

Analyses of Current Wind Energy Status of Turkey and its Future Prospect

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Abstract

In this study, wind power status of Turkey is extensively investigated. In this regards, wind power occasion, which is one of the most popular and promising renewable energy types of today, is studied for Turkey in the year range of 2009-2018. Finally, Turkey's long term wind energy status till 2030 is predicted. In this context, it is demonstrated that Turkey's wind energy status will even surpass the case of 2018; in which wind energy ratio by 2030 based on whole sources is expected to be 16.61% exceeding the case of 2018, which is 16.56%.

Keywords: Available power potential, Renewable energy, Wind energy

Türkiye'nin Mevcut ve Gelecekteki Rüzgar Enerjisi Durumunun Analizi

Öz

Bu çalışmada, Türkiye'nin rüzgâr enerjisi durumu etraflıca araştırılmıştır. Bu bağlamda, günümüzün en popüler ve gelecek vaat eden yenilenebilir enerji türlerinden birisi olan rüzgâr enerjisi uygulamaları, Türkiye için, 2009 ile 2018 yıl aralığını kapsayacak şekilde incelenmiştir. En son olarak ise, Türkiye'nin 2030 yılına kadar olan uzun vadeli rüzgar enerjisi durumu tahmin edilmiştir. Bu kapsamda, Türkiye'nin 2030 yılındaki rüzgâr enerjisi durumunun, 2018'deki durumunu bile aşacağı gösterilmiştir; şöyle ki, rüzgar enerjisinin, 2018 yılında, tüm enerjilere göre verilen oranı olan %16,56'lık değerinin, 2030 yılında aşılıp, %16,61'lik değere ulaşacağı beklenmektedir.

Anahtar Kelimeler: Mevcut güç potansiyeli, Rüzgar enerjisi, Yenilenebilir enerji

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1. INTRODUCTION

Fossil energy resources have declined rapidly over the past decade; on the other hand, the frequent increasing population and technological developments in parallel have substantially increased the demand for energy [1]. Thus, the use of fossil energy sources and the ever-increasing global warming associated with the greenhouse gas emissions are unfortunately the most critical and urgent global problems at the present time [2-4]. According to a report released by the International Energy Agency (IEA), unless any precautions are not taken; greenhouse gas emissions are foreseen to be doubled by 2050 year [5]. Therefore, it is quite essential to shift from the utilization of fossil fuels to renewable energy sources in order to meet this demand and to simultaneously reduce global CO₂ emissions down to tolerable levels.

1.1. Global Renewable Energy Generation

As a renewable energy source, the global installed capacity of 1,288 GW in 2009 rapidly increased by %58.09 and reached the total capacity of 2,036.493 GW in 2015, considering the global situation. On the other hand, energy generation from renewable sources up to 2016 reached the largest annual increase by this year; i.e., 173.839

GW of recent capacity in this sector was introduced to the global system of renewable power. This amount of renewable power corresponded to rise of 8.54% compared to the former case of 2015 and exhibited an overall enhancement of renewable power generation reaching to the value of 2,210.332 GW at the end of 2016. These new annual installations of renewable energy sources throughout 2016 contributed with percentages of 42.40%, 29.19%, and 19.42% by means of solar PV technology, wind energy, and hydropower, respectively to the total installed renewable energy capacity worldwide. Further increase of global installed capacity of the 2017 year was reported as to correspond 2,392.571 GW of total worldwide installations [6-7]. And finally, by 2018, the global total renewable power installations reached to 2,572.755 GW in which the shares of different sources including hydropower, wind energy, solar energy, bioenergy, geothermal energy, and marine energy are reported as 50.35%, 21.91%, 18.89%, 8.31%, 0.52%, and 0.02%, respectively, corresponding to 1,295.317 GW, 563.659 GW, 486.05 GW, 213.888 GW, 13.277 GW, and 0.529 GW, respectively. These explained situations are demonstrated in Figure 1 for to reveal global renewable power installations in terms of different source types [8].

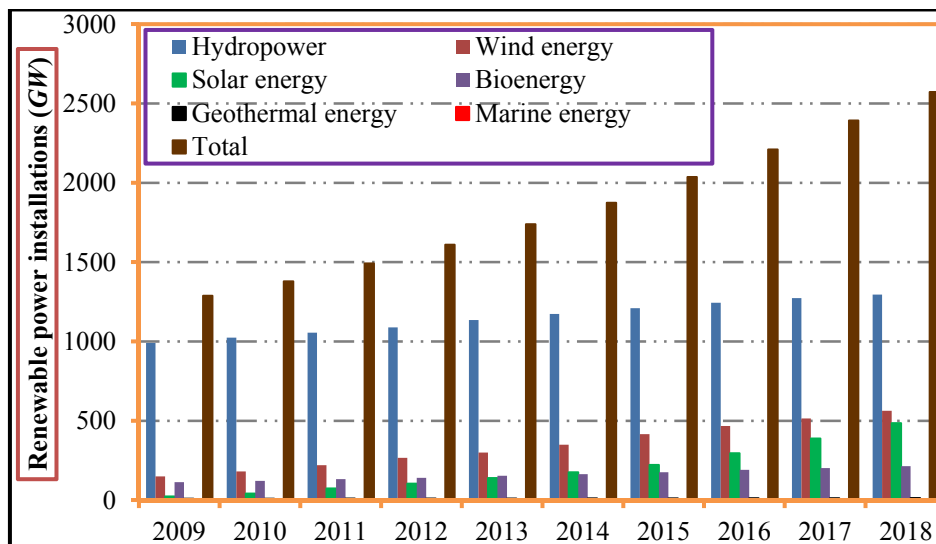


Figure 1. Cumulative global renewable power installations based on different sources

