RENEWABLE ENERGY RESOURCES POTENTIAL IN TURKEY, PRODUCTION AND CONSUMPTION

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Abstract: *The purpose of study; to analysis and the development of alternative energy sources years to years and numerically analysis them. Regarding to BP Energy Statistic Report 2016; renewable energy production has increased percent 15,2 on electricity production total. It can be shown analysis that renewable energy sources is the energy sources of the future. Since 2010, The Turkish government policies related to renewable energy sources in the World has been published and efforts are being made to focus on this issue for the future. The country which have good planning on work will meet a large percentage of energy demand through renewable energy. This paper aims to analysis the situation and potential of Turkey in terms of clean and renewable energy and to plan for the future energy policy.*

Keywords: *Renewable Energy, Wind Energy, Analysis of Energy.*

1. INTRODUCTION

Renewable energy sources are those, which can be produced on the earth and in the nature without the need for any generation process, during which CO₂ emissions are produced at a low level or none, on which the damage to the environment is lower than other energy sources, constantly renewed, clean and natural sources of energy such as wind, sun, geothermal, biomass, biogas, wave, current energy and tide.

There is a rapidly increasing demand for energy over time. International studies show that environmental issues arising from other fuels have increased, thus accelerating policies that support the use of renewable energy sources seen to be "clean" compared to other sources, making a positive contribution to the environment in terms of their use. The share of the use of renewable resources in total energy production is around 19% in 2006, but it is up to 20% in 2011 and 25% in 2018 thanks to increased work [1].

Our country, which has a significant potential in terms of renewable energy, ranks 7th in the world with its geothermal potential. In addition to this energy source, priority is given to the development of hydroelectric sources as well as wind and solar energy. According to the "Turkish National Renewable Energy Action Plan", the hydroelectricity installed capacity of 20.000 MW in 2023, the capacity of the wind energy capacity of 20.000 MW; Solar energy capacity to 3,000 MW and geothermal energy capacity to 1,000 MW, 30% of total electricity production is planned to be generated from renewable energy [2].

2. INVESTIGATION OF RENEWABLE ENERGY RESOURCES USED IN THE WORLD

Energy consumption, population growth, urbanization, industrialization, and the spread of technology all over the world are increasing. Non-renewable energy sources, on the other hand, are continuously decreasing in the world, inversely proportional to energy demand [3].

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While the energy consumption used in the world is increasing, different methods are being sought in energy production. The most noteworthy of the different methods is the energy generated from renewable energy sources, which are increasing in the year. The increased energy generated from renewable energy sources can be seen in Figure 1.

Figure 1. Shares of Energy Resources in the World Electricity Generation when the New Policy Scenario is Considered (2000-2040) [4]

It is observed that the capacity of renewable energy usage in the world between 2010 and 2013 increased by a third. According to past years, the reason for this increase is that the installed power capacity of wind and solar energy is used more than other sources. The installed capacity of wind energy in the world has increased by 17 percent since 2010 and costs have fallen by 45 percent. In the same period, the installed capacity in solar energy increased by 37 percent, while costs decreased by about 80 percent. Hydroelectric energy capacity increased by 3%, bioenergy and geothermal energy increased by 5% [3].

Between 2004 and 2015, renewable energy investments increased by 38% in China, 21% in the US and 6% in the European Union. Worldwide, renewable energy investments increased by 18% in the same period. The US and China, which are the largest producers of greenhouse gas emissions, show an increase above the world average, proving their willingness on renewable energy [8].

The world economy, population growth, industrialization and urbanization in the world, which are expected to grow at an average rate of 3.5% in the long term (2013-2040), significantly increase demand for natural resources and energy. Estimation studies indicate that in the continuation of current energy policies, the world energy demand in 2040 will increase by 1.38 percent year on year, to 44.9 percent (13.559 million tons of equivalent oil (Mtoe) to 19.643 Mtoe). The 90.7 percent of the increase in demand is estimated to be in non-OECD countries (especially in China and India) where the economic growth rates are expected to be high (4.5 percent annual average) in the period 2013-2040 and with a rapid population growth rate (annual average of 1 percent), with an average annual value of 2.0%. In the same period, annual average gross domestic product (GDP) increase is expected to be 1.9%, while in OECD countries it is expected to increase by an annual average of 0.2%. China is in the first place in energy consumption in 2013 and it is estimated that the US,

which is expected to be second in 2040, will consume about 94% more energy than the energy consumed in the past years. After 2030, India is predicted to be the future of these countries. As noted, these four countries will consume about 56% of the total energy demand in the world. By the year 2040, it is equal to 53.9% of the population over all consumed energy. In order for the increase in world energy demand to be met on a sustainable basis, it is estimated that in the 2015-2040 period, an investment worth about 68 trillion US dollars (2014 figures) is needed in the energy sector [4].

