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Analysis of Energy Resources in Mersin Region

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Abstract: In order to ensure the sustainable development and social welfare of our country, it needs to meet the increasing energy demand. Although our country is not a self-sufficient country despite its current energy resources, it can be stated that it is lucky to have a strategic geographic location in terms of energy potential compared to many countries. The need for energy in our country, which has been developing rapidly in recent years, is evident how effective and efficient use of available energy resources should be. For this reason, the current energy sources and the current situation in Mersin have been investigated. It is understood that the biggest share of renewable energy sources of Mersin is composed of hydroelectric power plants with an installed capacity of 569,48 MW. However, although there is a great potential in wind and solar energy of Mersin province, it was determined that the amount of installed power of wind and solar power was 123 MW and 33.88 MW respectively. Due to the intense solar radiation and wind speed in Mersin province, it is concluded that more solar and wind power plants should be established. This requires our government to support the private sector for the establishment of solar and wind power plants in Mersin.

Keywords: Energy Resources in Mersin, Power Generation, Renewable Energy.

Mersin Bölgesindeki Enerji Kaynaklarının Analizi

Özet: Ülkemizin sürdürülebilir kalkınmasını ve toplumsal refahını sağlayabilmesi için artan enerji talebini karşılaması gerekmektedir. Ülkemiz mevcut enerji kaynaklarına rağmen kendi kendine yetebilen bir ülke olmamasına rağmen stratejik bir coğrafi konumu itibariyle enerji potansiyeli açısından birçok ülkeye göre şanslı olduğu ifade edilebilir. Son yıllarda hızla gelişen ülkemizin enerjiye olan ihtiyacı, mevcut olan enerji kaynaklarının ne kadar etkin ve verimli kullanmamız gerektiği aşikârdır. Bu sebeple Mersin ilinin mevcut enerji kaynakları ve gelinen durum araştırılmıştır. Mersin İlinin yenilenebilir enerji kaynakları içinde en büyük payın 569,48 MW kurulu güç miktarı ile hidroelektrik santrallerinin oluşturduğu anlaşılmaktadır. Ancak Mersin İlinin rüzgâr ve güneş enerjisinde büyük bir potansiyele sahip olmasına rağmen, rüzgâr ve güneş enerjisi kurulu güç miktarları sırasıyla 123 MW ve 33.88 MW kurulu güç miktarı olduğu tespit edilmiştir. Mersin İlinde yoğun bir güneş ışıması ve rüzgâr hızı olması sebebiyle daha fazla güneş ve rüzgar enerji santrallerinin kurulması gerektiği sonucuna ulaşılmaktadır. Bunun içinde devletimizin Mersin İlinde güneş ve rüzgâr enerji santralleri kurulması için özel sektöre daha fazla destek vermesi gerekmektedir.

Anahtar Kelimeler: Mersindeki Enerji Kaynakları, Santraller, Yenilenebilir Enerji

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1. Introduction

Energy sources are the general terms given to the sources of energy. Energy sources are sources that produce energy by any means. Energy sources are divided into renewable and non-renewable energy sources. Non-renewable energy sources are coal, oil, natural gas and nuclear. It is important for renewable energy sources to be clean and sustainable. Due to its climatic conditions, geographical structure and geological characteristics, Mersin has different energy resources. Mersin is luckier in terms of hydraulic, solar and wind energy potential compared to many provinces. For this reason, in order to meet the energy demand in our country in the most effective way, it becomes evident that renewable energy sources should be utilized to the maximum extent possible [1-3].

2. Renewable Energy Resources in Mersin

There are 44 electric power plants in Mersin. The total installed power of the power plants produced in Mersin is 1037.84 MW. These, 22 are hydroelectric power plants, 13 are solar power plants, 3 are wind power plants, 1 are thermal power plants and 5 are waste material power plants. In Mersin, 54.57% of the total installed power is hydroelectric, 24.28% is thermal, 11.85% is wind, 3.26% is solar and 2.86% is waste. Approximately 3,173 GW of electricity is generated annually from Mersin Power Plants. The ratio of the electricity produced in Mersin to the electricity consumed in our country is around 1.24%. Figure 1 shows the share of power plants producing different electricity in Mersin Province in total installed power.