1.2. Renewable Energy Generation of Europe

Considering the importance of energy, especially renewable energy generation methods; this study aims to focus on general renewable energy situation of Europe as well. In this regards, Figure 2 indicates renewable power installations of Europe.

Renewable energy generation capacity of Europe having 338.653 GW in 2009 rapidly increased by %52.03 and reached the total capacity of 514.863 GW in 2015, considering the Europe's situation. Besides, energy generation from renewable sources reached a cumulative value of 539.886 GW by 2016; i.e., 25.023 GW of recent capacity in this sector was introduced to the total renewable power of Europe. This amount of renewable power corresponded to cumulative rise of 4.86% compared to the former case of 2015. These new annual installations of renewable

energy sources throughout 2016 in Europe contributed with percentages of 51.60%, 25.92%, and 15.19% by means of wind energy, solar energy, and hydropower, respectively to the total installed renewable energy capacity. Further increase of the installed capacity of the 2017 year was reported as to correspond a cumulative of 564.444 GW of total Europe's installations [6-7]. And finally, by 2018, the global total renewable power installations reached to 589.523 GW in which the shares of different sources including hydropower, wind energy, solar energy, bioenergy, geothermal energy, and marine energy are reported as 37.43%, 30.95%, 20.55%, 10.76%, 0.28%, and 0.04%, respectively, corresponding to 220.643 GW, 182.440 GW, 121.153 GW, 63.417 GW, 1.623 GW, and 0.247 GW, respectively. These explained situations are demonstrated in Figure 2 for to reveal renewable power installations of Europe Continent considering different sources [8].

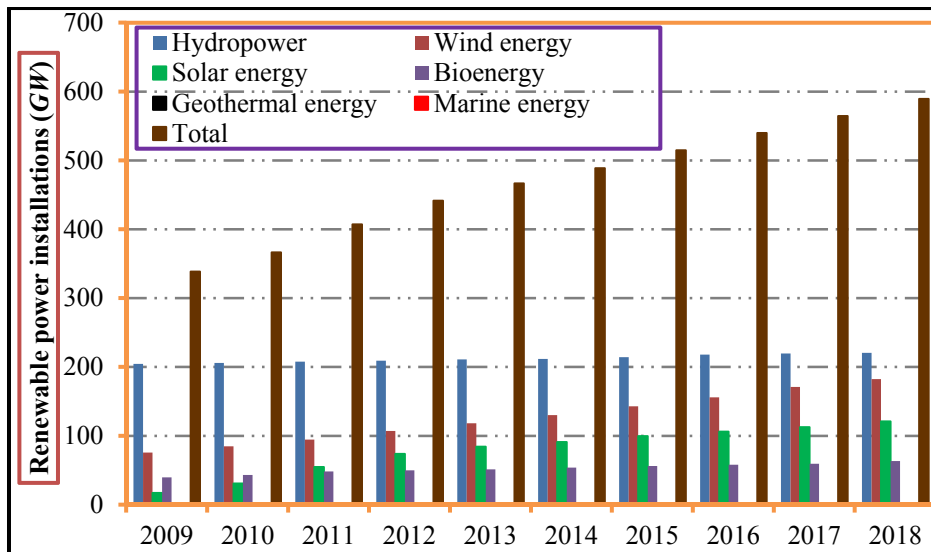


Figure 2. Cumulative renewable power installations based on different sources in Europe

1.3. Renewable Energy Generation of Eurasia

Armenia, Azerbaijan, Georgia, Russian Federation, and Turkey are the countries which are included in the Eurasia location. In this regards, renewable energy generation capacity of Eurasia having 70.124 GW in 2009 rapidly increased by 29.44%

and reached the total capacity of 90.770 GW in 2015, considering the location of Eurasia's situation. Besides, energy generation from renewable sources reached a cumulative value of 93.890 GW by 2016; i.e., 3.120 GW of recent capacity in this sector was introduced to the total renewable power of Europe. This amount of

renewable power corresponded to cumulative rise 3.44% compared to the former case of 2015. These new annual installations of renewable energy sources throughout 2016 in Eurasia contributed with percentages of 40.90%, 28.72%, and 19.87% by means of wind energy, hydropower, and solar energy, respectively to the total installed renewable energy capacity. Further increase of the installed capacity of the 2017 year was reported as to correspond a cumulative of 7.570 GW of total Eurasia's installations [6-7]. And finally, by 2018, the total renewable power installations of Eurasia

reached to 105.794 GW in which the shares of different sources including hydropower, wind energy, solar energy, bioenergy, geothermal energy, and marine energy are reported as 83.23%, 6.80%, 5.39%, 3.30%, 1.28%, and 0.002%, respectively, corresponding to 88.048 GW, 7.197 GW, 5.702 GW, 3.488 GW, 1.357 GW, and 0.002 GW, respectively. These explained situations are demonstrated in Figure 3 for to reveal renewable power installations of Eurasia location taking a variety of different sources into account [8].

