ResearchGate

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/387555771

Developments in Solar Energy Stations in Turkey

Conference Paper · November 2014

CITATION
1

3 authors, including:



Saban Yilmaz
Kilis 7 Aralık University
33 PUBLICATIONS **342** CITATIONS
SEE PROFILE



Ahmet Gani
Kayseri University
132 PUBLICATIONS **489** CITATIONS
SEE PROFILE

All content following this page was uploaded by Ahmet Gani on 31 December 2024.

The user has requested enhancement of the downloaded file.

0168 - DEVELOPMENTS IN SOLAR ENERGY STATIONS IN TURKEY

Saban Yilmaz [*1], Semih Eren Yüksel[2], Hasan Riza Ozcalik[2], Ahmet Gani[2]
[1]*Kahramanmaras Sutcu Imam University, Dept. of Electronic and Automation Science, Kahramanmaras/Turkey*
[2]*Kahramanmaras Sutcu Imam University, Dept. of Electrical and Electronics Engineering, Kahramanmaras/Turkey*

Corresponding author: Saban Yilmaz

ABSTRACT
Photovoltaic solar energy stations, one of the renewable energy sources, develop rapidly in Turkey just as they do all over the world. Although photovoltaic systems were considered as quite expensive and ineffective a few years ago, installation of solar stations have started recently. Turkey, a rich region in terms of radiation, is likely to witness a rapid development in photovoltaic systems. This study focuses on the latest technology in solar energy stations and potential developments in the future.

Keywords: Renewable Energy, Solar Energy, Photovoltaic, PV

1.INTRODUCTION

Turkey is located in a perfect geographic region in terms of benefiting from solar power plants. The Mediterranean Sun Belt goes through the country, placing Turkey in one of the most favorable positions in Europe when it comes to solar power generation. Turkey's solar radiation values are similar to that of Spain and Portugal, the countries with the highest solar radiation values in Europe. When compared with the rest of Europe, insolation values are higher, and conditions for solar power generation are similar to that of Spain [1]. Radiation map for Turkey is shown in Figure 1.

