



A Review of Solar Energy and its Applications

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ABSTRACT

Solar energy is a substitute for traditional energy sources in many parts of the world. In many regions of the world, solar energy provides a unique source of energy. It has been around for a very long time and has aided people inadvertently since the beginning of time. The ability of the sun's beams to create, start a chemical process, or produce electricity is known as solar energy. Humanity no longer needs to use any other electrical power source because of the sun's immense and potent energy. Fossil fuels are not environmentally friendly for several reasons, including the greenhouse gases they release into the atmosphere and water, in this regard so this paper will be discussing the applications of solar energy as there are still plenty of rural places in the Philippines that are far from urban areas and devoid of even the most necessities, still, in need of assistance, the primary objective of the paper is to study about a solar-powered portable refrigerator that can achieve the ideal temperature for the storage of insulin. An isolated solar PV system is a dependable way to supply electricity in outlying and rural areas. In this paper, we will be discussing a thermal performance evaluation of a stand-alone photovoltaics (PV) system constructed on the top of the EN Department building at the KIET Group of Institutions in Ghaziabad simulation of a solar central heat generation system for multi-purpose applications. A photovoltaic dimensioning of a village called "Boumhaout" in the south of Morocco, which is a rural and desert area similar to rural areas in sub-Saharan Africa, is being conducted in this context to compare grid and solar electrification following the success that Morocco has experienced willingness to transfer its expertise in electrification to Africa. Energy scarcity is seriously impairing the economies of developing nations. In the current studies, it is suggested that direct heating and cooling would be the most effective use of solar energy and some domestic applications of solar energy.

Keywords: *solar* energy, refrigeration, thermoelectric generator, rural electrification, solar electricity, insulin storage.

INTRODUCTION

There are still lots of isolated communities in the Philippines that need help. These communities are cut off from urban areas and frequently lack even the most necessities. The goal of this research was to create a solar-powered portable refrigerator that can keep insulin at the right temperature for storage and that can be used to solve the insulin storage problem in remote areas without access to electricity. This will make it possible to store insulin efficiently and conveniently in off-the-grid places that rely on solar power. Numerous research has examined the use of solar thermal energy for building heating and cooling. Lamoni et al investigated how insulating the envelope of a new administrative building in Morocco lowered its energy use through the use of TRNSYS simulation. TRNSYS carries out experimental measurements and calculations to assess the solar system's performance and structures. The Organic Rankine Cycle also illustrates the integration of solar space heating and cooling with small-scale power generation technologies (ORC). Several commercial systems ranging in size from a few kW to 10 MW are currently in use, demonstrating the widespread use of this technology. Among the major issues in the world's supply of energy in the coming decades is the electrification of 1.6 billion rural people who do not have access to electricity. A large part of them is living in Africa Sub-Sahara. Morocco has been chosen as an example since it has succeeded in rural electrification. a photovoltaic dimensioning of a village called "Boumhaout" located in southern Morocco and belongs to a rural and desert area that is like rural areas in sub-Saharan Africa to transfer a very reliable and effective model based on photovoltaic solar energy to cover the required needs in rural and desert areas.. Per capita utilization of energy is a strong indicator of development in a country. The energy divide between developed and developing countries is widening. Conventional energy sources in the form of oil, gas, and coal are being quickly depleted and becoming costly. s. In Pakistan, metrological studies have indicated a potential for wind energy in the belt from Karachi to Hyderabad and along the Mekran coast. Alternative Energy Development Board (AEDB) in Pakistan has started with a 100 MW unit near Karachi. Solar energy is a blessing for developing contain focus till now has been using solar cells for generating electricity. The major utilization of electricity in domestic and commercial applications in urban areas is for air conditioning a case study for domestic cooling and rural irrigation illustrates the economical use of solar energy.

Electricity plays a crucial role in the development of society. It is a fundamental part of our life and one can't think of a world without electricity. Since India is geographically located in the sunny belt, it receives 300 days of sunlight. As per NIWE estimates, India has a solar energy potential of 750 GW. India almost receives 4-7 kWh of solar radiation per sq. meters Under the National Solar Mission, India has a plan to build large grid-connected solar power plants, with a cumulative installed capacity of 20,000 MW by 2020. In this paper, the development and performance of this PV system are presented for the month of August 2018. We aim to promote the use of stand-alone solar PV systems in remote areas to supply power to laboratories in rural areas & remote locations. These stochastic energy sources cannot be used today without fossil energy power plants. We still need to generate electricity from fossil fuels, which are well-developed technologies. To keep electricity systems in balance, it is necessary to have a "rotating reserve", which best describes the operating principle of fossil fuel power plants. Load-shifting technology is designed to cope with stochastic production schedule energy sources, such as wind and solar. Baetens 2012 defined self-consumption and called it the cover factor. In the sources, a water tank and a battery as storage devices were connected to the microgrid containing PV electricity and wind production. With the help of the two water tanks, the demand cover factor has reached a maximum of 0.6 and using batteries as well, it is 0.7. Without the storage devices, the demand cover factor for these solutions would have been 0.27. Also, seasonal storage has been used to increase self-consumption.