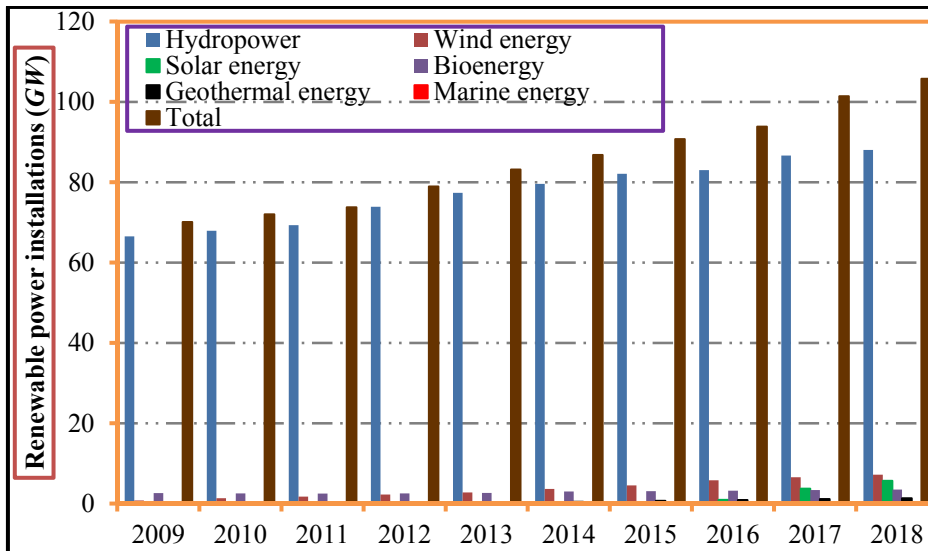


Figure 3. Cumulative renewable power installations based on different sources in Eurasia region

1.4. Renewable Energy Generation of Turkey

On the other hand, renewable energy generation capacity of Turkey being a member of Eurasia had a total 15.576 GW installed power by 2009, which later increased by 102.37% and reached the total capacity of 31.521 GW in 2015, considering this country's situation. As well as, energy generation from whole renewable sources reached a cumulative value of 34.494 GW by the year 2016; i.e., 2.973 GW of recent capacity in this sector was introduced to the total renewable power of Turkey. This amount of renewable power corresponded to cumulative rise 9.43% compared to the former case of 2015. These new annual installations of renewable energy sources throughout 2016 in this

country contributed with percentages of 41.98%, 27.35%, and 19.64% by means of wind energy, hydropower, and solar energy, respectively to the total installed renewable energy capacity of the country. Additional increase of the installed capacity of the 2017 was reported as to correspond a cumulative of 4.324 GW of total Turkey's installations [6-7]. And finally, by 2018, the total renewable power installations of Turkey have attained a value of 42.306 GW in which the shares of hydropower, wind energy, solar energy, bioenergy, geothermal energy, and marine energy are reported as 66.87%, 16.56%, 11.97%, 1.567%, 3.03%, and 0%, respectively, corresponding to 28.291 GW, 7.005 GW, 5.064 GW, 0.663 GW, 1.283 GW, and 0.000 GW, respectively. Similarly,

these explained situations are demonstrated in Figure 4 in order to demonstrate renewable power installations of Turkey regarding a variety of

different sources into account. As observed from this figure, no marine energy generation method has yet been used in this country [8].

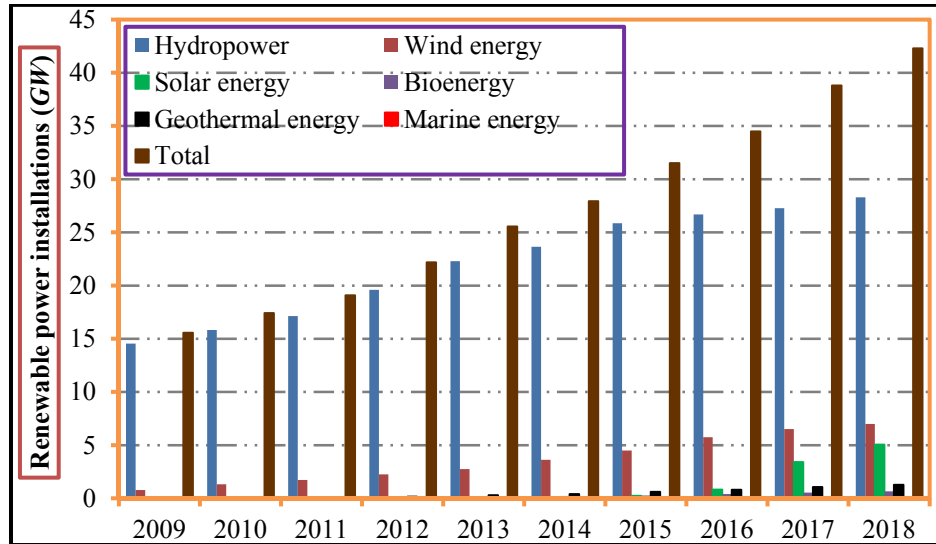


Figure 4. Cumulative renewable power installations based on different sources in Turkey