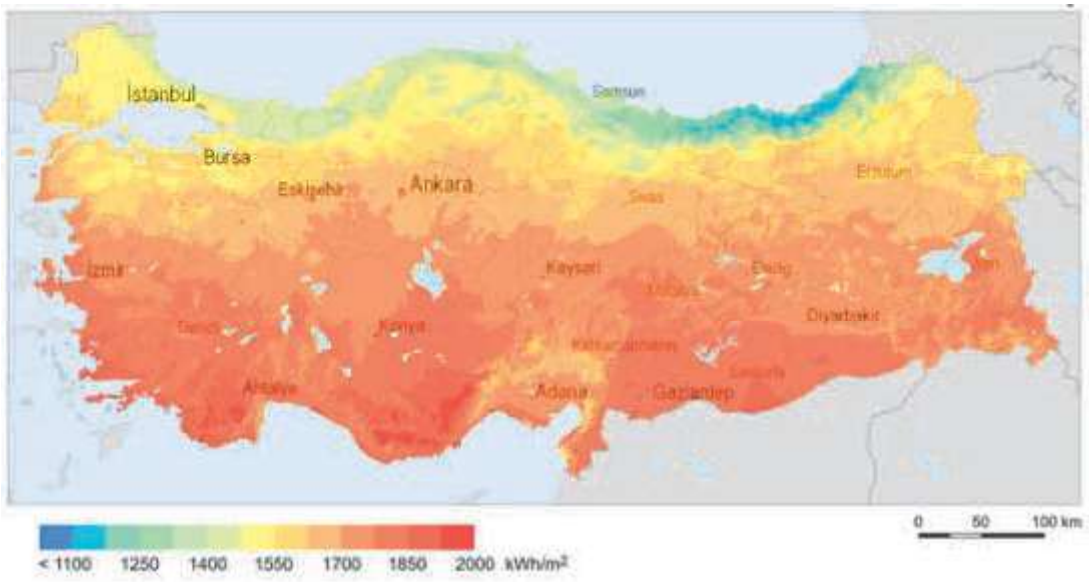


Figure 1. Radiation map for Turkey

Turkey is located in an advantageous position in Europe for solar energy. The annual average duration of total insolation is 2640 hours (7.2 hours per day). Average annual solar radiation is 1311 kW·h/(m²·yr). If one half of one percent of the land area of Turkey were covered with solar panels, all of the electricity demand would be supplied [2]. In 2010, Turkey enacted its second Renewable Energy Law, namely Law No. 6094 on Use of Renewable Energy Resources for the Generation of Electrical Energy [3]. Solar energy sources are encompassed by this law which states that facilities generating electricity from renewable energy sources shall be granted a certificate of renewable energy source (RER Certificate). This certificate entitles such facilities to benefit from the incentives granted by the Law. EMRA is the competent authority to grant RER Certificates. Unlicensed systems producing up to 1-megawatt (MW) of energy and plugged into the national grid are eligible for payments of $ 0.133 per kilowatt-hour [4]. Turkey possesses a fair feed in tariff [5]. Turkey is already at grid parity for private households and commercial users. In the upcoming years, solar energy will be feasible without any feed-in-tariff mechanism [6].

The flat-plate collectors in domestic hot water systems are the main solar energy utilizations in Turkey. Turkey is one of the leading countries in the world with a total installed capacity of 10 GWth as of 2011 (129 kWth/1,000 inhabitants) [7]. The industry is well developed with high quality manufacturing and export capacity. The number of companies is nearly 100 and annual manufacturing capacity is 750,000 m². Photovoltaics (PV) are expected to grow dramatically in the next few years [8]. A 5 MW solar power tower was installed at Mersin by Greenway CSP [9].

Boiler type is used Natural Circulation Direct Steam Generation. The system is designed with a closed circuit. Similar to LEGO blocks, complete field design is modular. Assembly and installation on site can be performed with minimal labor force. Heliostats are lightweight, strong, durable with an integrated data transfer system thanks to the wireless communication embedded in the PCB motion control board. Receiver is also modular with the tower and can be shipped and assembled easily on the respective site.

This project proved to be quite cost-efficient at a very competitive level with further savings in fabrication. Greenway heliostats are specially designed mirrors. Their reflection rate is high and they can track the sun in a dual axis, supported by composite arms for a unique, lightweight and easy to assemble product. Greenway Receiver has 4 evaporators and one super-heater. Receiver angle is 135 degrees.

Greenway's own designed GREENBOX is the key differentiator and the most innovative aspect of the system. GREENBOX device is a motion control box tracking the position of the Sun through an astronomical algorithm and optimizing heliostat position. All communication is performed via Greenway Secure Wireless System. The GREENBOX wireless communication port is embedded inside PCB, which also takes part in calibration process as well as other data transfer activities. Solar power plants located in Mersin and Malatya are shown in Figure 2 and 3, respectively.



Figure 2. Steam power plant in Mersin



Most important active solar power plants in Turkey [10]