A. For insulin storage-

The Peltier Effect asserts that thermal energy is absorbed in one junction and discharged at the other, making the first junction cooler and the second junction hotter, when an electric current travels across a circuit made up of multiple conductors. due to the temperature difference that the current flow has caused. The Peltier effect, a technique that alters the temperature across a thermoelectric cooler by providing a DC voltage, was applied to the thermoelectric cooler used in the study. When a DC voltage was connected to the thermoelectric module, it produced an electrical current resembling a 12V 100AH battery. The solar controller's wiring procedure got underway. One set of inputs and two sets of outputs make up the solar controller. The solar panels are the input, the battery charging is one output, and the load is another output. The solar controller was then attached to the three parallel-wired sets of solar panels. The W2809 was then positively and negatively connected to the controller's load output before the sensor was plugged in and set inside the refrigerator. The Peltier module and fans were then linked to the W2809's output wire to make sure that when it sends a signal, the desired temperature (which we set at 2 C cut-off and 7.2 C cut-in) is reached and shuts off the power supply to the Peltier and fans. As shown in figure 1



Figure 1 Final assembly used for testing

B. Electrification of Rural and Arid Areas-

Prior to 1995, PNER I and PNER II, the first and second phases of the national rural electrification (RE) initiative, respectively, achieved an electrification rate of 18%. However, the rate of RE in Morocco has significantly increased since the first phase of the Global Rural Electrification Program (PERG) was implemented in the middle of 1990. The rate of electrification varies greatly across the African continent. The electrification rates in the various African countries vary greatly; for example, they are 17% in Mali, 59% in Ivory Coast, and 82% in Gabon. These facts show how varied the energy situation is across the African continent. Solar household systems are thus the most economical off-grid systems to address the energy needs of Africa. Indeed, according to experts, a solar panel can generate twice as much electricity in Africa as it can in Central Europe due to the continents being among the highest levels of solar irradiation. Additionally, since 2010, the cost of solar panels has decreased by 80%. As a result, hundreds of thousands of Africans now have access to modest solar panels and batteries to cover their basic energy requirements.

Electrification model: "Boumhaout" belongs to southern Morocco, located 30 km from the city of Guelmim. The population number of this rural

area is about 300 inhabitants. This village is electrified by the electricity grid, however, it benefits from a great solar potential similar to the African countries, which will allow us to make a comparison between the electrification by the conventional way (electricity grid) and by the applications of solar energy, we surveyed to determine the electricity needs of this village. To conduct this survey, we visited almost 26 houses asking for information about the electrical machines they use, the number of hours of operation, and any useful information for dimensions as shown in fig.2

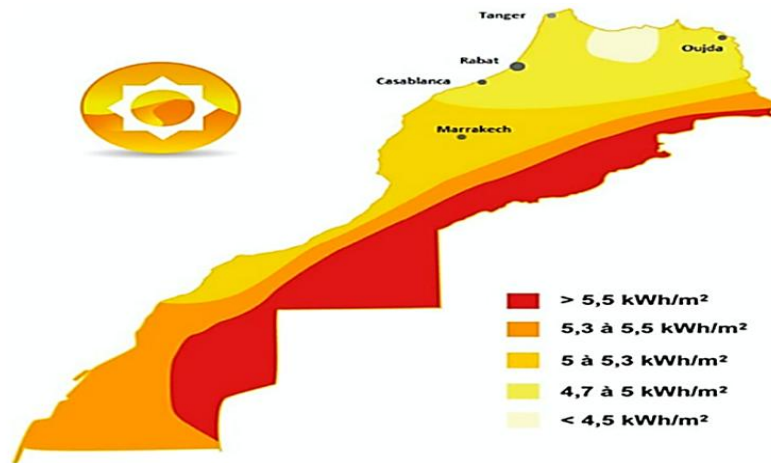


Figure 2 Renewable energies in Morocco

C. Domestic Applications -

For underdeveloped nations, solar energy is a boon. Pakistan is fortunate in this respect. Many efforts have been made in this direction. Utilizing solar cells to produce electricity has been the main focus up until now. In these situations, it is advised that sun absorption chillers be employed in metropolitan areas. A standalone DC supply is preferable in remote locations. Additionally, this would allow daytime water pumping without needing storage batteries. Solar energy is used economically for rural irrigation and cooling. The government's incentives in this area would increase the role of renewable resources even more.

Budget of electrical energy in Pakistan: The demand and supply for electricity in Pakistan are very precarious. Currently, there are about 17000 MW of total generation capacity available. This includes a hydel capacity of 6500 MW or about 38%. To develop the nation's renewable energy resources, the Alternate Energy Development Board (AEDB) was established in 2003. The board has started efforts to use wind energy along the coast of Mekran and from Karachi to Hyderabad. 100 MW of a pilot project are now being built. However, the use of photovoltaic cells has expanded dramatically in recent years. Grid-connected applications are being encouraged through preferential feed-in tariffs and financial public intensities.