2. WIND POWER EXAMINATION OF TURKEY

2.1. Territorial Wind Power Analysis of Turkey

Wind power of Turkey dealing with a specific region of eastern Mediterranean location of Turkey is studied in literature [9]. In this regards, while cumulative wind power installations of Turkey was presented in Figure 4; Figure 5 similarly demonstrates the power capacities of the operating, under construction, and licensed wind farms in Turkey based on the comparison of seven different state geographical territories. It is specified in this figure that the main operating wind farms are mainly constructed in the West and South parts of Turkey, i.e., Aegean, Marmara, and the Mediterranean territorial regions are pretty dense with operating wind farms. However, the leader region in terms of the operating wind power in Turkey is reported to be the Aegean region having the largest wind farm installations by the end of 2019, corresponding to a total installed wind power of 3.098 GW. This power value of operating

wind farms in Aegean region is secondly and thirdly followed by Marmara and Mediterranean regions having 2796.45 MW and 996.10 MW of installed power, respectively. However, Central Anatolia, Black Sea, Southeastern Anatolia, and Eastern Anatolia Regions have comparatively less installed operating power values corresponding to 763.90 MW, 297.20 MW, 93.05 MW, and 11.70 MW of installations, respectively.

On the other hand, the fastest construction site in the wind power sector was observed to be located in the Marmara region by the end of 2019. While, the additional wind power capacity including under constructional wind power capacity of this territory reached 729.40 MW in end of this year, it is observed that no wind farms are observed to be under construction in state geographical territories of Black Sea and Southeastern Anatolia regions. Followed by Marmara region, Aegean region has second highest wind power capacity of 410.49 MW of installations which is under construction. However, the least regional based wind power under construction was observed in

the Central Anatolia region with the maximum capacity of 52.80 MW. Similarly, Mediterranean and Eastern Anatolia regions have 63.90 MW and 53.20 MW of installed power which can also be referred few in amount in terms of under constructional wind power. But, most of these additional under constructional installations in these cited provinces are reported to be probably completed by end of 2023.

The territory where the licensed wind farms were most concentrated is conducted to be Marmara region by the end of 2019 to be 825 MW of wind power. As well as, the region where the licensed wind farms were least concentrated is the Mediterranean Region corresponding to only 12 MW of wind power installations in this year.

On the other hand, wind power situation of Turkey based on two types of wind farms of operating and under constructional types reveals that the leader state territorial location in terms of wind power applications is the Marmara region having total of 3525.85 MW of power. This is followed by Aegean and Mediterranean regions having 3508.64 MW and 1060.00 MW of installations, respectively. But, state territorial regions including Central Anatolia, Black Sea, Southeastern Anatolia, and Eastern Anatolia Regions have

comparatively less total power values corresponding to 816.70 MW, 297.20 MW, 93.05 MW, and 64.90 MW of capacities, respectively. Since these power values include under constructional wind farm applications besides the operating ones, this situation states that these power values will be reached by the end of 2023 year, according to the policy of Turkey State.

Finally, the total power values of wind farms including three groups are observed to be highest in Marmara region having 4350.95 MW of total installations, followed by Aegean and Mediterranean regions having 3592.49 MW and 1072.00 MW of capacities, respectively. These results demonstrate that Turkey is performing an essential attack in terms of wind power applications, especially in these three state geographical territories. However, state territorial regions including Central Anatolia, Black Sea, Southeastern Anatolia, and Eastern Anatolia Regions have comparatively less total power values corresponding to 953.70 MW, 472.80 MW, 93.05 MW, and 64.90 MW of capacities, respectively. The reason of high capacities in Marmara, Aegean and Mediterranean regions is due to the high wind power potentials in these regions [10].