1)	Malatya İnönü Üni. Güneş Santrali	Malatya	Malatya İnönü Üniversitesi	5,30 MW
2)	Mersin Toroslar Termal Güneş Enerji Santrali	Mersin	Greenway Enerji	5,00 MW
3)	Elmeks Maden ve Dekel Güneş Enerji Santrali	Kayseri	Elmeks Maden ve Dekel	2,30 MW
4)	Polatlı Güneş Enerji Santrali	Ankara	Halk, Metag, Teknologis, Yenigün	1,80 MW
5)	Özkoyuncu Enerji Güneş Enerji Santrali	Kayseri	Özkoyuncu Madencilik	1,04 MW
6)	Beşler Tekstil Güneş Santrali	Kayseri	Beşler Tekstil	1,02 MW
7)	Has Çelik Güneş Santrali	Kayseri	Has Çelik	1,02 MW
8)	Özkoyuncu Madencilik Güneş Santrali	Kayseri	Özkoyuncu Madencilik	1,01 MW
9)	Adıyaman Gölbaşı Güneş Enerji Santrali (GES)	Adıyaman	Ahmet Dağılmış	1,00 MW
10)	Aksu Enerji Güneş Enerji Santrali	Isparta	Aksu Enerji	1,00 MW
11)	Gürkan Mobilya Güneş Santrali	Kayseri	Gürkan Mobilya	1,00 MW
12)	Jantsa Güneş Santrali	Aydın	Jantsa	1,00 MW
13)	Konya OSB (KOS) Güneş Enerjisi Santrali	Konya	Konya OSB	1,00 MW
14)	Fina Güneş Enerji Santrali	Denizli		1,00 MW
15)	Ekinözü Güneş Enerji Santrali	Kahramanmaraş	Akdemir Kömür Madencilik	0,73 MW
16)	Winsa Kocaeli Güneş Enerji Santrali	Kocaeli	Winsa	0,65 MW
17)	Adilcevaz Belediyesi Güneş Enerjisi Santrali	Bitlis	Adilcevaz Belediyesi	0,51 MW
18)	Cem İplik Güneş Santrali	Kahramanmaraş	Cem İplik	0,50 MW
19)	Eczacıbaşı Esan Güneş Santrali	Muğla	Eczacıbaşı Esan	0,50 MW
20)	Ege Orman Vakfı Güneş Santrali	İzmir	Ege Orman Vakfı	0,50 MW
21)	Erikoğlu Holding Güneş Santrali	Denizli	Erikoğlu Holding	0,50 MW
22)	İkitelli Termal Güneş Enerji Santrali	İstanbul		0,50 MW
23)	İzmir Atatürk OSB Güneş Enerji Santrali	İzmir	İzmir Atatürk OSB	0,50 MW
24)	Kamer Tekstil Güneş Enerji Santrali	Kahramanmaraş	Kamer Tekstil	0,50 MW
25)	Karşıyaka Belediyesi Güneş Tarlası	İzmir	Karşıyaka Belediyesi	0,50 MW
26)	Kayseri Şeker Fabrikası GES	Kayseri	Kayseri Şeker Fabrikası	0,50 MW
27)	Kemalpaşa OSB Güneş Enerji Santrali	İzmir	Kemalpaşa Organize Sanayi Bölgesi	0,50 MW
28)	Kırteks Tekstil Güneş Santrali	Kahramanmaraş	Kırteks Tekstil	0,50 MW
29)	Marka Grup Güneş Enerji Santrali	Sivas	Marka Grup	0,50 MW
30)	Mercan Mermer Güneş Enerji Santrali	Burdur	Mercan Mermer	0,50 MW
31)	Mumcu Teneke Güneş Enerjisi Santrali	Balıkesir	Mumcu Teneke	0,50 MW
32)	Prokon A.Ş. Güneş Enerji Santrali	Ankara	Prokon A.Ş.	0,50 MW
33)	Süral Su Manavgat Güneş Enerji Santrali	Antalya	Süral Su	0,50 MW
34)	Tad Piliç Güneş Santrali	Gaziantep	Tad Piliç	0,50 MW
35)	Tire Organize Sanayi Bölgesi Güneş Enerji Santrali (GES)	İzmir	Tire OSB	0,50 MW
36)	Kıvanç Tekstil Güneş Enerji Santrali	Adana	Kıvanç Tekstil	0,50 MW
37)	Adana Çimento Güneş Enerji Santrali	Adana	OYAK	0,50 MW
38)	Alkor Alüminyum Güneş Enerjisi Santrali	İzmir	Alkor Alüminyum	0,50 MW
39)	Efe Endüstri Güneş Enerji Santrali (GES)	İzmir	Efe Endüstri	0,48 MW
40)	Teknopark İstanbul Güneş Santrali	İstanbul	Teknopark İstanbul	0,46 MW
41)	Cemer Kent Ekipmanları Güneş Enerji Santrali	İzmir	Cemer Kent Ekipmanları	0,40 MW
42)	Van YYÜ Güneş Enerji Santrali	Van	Yüzüncü Yıl Üniversitesi	0,40 MW
43)	Özyeğin Üniversitesi Güneş Santrali	İstanbul	Fina Enerji	0,38 MW
44)	Bozyaka Pazaryeri Güneş Enerji Santrali	İzmir	Karabağlar Belediyesi	0,32 MW
45)	Sapmaz Soğuk Hava Deposu Güneş Enerji Santrali	Antalya	Sapmaz Soğuk Hava Deposu	0,32 MW