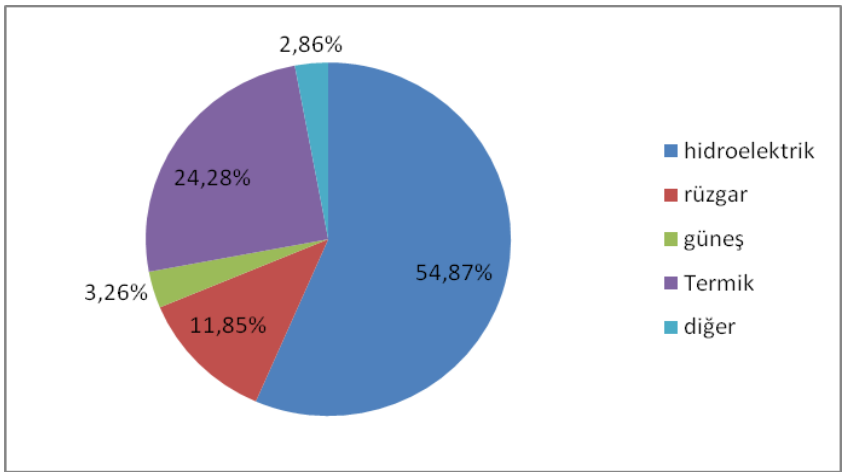

Figure 1. Electricity Generating Power Plants of Mersin Province

2.1 Hydroelectric Power

Figure 2. Hydroelectric Power Plant (HEPP)

Hydraulic energy is the potential energy of water which is elevated compared to the turbine which converts motion energy into electrical energy [4-6]. This energy is converted to mechanical energy by impinging potential energy into the turbine, and it is called hydroelectric energy. As can be seen in Figure 2, the place where these mechanical and electrical systems are located is dams and the facilities where energy conversion is made is called HEPP. Table 1 shows the hydroelectric power plants and installed power in Mersin.

Table 1. Hydroelectric power plants in Mersin

Power Plants	Installed Power
Gezende Hydroelectric	159 MW
Kadıncık 1 Hydroelectric	70 MW
Kadıncık 2 Hydroelectric	56 MW
Birkapılı Hydroelectric	49 MW
Otluca 1 ve 2 Hydroelectric	48 MW
Lamas 3 ve 4 Hydroelectric	36 MW
Alaköprü Hydroelectric	29 MW
Azmak 1, 2 ve Kirpilik Hydroelectric	24 MW
Pamuk Hydroelectric	24 MW
Sebil Hydroelectric	23 MW
Dagbaşı Hydroelectric	10 MW
Berdan Hydroelectric	10 MW
Gök Hydroelectric	10 MW
Sarıkavak Hydroelectric	8,06 MW
Yazılı 1, 2, 3 Hydroelectric	6,62 MW
Dinç Hydroelectric	1,97 MW
Remsu Hydroelectric	1,96 MW
Mut Derinçay Hydroelectric	0,88 MW
Anamur Hydroelectric	0,84 MW
Bozyazı Hydroelectric	0,42 MW
Silifke Hydroelectric	0,40 MW
Zeyne Hydroelectric	0,33 MW

It is understood that the Gezende Dam Hydroelectric Power Plant and the Kadıncık 1- 2 Hydroelectric Power Plant have the highest installed capacity. It is understood that due to the heavy rainfall climate of Mersin Province, the existing installed power is not sufficient and more hydroelectric power plants should be installed on the stream with sufficient flow power. In order to transfer private sector investments, our state should give more support.