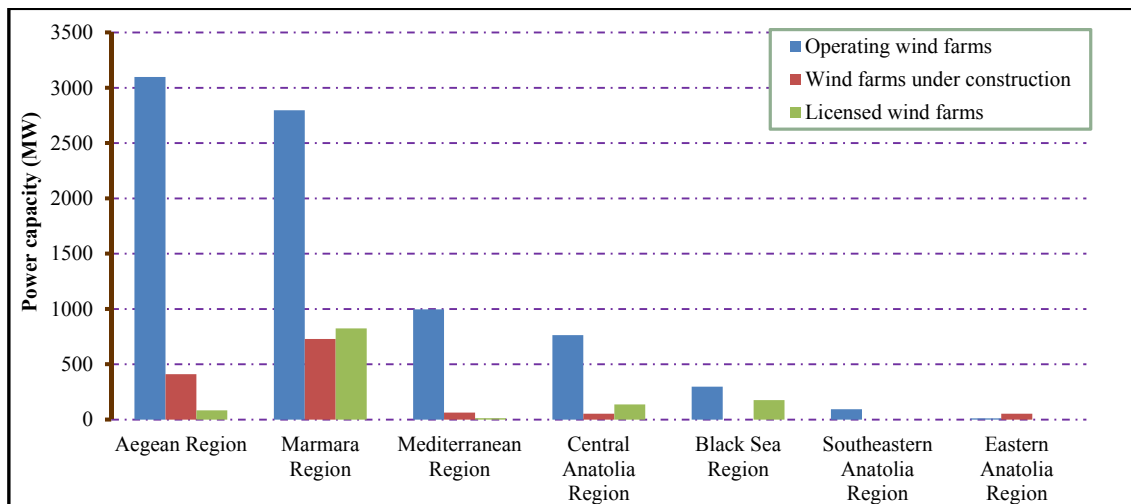


Figure 5. Wind power capacities in Turkey expressed by geographical territories and installation types

2.2. Province Based Wind Power Analysis of Turkey

Electric energy demand of Turkey is rapidly increasing, in which it is concluded in this study that a solution to this problem could be handled by the utilization of unused wind energy potential in this country [11]. In this regards, wind power potential analysis performs a significant role of determining unused wind power potential of a considered location [12-15].

Similarly in this study, Turkey's theoretical potential of the wind power is expressed in terms of the provinces as well the power extraction of each province is shown to reveal how much the total theoretical potential of the provinces have turned into reality [10,16,17]. According to the Turkish Wind Energy Association (TWEA), total available wind power potential of Turkey corresponding to 115,329 MW is quite higher than the current cumulative installed power of this country. Since, the installed wind power of Turkey, also including pre-licensed potential reveals that the total installations of this state had

only reached 14,958 MW. Namely, in the case of utilizing the remaining unused 87% of the theoretical wind potential of Turkey, the greenhouse gas emissions in this country can be reduced to a quite tolerable level. Secondly, the significant reduction in energy generations from the carbon-based fuels would be reduced. In this perspective, the theoretical wind power potential map and province-based wind power analysis of Turkey are reported in detail as indicated in Figure 6 and Table 1, respectively. The available data presented for the theoretical potential of Turkey indicates the total wind potential of Turkey including wind power generations with wind speeds of 6.8 m/s and higher. On the other hand, for power generation using larger wind turbines, the wind speed is required to exceed 7 m/s resulting the theoretical potential of Turkey to be less than half of the cited 115,329 MW of projected power as seen in this table. Besides, the wind power potential that can be settled at offshore is around 17.393 MW which is not included in Table 1 [17].

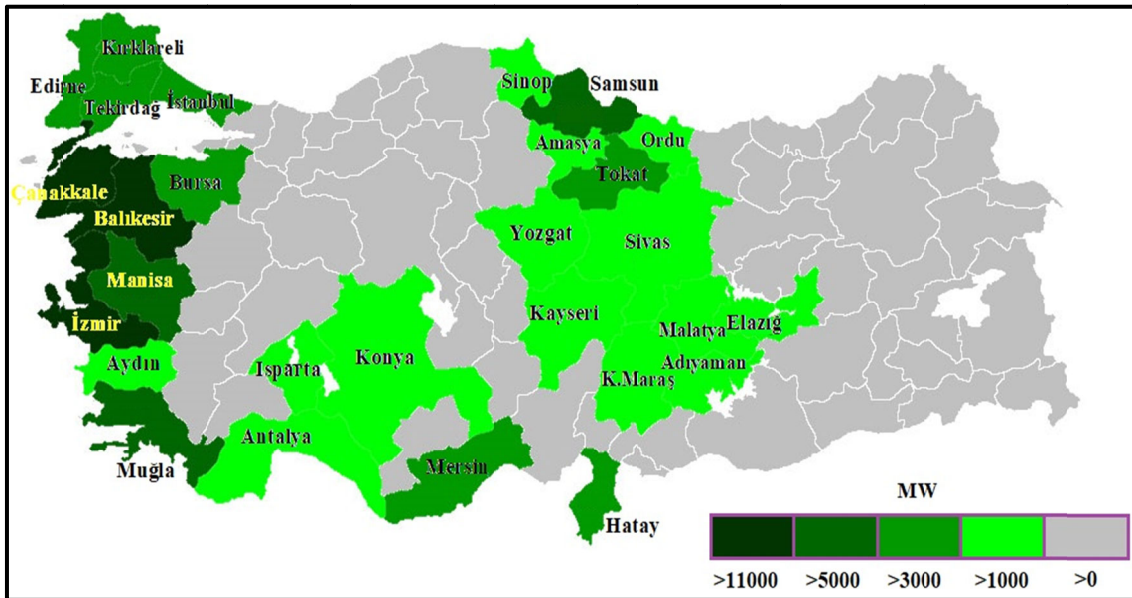


Figure 6. The map indicating the regions where desirable theoretical wind power exists for electricity generation in Turkey

Table 1. Turkey’s total available theoretical wind energy potential and its current production