46)	Blok Bims Güneş Santrali	Nevşehir	Blok Bims	0,30 MW
47)	Gazi Teknopark Güneş Santrali	Ankara	Gazi Teknopark	0,30 MW
48)	Hacıyusuflar Güneş Santrali	Malatya	Malatya İl Özel İdaresi	0,29 MW
49)	Attalos Güneş Enerji Santrali	Manisa	Hun Yapı Enerji Grubu	0,26 MW
50)	Elbeyli Güneş Enerji Santrali	Kilis		0,25 MW
51)	Antalya Havalimanı Güneş Enerji Santrali	Antalya		0,25 MW
52)	Bartın Güneş Enerji Santrali	Bartın	Bartın İl Özel İdaresi	0,25 MW
53)	Dalaman Havalimanı Güneş Enerji Santrali	Antalya		0,25 MW
54)	Odaş Şanlıurfa Güneş Enerji Santrali	Şanlıurfa	Odaş Enerji	0,25 MW
55)	Atea Ambalaj Güneş Enerji Santrali	Balıkesir	Atea Ambalaj	0,25 MW
56)	Ali Süreyya Perçin Tavuk Çiftliği GES	İzmir	Ali Süreyya Perçin	0,22 MW
57)	Aksaray Belediyesi Güneş Enerji Santrali	Aksaray	Aksaray Belediyesi	0,20 MW
58)	Medaş Elektrik Güneş Santrali	Konya	Medaş Elektrik	0,20 MW
59)	Seferihisar Belediyesi Güneş Enerji Santrali	İzmir	Seferihisar Belediyesi	0,20 MW
60)	Hasan Kalyoncu Üni. GES	Gaziantep	Hasan Kalyoncu Üniversitesi	0,20 MW
61)	Algür Süt Ürünleri Güneş Santrali	Aydın	Algür Süt Ürünleri	0,15 MW
62)	Çatak Belediyesi Güneş Enerji Santrali	Van	Çatak Belediyesi	0,15 MW
63)	Selçuk Belediyesi Sebze ve Meyve Hali GES	İzmir	Selçuk Belediyesi	0,15 MW
64)	Güler Soğuk Hava Deposu Güneş Enerji Santrali	Isparta	Güler Soğuk Hava Deposu	0,14 MW
65)	Özlüce Atıksu Arıtma Güneş Santrali	Bursa	Bursa Büyükşehir Belediyesi	0,13 MW
66)	Muğla Belediyesi Mezbaha Tesisi Güneş Enerji Santrali	Muğla	Muğla Belediyesi	0,11 MW
67)	Gürsu Belediyesi Güneş Enerji Santrali	Bursa	Gürsu Belediyesi	0,10 MW
68)	Hoca Elektrik Güneş Enerji Santrali	Afyonkarahisar	Hoca Elektrik	0,10 MW

Solar energy is fairly promising in today's world as technologic developments grow rapidly in Turkey and in the world. More and more attempts and investments are witnessed in this field every day. Various studies demonstrate that global solar energy capacity will increase by 400 GW to 600 GW until 2020, which means an investment of 1 trillion dollars is expected. Similarly, Turkey is likely to keep pace with these global developments and invest in this sector to increase solar energy capacity.

2.CONCLUSION

Additional efforts are needed in order for Turkey to succeed in the solar energy economy. As an initial step, Turkish government should identify strategic targets for a sustainable solar energy market. Solar energy systems should be immediately integrated into Turkey’s energy production policy to meet the increasing demand for energy. It is necessary to create solar energy with cost effective methods. The local production of solar energy technology can reduce the investment costs significantly. The government, universities and companies should be encouraged via subsidies for research on and development of solar energy all around the country. Government plays a vital role in formulating and implementing favorable policies for solar energy development. However, the private sector is capable of mobilizing funds and thus must be involved in the renewable energy development.

3.REFERENCES

1. Werner Weiss, Potential of Solar Thermal in Europe http://www.eeg.tuwien.ac.at/eeg.tuwien.ac.at_pages/publications/pdf/WER1.pdf.
2. "Using Solar Energy Sources To Generate Electricity In Turkey".
3. Renewable Energy Law
4. http://www.solarnovus.com/policy-in-turkey-encourages-renewable-energy-generation_N7146.html
5. "Turkey Photovoltaic (Solar PV) Market: Outlook 2014 - 2025".
6. http://www.renewableenergyworld.com/rea/news/article/2013/10/why-should-investors-choose-the-turkish-solar-market
7. "SOLAR HEAT WORLDWIDE 2011".
8. "Solar Power Surges On Turkish Policy Backing".
9. "Global Market Outlook for Photovoltaics 2014-2018" (PDF). www.epia.org. EPIA - European Photovoltaic Industry Association. p. 24. Archived from the original on 12 June 2014. Retrieved 12 June 2014.
10. http://www.enerjiatlasi.com/
11. http://greenwaycsp.com/en/projects/mersin-5-mwth-solar-tower-plant.aspx