2.2 Wind Energy

The kinetic energy of rotation and repulsion of wind power is called wind energy. As can be seen in Figure 3, this water is called wind power plants, where the kinetic energy is hit by the wind rose, and the plants where the electrical circuits are transformed by magnetic circuits are called WPP [7,8].

Figure 3. Wind Power Plant (RES)

Table 2 shows the wind power plants and installed forces in Mersin.

Table 2. Wind power plants and installed power in Mersin

Power Plants	Installed Power
The Mut Borusan Wind Power Plant	50 MW
The Dağpazarı Wind Power Plant	39 MW
The Doğan Wind Power Plant	34 MW

There are only three wind power plants in Mersin. Among these, the Mut Borusan Wind Power Plant has the highest installed capacity. It is evident that the current installed capacity and the number of power plants are not sufficient due to the fact that Mersin Province has a windy climate. It is understood that more wind farms should be established in Erdemli, Silifke, Taşucu, Gülnar and Anamur districts with sufficient wind power. The Energy Market Regulatory Authority (EMRA) amended the regulation on ‘‘Certification and Support of Renewable Energy Resources’’. It allowed the wind power plant to be established by the state without license. At the same time, the government pledged to buy the energy produced in these plants. With these amendments, it has enabled the generation of electrical energy up to 1 MW of installed power without obtaining small and medium-sized licenses.

2.3 Solar Power

Solar energy is the radiation energy produced by the fusion process in the nucleus of the sun and the conversion of hydrogen gas in the sun to helium [9,10]. Turkey's total annual average sunshine time of 2,640 square meters on the hour, an average 1,311 kwh per square meter of total annual solar radiation. In our country with a surface area of 779.452 km^2, the radiation intensity is 1.021.861.572.000.000 kWh per year. This is more than 5,000 times the annual consumption of 197.100.000.000 kWh of electricity in our country. As it is understood from here, our country and Mersin province, which has plenty of sunlight, should turn to alternative energy sources and benefit from the existing solar energy efficiently. Solar panels contain photovoltaic cells that were previously used in calculators and clocks. Photovoltaic cells are made of semiconductor material used in computer chips. When sunlight is absorbed by these substances, electrons are separated from the atoms in which they are released and an electric current is formed in the matter. The conversion of light to electricity is called photovoltaic. As can be seen in Figure 4, the plants that convert solar radiation into electrical energy by means of a large number of photovoltaic panels are called solar power plants.

Figure 4. Solar Power Plant (SPP)

Table 3 shows the solar power plants and installed power in Mersin. There are only six solar power plants in Mersin Province. There are 7 personal small powerful solar power plants to produce the electrical energy used in its own enterprise. It is understood that the Dayıcık Solar Power Plant has the highest installed capacity in Mersin. It is obvious that the number of installed power and number of power plants is not sufficient due to the fact that Mersin Province is a region receiving intense solar radiation.

Table 3. Solar power plants and installed power in Mersin Province

Power Plants	Installed Power
Dayıcık SPP	6 MW
Gülnar SPP	5,75 MW
Gülnar T Dinamik SPP	5,53 MW
Nar SPP	5 MW
Tiryaki Agro SPP	4 MW
Göl, Hörç ve Akova Tuluk SPP	3 MW
Yayla Agro SPP	1 MW
Özipek SPP	1 MW
Cemile Bingül	1 MW
Ah-Fer SPP	0,97 MW
Eren Tarım SPP	0,48 MW
Opat Otomotiv SPP	0,15 MW
Büyükeceli SPP	0,003 MW

In Mersin, the total amount of solar energy measured annually was 1900 (kwh/m^2), the average monthly amount of solar energy was 158 (kwh/m^2) and the annual sunshine duration was 2900 (hour/year). Mersin has an important place in terms of solar energy potential. Because of this feature, it is understood that it should be evaluated in the best way in terms of solar energy production and important studies should be done on this subject.