No	City	Theoretical potential (MW)	Operational (MW)	Under construction (MW)	Licensed (MW)	Pre-licensed (MW)	Total process (MW)	Process/theoretical (%)
1	Balikesir	13,827	1,091	173	74	478	1,816	13.1
2	Çanakkale	13,013	323	70	425	501	1,319	10.1
3	İzmir	11,854	1,295	266	62	73	1,696	14.3
4	Manisa	5,302	640	58	10	30	738	13.9
5	Samsun	5,222	0	52	9	49	110	2.1
6	Muğla	5,171	196	59	0	275	530	10.2
7	Tekirdağ	4,627	153	49	19	60	281	6.1
8	İstanbul	4,177	231	108	277	250	866	20.7
9	Bursa	3,882	119	4	0	130	253	6.5
10	Mersin	3,531	173	0	0	30	203	5.7
11	Edirne	3,470	167	27	0	344	538	15.5
12	Hatay	3,414	360	27	33	30	450	13.2
13	Kırklareli	3,079	116	11	150	145	422	13.7
14	Tokat	3,002	128	1	0	40	169	5.6
15	Aydın	2,524	250	2	184	250	686	27.2
16	Ordu	2,276	0	0	10	50	60	2.6
17	Kahramanmaraş	2,072	82	36	0	40	158	7.6
18	Kayseri	1,885	264	8	0	80	352	18.7
19	Konya	1,860	130	71	60	48	309	16.6
20	Sivas	1,642	150	0	37	240	427	26.0
21	Sinop	1,491	0	0	5	5	10	0.7
22	Isparta	1,423	60	0	0	0	60	4.2
23	Malatya	1,395	0	0	10	80	90	6.5
24	Amasya	1,200	126	4	0	60	190	15.8
25	Adıyaman	1,197	25	0	0	40	65	5.4
26	Antalya	1,170	0	0	0	100	100	8.5
27	Yozgat	1,076	0	5	0	0	5	0.5
28	Elazığ	1,028	0	0	0	40	40	3.9
29	Karaman	934	7	0	40	0	47	5.0
30	Adana	899	0	0	0	120	120	13.3
31	Afyonkarahisar	860	263	0	88	0	351	40.8
32	Osmaniye	718	235	0	0	0	235	32.7
33	Diyarbakır	635	0	0	0	0	0	0.0
34	Yalova	533	84	50	32	110	276	51.8
35	Kastamonu	515	0	0	0	0	0	0.0
36	Mardin	509	0	0	0	0	0	0.0
37	Erzincan	383	0	0	0	50	50	13.1
38	Kocaeli	334	10	294	0	30	334	100.0
39	Çankırı	315	0	0	0	50	50	15.9
40	Bilecik	309	39	41	90	0	170	55.0
41	Gaziantep	267	86	0	0	0	86	32.2
42	Denizli	239	0	0	66	0	66	27.6
43	Kütahya	190	0	0	0	50	50	26.3
44	Sakarya	180	0	0	70	110	180	100.0
45	Kırşehir	168	168	0	0	0	168	100.0
46	Giresun	160	0	0	0	0	0	0.0
47	Çorum	156	0	0	0	65	65	41.7
48	Zonguldak	120	0	0	120	0	120	100.0
49	Bolu	117	0	0	0	0	0	0.0
50	Eskişehir	89	0	39	0	50	89	100.0

51	Ankara	80	0	0	0	80	80	100.0
52	Karabük	73	0	0	0	30	30	41.1
53	Bartın	62	0	0	0	0	0	0.0
54	Niğde	62	0	0	0	0	0	0.0
55	Bingöl	61	0	0	0	50	50	82.0
56	Burdur	58	0	1	0	0	1	1.7
57	Uşak	57	54	3	0	0	57	100.0
58	Ağrı	50	0	0	0	50	50	100.0
59	Erzurum	50	0	0	0	50	50	100.0
60	Van	50	0	0	0	50	50	100.0
61	Bitlis	40	0	0	0	40	40	100.0
62	Kars	40	0	0	0	40	40	100.0
63	Kilis	40	0	0	0	40	40	100.0
64	Kırıkkale	40	0	0	0	40	40	100.0
65	Trabzon	30	0	0	0	30	30	100.0
66	Hakkâri	29	0	0	0	0	0	0.0
67	Siirt	15	0	0	0	0	0	0.0
68	Tunceli	13	0	0	0	0	0	0.0
69	Artvin	10	0	0	0	0	0	0.0
70	Ardahan	9	0	0	0	0	0	0.0
71	Batman	8	0	0	0	0	0	0.0
72	Nevşehir	8	0	0	0	0	0	0.0
73	Iğdır	2	0	0	0	0	0	0.0
74	Gümüşhane	1	0	0	0	0	0	0.0
75	Şanlıurfa	1	0	0	0	0	0	0.0
76	Aksaray	0	0	0	0	0	0	0.0
77	Bayburt	0	0	0	0	0	0	0.0
78	Düzce	0	0	0	0	0	0	0.0
79	Muş	0	0	0	0	0	0	0.0
80	Rize	0	0	0	0	0	0	0.0
81	Şırnak	0	0	0	0	0	0	0.0
TOTAL		115,329	7,025	1,459	1,871	4,603	14,958	13.0

