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Implementation of Solar PV Power Plant Sıçan Island Located in the Turkish Territorial Waters in the Mediterranean

Ufuk ELİBÜYÜK[a*], İbrahim ÜÇGÜL[b], Tansel KOYUN[c], Mustafa ACAR[d]
[a]*Elektrik ve Enerji Bölümü, Keçiborlu Meslek Yüksekokulu, Isparta Uygulamalı Bilimler Üniversitesi, Isparta*
[b]*Tekstil Mühendisliği Bölümü, Mühendislik Fakültesi, Süleyman Demirel Üniversitesi, Isparta*
[cd]*Makine Mühendisliği Bölümü, Mühendislik Fakültesi, Süleyman Demirel Üniversitesi, Isparta*
[*]*Sorumlu yazar e-posta adres: ufukelibuyuk@isparta.edu.tr*

ABSTRACT:

In today's increasing dependence on fossil-based energy resources, the trend towards renewable energy sources is increasing day by day. Renewable energy sources, especially in terms of the potential of solar energy in our country have a very high value. We are evaluating the use of this great potential in our country by investing in valuable agricultural land and establishing a solar energy plant in the living areas. This use causes degradation of valuable agricultural land and ecological equilibrium. The construction of solar power plants by choosing places that are not suitable for agriculture and where they cannot be used vitally will affect natural life less and will provide a brighter future. A preliminary study of the land to be used for energy production will be carried out in this study. The solar energy power plant will be installed in the small and vital unused Sıçan Island in Kaş province and the power generation of the power plant will be examined.

Anahtar Kelimeler: *Solar Energy, Sıçan Island, Established SPP Features, Investment Cost*

Akdeniz'de Türkiye Karasularında Bulunan Sıçan Adası'na Güneş Enerjisi Santrali Uygulanması

ÖZET:

Günümüzde fosil kaynaklı enerji kaynaklarına artan bağımlılıkta, yenilenebilir enerji kaynaklarına yönelik eğilim gün geçtikçe artmaktadır. Yenilenebilir enerji kaynakları, özellikle ülkemizdeki güneş enerjisi potansiyeli açısından çok yüksek bir değere sahiptir. Değerli tarım alanlarına yatırım yaparak ve yaşam alanlarında güneş enerjisi tesisi kurarak ülkemizde bu büyük potansiyelin kullanımını değerlendiriyoruz. Bu kullanım, değerli tarım arazilerinin bozulmasına ve ekolojik dengesizliğe neden olur. Güneş enerjisi santrallerinin tarıma elverişli olmayan ve hayati olarak kullanılamayacak yerleri seçerek inşa edilmesi doğal hayatı daha az etkileyecek ve daha parlak bir gelecek sağlayacaktır. Bu çalışmada enerji üretiminde kullanılacak arazinin ön incelemesi yapılacaktır. Güneş enerji santrali, Kaş ilindeki küçük ve hayati kullanılmayan Sıçan Adası'na kurulacak ve santralin enerji üretimi incelenecektir.

Keywords: *Güneş Enerjisi, Sıçan Adası, Yerleşik SPP Özellikleri, Yatırım Maliyet*

1. INTRODUCTION

Owing to the rapidly increasing need for energy today and fossil fuels being limited and environmentally damaging, studies in the field of renewable energy have been on the rapid increase and become extremely important. The use of renewable energy resources is increasing rapidly today and the fact that solar energy is easily accessible and limitless in nature brings it forward among other renewable energy sources [1-2].

In Turkey, which enjoys a comparatively higher sunshine duration and solar radiation nowing to its advantageous location on earth, solar energy stands out as an alternative energy source. Considering Turkey's potential to benefit from solar energy, it is seen that it has a higher potential than all European countries, except for Spain (Fig 1).According to the data obtained from the Directorate General of Meteorology, Turkey has an average of 1322 kWh/per square solar radiation perannum [3].

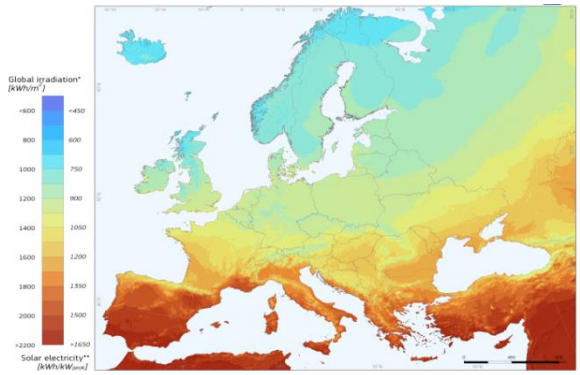

Fig 1. *Potential of Solar Energy Across Europe [4]*

According to the Atlas of Solar Energy Potential of Turkey (GEPA), it has been found out that the yearly sunshine duration equals 2737 hours (7,5 hours per day), which means a total of 1527 kWh/m^2 of solar energy (4.2 kWh/m^2 per day). Solar energy Technologies vary in terms of method, materials and technological level [5]. These are thermal solar energy and photovoltaic solar energy technologies.