It is thought that the installed power ratio of renewable energy sources other than hydropower will increase from 9.6% in 2013 to 15.2% in 2020, 18.5% in 2030 and 20.7% in 2040. For hydraulics, it is predicted to decrease from 19.3% to 16.4% in the same period. In the production of renewable energy sources, the future of wind and solar energy is considered. It is expected that the share of renewable energy sources in electricity generation will reach 25.2% in 2020 and 26.6% in 2040 from 21.9% (2013)[4].

In Table 1 it is expected that other renewable energy sources and bioenergy will increase 117% in 2020 new policy scenario. When the current policy scenario is examined, it is estimated that renewable energy sources will increase. Other sources are likely to increase, but not as much as renewable energy sources.

Table 1. World Primary Energy Demand (million ton oil equivalent - mtoe) [5]

	2012	New policy scenario 2020	New policy scenario 2040	Current policy scenario 2020	Current policy scenario 2040
Coal	3.879	4.211	4.448	4.457	5.860
Oil	4.194	4.487	4.761	4.584	5.337
Natural Gas	2.844	3.182	4.418	3.215	4.742
Nuclear	642	845	1.210	838	1.005
Hydro	316	392	535	383	504
Bioenergy	1.344	1.554	2.002	1.551	1.933
Other renewable	142	308	918	289	658
TOTAL	13.361	14.978	18.293	15.317	20.039
The ratio of fuel in the fossil (%)	82	79	74	80	80
The ratio out of OECD(%)	60	63	70	63	70

3. THE POTENTIAL OF RENEWABLE ENERGY RESOURCES IN OUR COUNTRY

According to the Mediterranean Energy Perspectives (MEP) – Turkey Report prepared by Observatoire Mediterranéen de l'Energie (OME), fossil fuels that meet 90% of demand in 2012 as a resource in our country are dominant in energy demand. Request; Coal (30%), oil (28%) and natural gas (32%). The remaining part is covered by renewable energy sources [6].

In our country, as in other countries, energy is produced from fossil fuels such as coal, oil, and natural gas. Fossil resources will cause problems in energy production in the coming years when we do not have enough reserves in our country and the damages it gives to the environment, and it will cause our external dependency.

Figure 2.

Turkey's Primary Energy Resource Requirement (mtpe) between 1970-2030 [7]

If we look at the two graphs in Figure 2, the renewable energy source has increased since 2010 and it is expected to increase until 2030. As a renewable energy source, wind, sun and biogas are used in our country. These energy sources we use in terms of clean and renewable energy should be evaluated in our country. The Tenth Development Plan to be implemented between 2014-2018 is important in this respect. In the Tenth Development Plan; It is pointed out that renewable energy investments are increasing in the world. For this reason, it is pointed out that Turkey needs to increase energy production through renewable energy, that renewable energy will continue to be supported and encouraged, that maximum utilization of renewable energy is necessary due to dependence on some sources of energy imports and increase of domestic production level for necessary equipment in renewable energies. In this direction, Turkey aims to increase the share of renewable resources in energy production to 29% by 2018 [8].

4. ANNUAL PRODUCTION OF RENEWABLE ENERGY RESOURCES IN TURKEY

In our country, in terms of installed power, there are facilities that generate electricity from hydro, wind and geothermal energy sources, and in recent years the establishment of solar and biogas power plants has gained speed.

When Figure 3, 4, 5, and 6 are examined, the annual amount of wind energy production at the end of 2015 is 11.652 GWh in Country. The installed power of wind power plants operating until the end of September 2016 increased by 5.1% to 16% compared to the same period of 2015. By the end of June 2016 with the establishment of unlicensed electricity generation plants, while the number of solar power plants is seen as 673, the total installed power of these plants is 505,9 MW. It is estimated that the amount of biogas that can be produced corresponding to Turkey's animal waste potency is 1.5-2 million tons equivalent petroleum (MTEP) [10].