3. TURKEY'S WIND ENERGY PREDICTION AMONG THE OTHER SOURCES

The investigations on wind energy status of Turkey compared to other renewables, considering above analyses, indicated that Turkey's wind power installations by 2009 were only 5.08% to total installed renewable power. However, this situation is rapidly accelerated reaching 2018 in which the percentage is increased to 16.56%, at the end of this year. According to seven territorial geographical regions of Turkey and considering operating, under constructional, and licensed wind farms, it is investigated that Marmara region of the state will have the highest wind power installations reaching 2023. This will be followed by Aegean and Mediterranean regions of the state. So, the expected wind power installations based on

operating wind farms, and the other two types reveal that Marmara, Aegean, and Mediterranean regions of the state will have 3525.85 MW, 3508.64 MW, and 1060.00 MW, respectively, by 2023 year. Furthermore, installed power analysis considering 81 cities of Turkey are conducted. In this context, reaching 2023, it is analyzed that Turkey will have 251 wind farms in operating which are currently in the status of operating, under constructional and licensed wind farms. Apart from that, it is shown that Turkey has a high potential of wind power. But, most of this potential of wind power is unfortunately not benefited in electricity generations. Namely, while Turkey has 115,329 MW of total wind power potential, only 13.0% of the total potential is assessed in wind energy conversion systems for power generation. This percentage corresponds to 14,958 MW of installed wind power including pre-licensed wind

farms as well. Besides, it is investigated that Balıkesir province of Turkey being the leader city in terms of wind power applications. In this city, it is shown that wind power installations exceeds the average of Turkey, i.e., in this city 13.1% of the total theoretical wind power potential has been turned to benefited wind power, surpassing the average situation of Turkey, i.e. 13%.

Besides, based on 2023 renewable vision plans of Turkey for hydroelectricity, wind power, solar energy, geothermal, and biomass were expected to reach 36 GW, 20 GW, 3 GW, 0.6 GW, and 2 GW of power, respectively. On the other hand, the total installed power capacity of Turkey considering whole resources were expected to exceed 120 GW according to this vision plan by 2023 [18]. Similarly, with a slight difference, Ozcan (2018) reported the forecasted installations for the same renewable resources were expected to be 34 GW, 20 GW, 5 GW, 1 GW, and 1 GW of power, respectively by 2023 [19]. However, as reported in Figure 4, it is shown that Turkey is in a better situation by 2018 compared with respect to the forecasted plans constituted earlier. Since, these values of two model forecasting data predicting 2023 case are already exceeded in reality, especially in the case of solar and geothermal power installations, as shown in Figure 4.

Similarly, another forecasting model of power generation of Turkey till the year 2030 is shown in Figure 7 considering the annual source-based installations which have rapidly accelerated since 2014. This figure involves the situation of the whole source-based power generations depending on the current politics scenario including the period range of 2014-2030. This forecasting scenario was structured based on the state politics of Turkey. Thus, the relevant institution that conducts the task of related matters; i.e., Energy Marketing Regulation Board of Turkey performed the study of the estimations till the year 2030 [10].

Eight different energy sources are compared in this figure to reveal the situation of the wind energy source on the total generated power of Turkey based on the state forecasting results. In these regards, the eight sources including the stone coal,

lignite, oil, natural gas, nuclear, hydroelectric power, wind, and solar types are considered in this figure. In this regards, the total of the eight sources indicates that the total installations currently is expected to rise from the current total installed power of 88.551 GW to reach 120.406 GW of cumulative installations by the end of 2030 year [20]. In this context, it is reported that at least 35.97% enhancement in total installed power of Turkey is necessarily required in forthcoming 10 years based on this forecasting model, due to the rapid social, industrial, and technological developments, as well the population rise.

Based on the forecasted plans shown in Figure 7, hydropower was expected to reach a total of 26.410 GW of installations by 2018, however in reality, at the end of 2018, Turkey's total installed power in hydroelectricity is shown to reach 28.291 GW of installations as demonstrated in Figure 4. Similarly, forecasting indicates that 6.815 GW of installations could be attained by 2018 in wind power, on the other hand in reality, by 2018 shown in Figure 4, total wind power of Turkey reached a total of 7.005 GW of installations at the end of this year. Additionally, while forecasting plans declared that total installed power of solar energy of Turkey could reach 2.840 GW of installations by 2018, real installations exceeded this value in which 5.064 GW of installations had occurred by this year in this sector.

In this figure, it is shown that the development of the wind power reported with respect to other sources is generally better. Based on the current progress in wind power, the forecasting reveals that 10.8 GW of total wind power installations will be obtained until the end of 2023. This case corresponds to 16.187 GW for the installations until the end of 2030 year. So, the state forecasting scenario absolutely requires 765.134 MW/year annual renewable installations for wind power in the period between 2018 and 2030, when considered the case of wind power situation by 2018 year in Figure 4 [10].

On the other hand, beyond the plans of Energy Marketing Regulation Board of Turkey, the

Ministry of Energy and Natural Resources of Turkey also forecasts a strategic plan of wind power installations till the end of 2020 to reach in the total of 10,000 MW of power generations. The related prediction is performed according to the current performance indicators of wind power installations eventuated up to the present time.

