9	6	11	9	3	13	26	27	29	11	7	3	5
9 ≤ V < 10	3	8	4	3	8	11	17	16	5	5	2	2
10 ≤ V < 11	1	4	2	4	0	2	8	5	1	2	0	3
11 ≤ V < 12	0	3	3	0	1	2	3	0	0	2	1	3
12 ≤ V < 13	0	5	2	0	0	0	1	1	0	3	0	1
13 ≤ V < 14	21	3	1	0	0	0	0	0	0	1	0	10

Table 1 : The hourly wind scale of a year

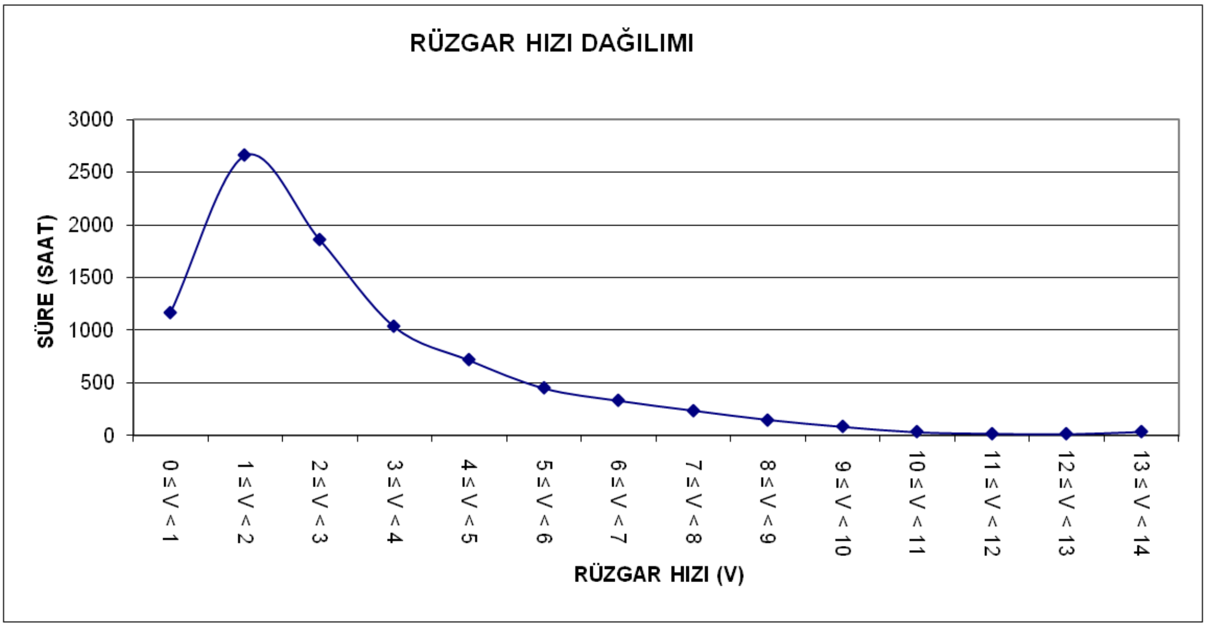


Fig. 3: The graphical distribution of the hourly wind scale for a year

3 CONCLUSION

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