2.4 Other Power Plants

Table 4 shows the other power plants and installed power in Mersin. Fuel oil, naphtha and diesel etc. The plants that produce electrical energy by using a lot of fuel are called Nafta Power Plant. The Toros Tarım Mersin Power Plant has an installed capacity of 12 MW in Mersin.

Table 4. Other power plants and installed power in Mersin

Power Plants	Installed Power
Toros Agriculture Mersin PP	12 MW
Çimsa Waste Heat Power Plant	9,56 MW
Durum Food Natural Gas Power Plant	5,62 MW
Karaduvar Wastewater Biogas Plant	1,90 MW
Frito Lay Food Biogas Plant	0,66 MW

The plants that convert the waste gases of the factory into electrical energy are called Waste Heat Power Plants. From this power plant in Mersin Province, 9.56 MW. The Çimsa Waste Heat Power Plant has an installed capacity. Power plants that generate electricity from natural gas are called Natural Gas Power Plants. From this power plant, there is the Durum Food Natural Gas Power Plant with an installed capacity of 5.62 MW in Mersin Province. Biogas Power Plants are the plants that generate electrical energy from gas that occurs during the treatment of liquid, solid and gas wastes. There is the Karaduvar Wastewater Biogas Plant with an installed capacity of 1.90 MW and the Frito Lay Food Biogas Plant with an installed capacity of 0.66 MW in Mersin.

3. Power plants under construction

The Akkuyu Nuclear Power Plant with an installed capacity of 4,800 MW, the Sorgun Dam Hydroelectric Power Plant with an installed capacity of 12 MW, the Bozyazı Hydroelectric Power Plant with an installed capacity of 9,73 MW, the Tarsus Closed Marketplaces with an installed capacity of 3,50 MW and the Aksıfat Dam Hydroelectric Power Plant with an installed capacity of 2.25 MW. The pre-licensed and planned power plants are the Işıklar Enerjisa Wind Power Plant with an installed capacity of 250 MW, the Gücler Enerjisa Wind Power Plant with an installed capacity of 248 MW and the Sertavul Wind Power Plant with an installed capacity of 30 MW.

4. Conclusion

The total installed power of the power plants produced in Mersin is 1037.84 MW. In Mersin, 54.57% of the total installed power is hydroelectric, 24.28% is thermal, 11.85% is wind, 3.26% is solar and 2.86% is waste. Approximately 3,173 GW of electricity is generated annually from Mersin Power Plants. The ratio of the electricity produced in Mersin to the electricity consumed in our country is around 1.24%. It is understood that due to the heavy rainfall climate of Mersin Province, the existing installed power is not sufficient and more hydroelectric power plants should be installed on the stream with sufficient flow power. In order to transfer private sector investments, our state should give more support. It is evident that the current installed capacity and the number of power plants are not sufficient due to the fact that Mersin Province has a windy climate. It is understood that more wind farms should be established in Erdemli, Silifke, Taşucu, Gülnar and Anamur districts with sufficient wind power. The government pledged to buy the energy produced in these plants. With these amendments, it has enabled the generation of electrical energy up to 1 MW of installed power without obtaining small and medium-sized licenses. It is obvious that the number of installed power and number of power plants is not sufficient due to the fact that Mersin Province is a region receiving intense solar radiation. Mersin has an important place in terms of solar energy potential. Because of this feature, it is understood that it should be evaluated in the best way in terms of solar energy production and important studies should be done on this subject. Environmental problems such as air pollution, global warming, soil and water pollution during the production of energy from fossil fuels are

increasing day by day. It is necessary to use renewable energy sources to eliminate these problems and to reduce the increase in production and transmission costs. Especially in Mersin, where there are many sunny and windy days, it is very important to benefit from solar and wind energy. In addition, energy costs are one of the most important inputs of enterprises, industrialists, public institutions and municipalities. For this reason, solar and wind energy should be utilized in the most effective way in Mersin Province in order to solve the problems and to provide a clean and peaceful environment.

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