Because the equipment and solar cells used in photovoltaic systems cost higher, their initial investment costs are naturally higher. Compared too there energy production systems, photovoltaic systems require the highest initial investment cost; however, they can operate for relatively longer years (20 to 25 years). Owing to the higher initial investment costs of such systems, calculations must be done in order to yield the maximum benefit and units of the system must be determined in accordance with this. Naturally, the geographical characteristics of the site on which the system to be established are one of the most important parameters of the system. Photovoltaic solar energy systems have become wide spread thanks to the support by governments [6]. Especially, thanks to the support given by the government in our country, 34 solar power plants with an installed power of 402 MW were given pre-licence and 2 solar power plants with an installed power of 12,9 MW were given

licence as of the end of the year 2016.Withtheinstalment of unlicensed solar power plants, the numbers of solar power plants have reached 1043 as of 2017 and the installed power was 819,6 MW. With two licenced plants included in the number, the total installed power has gone up to 832,5 MW [5].

Whereas our solar power capacity has been increasing thanks to the support given by the government in Turkey, unlicensed solar power plants are installed on agricultural land and on areas suitable for human settlement. This damages agriculture and causes ecological imbalances. Non arable areas and areas not suitable for human settlement must choose in order to build solar power plants, which will ower negative effects on nature. In the light of these, the sites on which solar energy plants will be built must be chosen after meticulous research. This study, which is a pioneer study as regards sites suitable for building solar energy plants on, discusses building a solar power plant on Island of Sıçan off the shore of Kaş (a town on the western Mediterranean coast in Turkey, its potential electricity production and cost analysis.

2. GEOGRAPHICAL FEATURES OF THE ISLAND OF SIÇAN

The Island of Rat is located 5,67 kilo meters (3,60 miles) off the coast of Kaş in the province of Antalya. It is located within the coordinates 36°13'13'' north, 29° 22'22'' east and is not used for human settle ment. The island, where the highest point is 70 meters, covers an area of approximately 219.233 m^2 (approximately equals 200 decares) (Fig 2).

Fig 2. *Google Earth Image of the Island*

The radiation values on the island found through calculations carried out by some programs are given in figure 3.

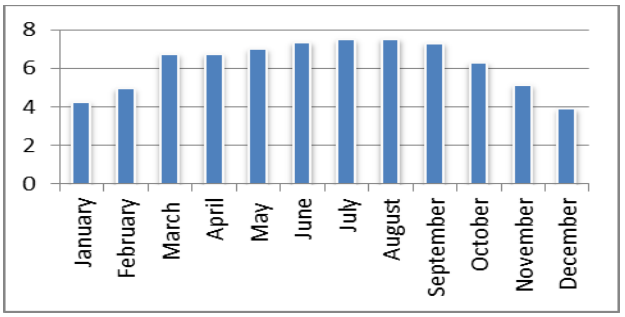

Fig 3. *Radiation Values of the Island of Sıçan (kWh/m^2-day)*

The average day time temperature and 24 hour average temperature of the island are given in figure 4.

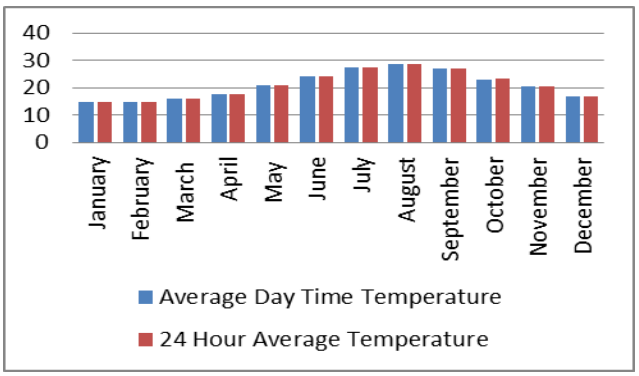

Fig 4. *The Average Day Time and 24-Hour Average Temperature of the Island*

3. 5 MW SOLAR POWER PLANT TO BE BUILT ON THE ISLAND OF SIÇAN

5 megawatt solar power plant is to be built on the south part of the island. The properties of the power plant to be built are given in table 1.

Table 1. *The Properties of the Power Plant*

PV Technology	Crystal Silicon
PV Power	5 MW
Mounting Position	Constant
Land Need for Investment	100.000 m^2
Slope	35˚
Azimuth Angle	0˚
System Life	25 Years
System Loss Ratios	%14
Sales Price ($ / kWh)	0,133
Yearly Yield Loss of Panels	0,8

Under the renewable energy law (law number 5346), electricity market law (law number 6446) and unlicensed electricity production regulation, the price of the electricity to be produced by the solar power plants which will be put into operation (by all real or legal persons) until December 31, 2020 is 0,133 US dollar perk kWh.