However, the ministry also declares that the necessary annual investment has to be done according to the annual plan of the ministry to exceed 20 GW of installations until the end of 2023 year, in order to achieve the Turkish Republic policy planned initially [21-23].

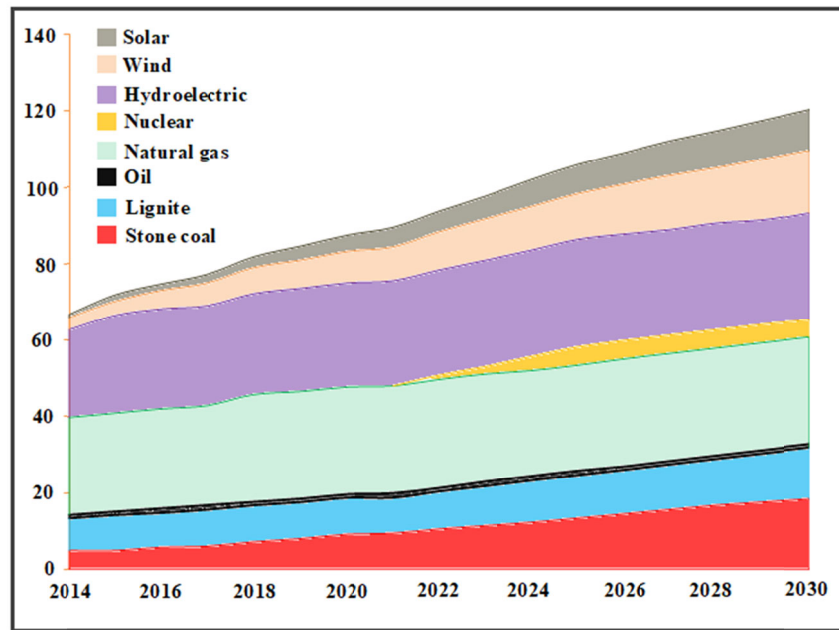


Figure 7. Variation of the source based installed power (GW) in Turkey based on the current state politics scenario

4. CONCLUSIONS

This study presented the importance of renewable power applications, especially wind energy status of Turkey are focused on. So in this study, wind energy generation status of Turkey and its future prospect are revealed. Wind energy production of Turkey is compared with other renewable energy generation methods in this country, as well as, World's, Europe's and Eurasia's renewable power generation status are shown. So, Turkey's situation in renewable power applications considering World, Europe, and Eurasia's location is clarified.

In this regards, while renewable power installations of Turkey are reported to correspond 42.306 GW; renewable power installations of

World, Europe, and Eurasia location are demonstrated to reach 2573 GW, 589.523 GW, and 105.794 GW, respectively. While there are 42 countries found in the Europe continent, there are 5 countries including Armenia, Azerbaijan, Georgia, Russian Federation, and Turkey found in the Eurasia region. In this way, the current study indicates the total installed renewable power of Turkey based on European continent is 7.18%, and as well as demonstrates 39.99% with respect to Eurasia location, revealing Turkey's good position in renewable power generation. Namely, it is presented that Turkey has performed a great attack of reducing the percentage of conventional fossil fuel power generation methods, and showed a rapid attack of renewable power applications in electricity generations. Turkey, being a country of

the European continent and when compared with its neighbors in Eurasia location; in this study, it is revealed that this country has shown a very good development in the field of renewable energy sector applications when compared with respect to other countries located in Europe continent and Eurasia region.

On the other hand, wind energy is one of the most popular and promising renewable energy types of today. Therefore, wind energy status of Turkey compared to whole renewable energy sectors is presented in the study, as well. Based on the conducted results of the year range between 2009 and 2018; it is demonstrated that, in 2009, while wind power applications were only 5.08% of total renewable generation types, in 2018, those reached 16.56% of total renewable generation methods in this state. Besides, today's territorial wind power analysis, as well as, near future prediction of these territories till 2023 based on the current progress are also conducted. Among the seven territorial geographical locations of the State, based on the results, it is shown that Marmara region will have the highest applications of wind power attaining 3525.85 MW of installations reaching 2023 year. Similarly, by 2023, this power value is followed secondly and thirdly by Aegean and Mediterranean regions of the State, respectively, which will have 3508.64 MW and 1060.00 MW, respectively.

Based on the total of 251 operating, under construction, and licensed wind farms, province based wind power analysis of Turkey is also performed considering 81 discrete cities of the country. So, total wind power installations of each, including pre-licensed wind farm installations as well, are shown, in which it is demonstrated that Balıkesir province is the leading city in terms of wind power applications. In this city, it is investigated that 13.1% of the total theoretical wind power potential has been turned benefited wind power in electricity generations.

Finally in this study, Turkey's wind energy status by 2030 is forecasted. Based on the predictions, it is foreseen that the total installed power of Turkey by 2030 is expected to reach 120.406 GW in which the share of wind power in this total

installed power is expected to reach approximately 16.61%, corresponding to approximately 20 GW of installations at 2030. These predictions indicate Turkey's attacks in wind power applications in the next decade, in terms of transforming unused wind power potential to used wind power converted to beneficial electrical power.

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