0171 - A NEW SOLAR RECHARGEABLE ELECTRONIC NOTICEBOARD DESIGN

Said Mahmut Çınar*, Fatih Serttaş, Emre Akarslan
Afyon Kocatepe University, Afyonkarahisar

**Corresponding author: Said Mahmut ÇINAR*

In this study, an electronic noticeboard is designed which can be recharged by solar panels. The noticeboard is built with 8x8 dot matrix led displays. LabVIEW based user interface is developed to access noticeboard on network for distance control the led screen. The designed noticeboard is able to show both information about energy production of solar panels and announcement related with laboratory lectures. The electronic noticeboard is planned to use in Renewable Energy Laboratories of Solar and Wind Applications Research Center.
Keywords: Dot Matrix Display, Solar Rechargeable, Electronic Noticeboard, LabVIEW.

1. INTRODUCTION

Laboratory studies has critical importance in engineering education. Nearly all technical courses are practical and applied in laboratory classes. Although there are many students, in the developing universities, limited opportunities and equipment force lecturers to divide classes into working groups. In this case, distance controlled announcements for the students become necessary.

Meanwhile, in renewable energy laboratory, electronic noticeboard is utilized to show information about PV energy generation min-by-min. The present energy producing value can be seen on the noticeboard whole day long without any other electricity supply. As a new study and design, in this study, the electronic noticeboard is powered by sun. PV panels recharge the batteries of the electronic noticeboard. Therefore system provides requirement energy itself.

There are many studies and technologies in the literature about led screen controlling[1] [2][3][4]. Gago et al. develops a driver from D type flip flops to control the dot matrix RGB-LED display. Instead of using complex structures and constant current, D type flip flops are used to realize low energy consumption driver which is more economical [5]. Xiao C et al. carry out a new smart display using a microcomputer and complex programmable logic device (CPLD). The microprocessor is used for distance control and the CPLD is used to control information on the screen dynamically. Their method has more efficiency than the previous traditional methods with qualified imaging and is able to be changed easily [6]. Grantham and Pang, in their interesting study, realize the voice signal transmission in free space using a visual information screen with three-colored LED's [7]. Alfonso et al. create a novel method which is parallel and distributed architecture to control LED's continuously. They use individual control for each color with this architecture. Recommendation in this paper is using digital signal processing which is easy to use [8]. Yanchuang and Jinying design a LED display system controlled by AT89C52 MCU (Microcomputer Controller Unit). DS1302 is used to control the real time display. Language C is applied to compile program in Keil uVision3 programming environment. The display system is simulated through Proteus software. With their system, Chinese characters are showed on the 16x16 dot matrix [9]. Liu et al. introduce the system design and implementation of a low-cost 360-degree true-color light emitting diode (LED) display system. This energy-saving LED display system employs both rotating scan scheme and a precision control in combination of time and space to provide three same screen displays of resolution 320×240 with only three columns of tricolor (Red, Green, Blue) LEDs. The frequency of scan and the speed of rotation are high enough to be indistinguishable by human eyes, hence the display appears to be constantly illuminated and the brilliant color image can be seen from any viewing angle. The experimental results show that the LED display system has an efficient and satisfying display quality, compared to the traditional LED dot matrix display and commercial surround color LED display [10].

In this study, PIC microcontrollers are selected to control 8x8 dot matrix led displays in terms of their well prices and easy accessible situation. LabVIEW based user interface is used to control the system from distance.

2. ELECTRONIC NOTICEBOARD

In recent years, light-emitting diodes dot-matrix text (LED text) becomes widely used for displaying information and announcement [11]. When a small, simple display device is required on a machinery surface or in a building, a light-emitting-diode (LED) matrix display can be an adequate choice. Although humans had been using the 5x7 LED matrices to create dot matrix patterns for characters of different languages, nowadays the small symbols and characters displayed on the 8x8 LED dot-matrix displays are seen almost everywhere in the world [11] [12] [13] [14]. The schematic diagram of an 8x8 RGB LED dot matrix is shown in Figure 1. This display includes eight light dot rows by eight light dot columns. Red, green and blue LED's are combined to build each light dots. Therefore, there are sixty four light LED's for each color in an 8x8 dot matrix display. The cathode terminals of the sixteen LEDs in a single row are connected together. The RGB dot matrix display used in this study is shown in Figure 2. With different combinations of these displays, many electronic noticeboards could be built in different size according to requirements.