Installed power (09/2016): 78.102,8 MW

Figure 3. Electricity Power Installed Power in Turkey 2016 September [9]

Installed power (2015): 73.146,7 MW

Figure 4. Electricity Power Installed Power in Turkey 2015 [9]

PRODUCTION (09/2016): 201.443.400.730 kWh
[CONSUMPTION (09/2016): 205.164.582.990 kWh]

Figure 5. Electricity Generation in Turkey September 2016 [9]

PRODUCTION (2015): 261.783.303.546 kWh
[CONSUMPTION (2015): 265.724.353.916 kWh]

Figure 6. Electricity Generation in Turkey 2015 [9]

Table 2. Location of Turkish Electricity Market and TETAŞ between 2002 and 2015 [11]

YEARS	PRODUCTION(GWh)			IMPORT(GWh)			EXPORT(GWh)			CONSUMPTION(GWh)		
	TÜRKİYE	TETAŞ (ENERGY RECEIVED)	TETAŞ SHARE (%)	TÜRKİYE	TETAŞ	TETAŞ SHARE (%)	TÜRKİYE	TETAŞ	TETAŞ SHARE (%)	TÜRKİYE	TETAŞ (ENERGY SOLAR)	TETAŞ SHARE (%)
2002	129.400	106.230	82	3.588	3.588	100	435	435	100	132.553	101.990	77
2003	140.580	113.170	81	1.158	1.158	100	588	402	68	141.151	109.370	77
2004	150.698	120.690	80	464	464	100	1.144	379	33	150.018	116.820	78
2005	161.956	128.890	80	636	636	100	1.798	412	23	160.794	125.420	78
2006	176.300	122.220	69	573	573	100	2.236	564	25	174.637	118.610	68
2007	191.558	89.110	47	864	864	100	2.422	1.215	50	190.000	87.350	46
2008	198.418	86.950	44	789	789	100	1.122	152	14	198.085	85.340	43
2009	194.813	84.457	43	812	812	100	1.546	331	21	194.079	83.027	43
2010	211.208	87.032	41	1.144	932	81	1.918	627	33	210.434	85.263	41
2011	229.395	82.284	36	4.556	415	9	3.645	19	0.5	230.306	80.754	35
2012	239.497	83.557	35	5.827	317	5	2.954	13	0.9	242.369	82.214	34
2013	240.154	131.079	55	7.429	277	4	1.227	0.2	0.01	246.357	129.597	53
2014	251.963	123.149	49	7.953	103	1	2.696	0	0	257.220	121.604	47
2015	259.690	113.039	44	7.411	0	0	2.947	0	0	264.137	111.815	42

Electricity consumption of 132,553 GWh in 2002 was 264,137 GWh in 2015. Electricity imports, which were 3.588 GWh in 2002, increased by 100% to 7.411 GWh in parallel with the increase in electricity consumption in 2015. However, when looking at the electricity export figures, the exports which were 435 GWh in 2002, increased 477% in 2015 and reached 2.947 GWh. It can be said that electricity exports will reach much larger numbers if renewable energy is used more.

5. CONCLUSION

Having renewable energy in our country, increasing the share of this energy in energy production will reduce energy dependency on the outside. When solar power plants are evaluated, we are well in terms of the number of annual sunny days, annual sunshine periods, and the amount of annual solar radiation, and it turns out that we have high potentials as a result of research. It is estimated that wind, geothermal and biogas plants will increase in our country in the coming years as well as solar power plants.

Given the distribution of electricity generation, consumption, imports, exports and renewable energy, it is first thought that electricity production should be increased at very high levels. In order to increase electricity production, it is thought that we can increase our production by using renewable energy resources in consideration of environment and recycling.

The incentives for renewable energy sources are increasing. By using this situation, we will have a clean energy source and a clean air field, as if there is no air pollution, as we reduce the dependency on the outside with the energy we produce when the appropriate power plants are installed. Utilizing incentives, our public institutions and our industries will be able to produce troubles in the coming years when we can not produce renewable energy.

6. RESOURCES

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