The average power production per day and month of the plant; the average daily and monthly radiation of the plant received by the modules are given in table 2.

Table 2. *PV Performance Depending on the Network*

MONTHS	Daily Average Electricity Production of the System (kWh)	Monthly Average Electricity Production of the System (kWh)	Daily Average Radiance Received by Modules (kWh/m^2)	Monthly Average Radiation Received by Modules (kWh/m^2)
January	16.400	510.000	4,26	132
February	18.800	525.000	4,94	138
March	25.150	780.000	6,72	208
April	25.100	755.000	6,72	202
May	25.650	795.000	6,99	217
June	26.750	805.000	7,35	221
July	27.000	835.000	7,48	232
August	26.900	835.000	7,52	233
September	26.250	790.000	7,3	219
October	22.950	710.000	6,28	195
November	19.100	570.000	5,12	153
December	14.850	460.000	3,88	120
Years	***22.950***	***695.000***	***6,22***	***189***
TOTAL		***8.350.000***		***2270***

Table 2 shows that while power production is the highest in the months of July and August, it is the lowest in December. When a 5 MW solar power plant is built on the site mentioned above, 8,35 MW of power will be produced .The outline of horizon with sun path for winter and summer solstice is given in figure5.

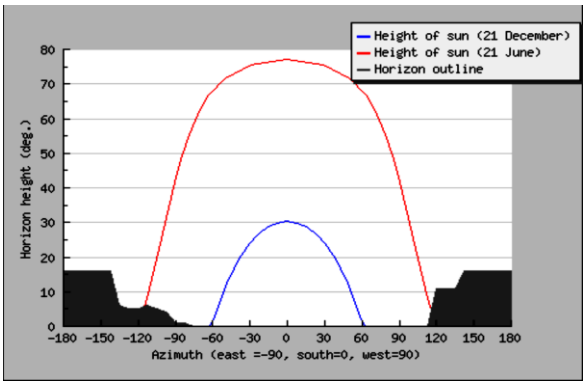

Fig 5.*Outline of Horizon with Sun Path for Winter and Summer Solstice*

4. THE COST AND AMORTISATION OF THE SOLAR POWER PLANT TO BE BUILT

Cost items of the power plant are given in table 3.

Table 3.*Cost Items of the Power Plant*

SANTRAL COST INSTRUCTIONS	1 WATT UNIT PRICE (€)	5000 KW (5MW) COST (€)
Solar panel	0,54 – 0,64	2.700.000 – 3.200.000
Inventors	0,20 – 0,25	1.000.000 – 1.250.000
the construction	0,07 – 0,08	350.000 – 400.000
Wiring DC-AC	0,05 – 0,07	250.000 – 350.000
Protection Equipment	0,02 – 0,03	100.000 – 150.000
Transformer	0,02 – 0,03	100.000 – 150.000
Other (Remote Monitoring, Counter, Transformer Cabinet, Panels, Wire Mesh, Concrete etc.)	0,06 – 0,07	300.000 – 350.000
Labor + Shipping	0,06 – 0,07	300.000 – 350.000
TOTAL (EXCLUDING KDV)	***1,02 – 1,24***	***5.100.000 – 6.200.000***

When table 3 is examined, it is seen that the investment cost is around 5.700.000 Euros, which equals 7.000.000 US dollars.

Under the law number 5346 (renewable energy law), the marketing price of the solar power produced is 13,3 cent/kWh; however, when domestically produced construction is used, an additional incentive pay of 0.8 cent/kWh will be added to this amount, making the amount 14,1 cent/kWh.

There will be an estimated profit of 1.177.350 US dollars per annum. Therefore, the power plant to be built will pay for itself in six years. Taking into account the fact that the working lives of panels are 25 years, the system will make a profit of 90.000 US dollars monthly.

5. CONCLUSION

Renewable energy is produced from the exist in energy in continual natural periods. Generally, renewable energy is defined as energy which can replenish itself at the same rate (some times faster) as it is use dup. For example, a technology which operates using solar energy consumes this energy; however, the amount of energy use dup is too small compared to the total energy of the sun. The most wide spread renewable energy is solar energy.

Thanks to the incentives today, photovoltaic technology, one of the solar energy technologies, have become the most wide spread system which can directly produce power. The install ment of such a system on the Island of Sıçan, which is no arable and not suitable for human settlement, the setup cost, and the period of redemption are discussed and calculated in this study. When this Project is put into operation, it is expected that a certain percentage of the energy need of the town Kaş will be obtained from this power plant.

Exploiting islands small or big on high seas or renewable energy will be encouraging and hope in spiring for the future.

RESOURCES

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