D. Multi-purpose applications -

Model TRNSYS Transient systems simulation TRNSYS software version 18 is used to create the proposed system, which includes a solar field, a space heating unit, and a desalination unit. Fig 3 shows the schematic diagram of the entire system. A program for simulating quasi-steady states is TRNSYS. The solar field of evacuated tubes solar collectors (Type 1288), the building model (Type 56), the hot water cylinder (Type 534), the pipe duct (Type 31), and differential control are the model's primary elements.

Building Description: The administrative building of the CSERS was built in 2002 and is located in Tajoura (latitude 32° 48', N, longitude 13° 26' E, elevation 65 m), within Tripoli municipality. The targeted building is a ground-floor building and the total area considered for space heating is 265.5 m², and the height is 2.6 m. The building's main façade is oriented to the west. The building is consisting of 30 offices and the building envelope adopts 200mm concrete slabs with 60 mm thickness EPS (expanded polystyrene) insulation.

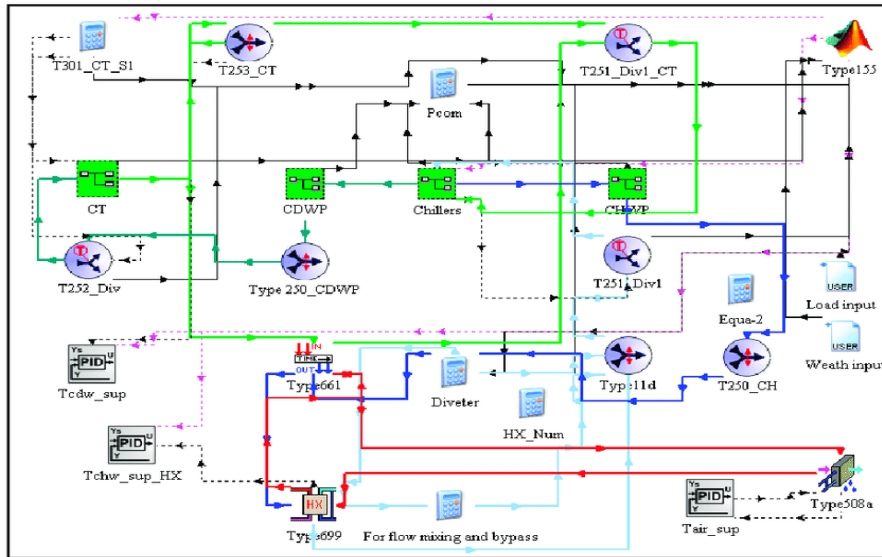


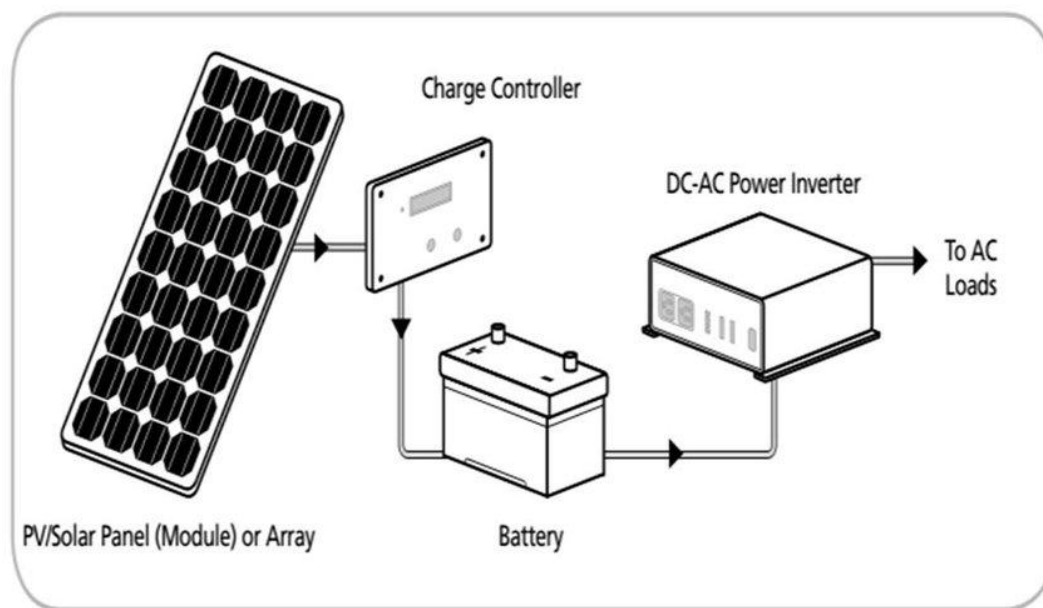
Fig 3- The TRNSYS model for the heating system

Table-Utilization Pattern for a typical house.

T TOTAL Area	50 sq. ft.(one Kanal)
Covered Area	6 3000sq.ft
Connected load	:
Air conditioning	5kw
Lighting	2kw
Refrigeration	1kw
Vacuum cleaner, electric iron, kitchen accessories, pumps, and PCs	2kw
Total connected load	10kw

E. Power management for a computer lab in Rural areas -

The array of PV panels, mounting frames, battery bank (energy storage device), PWM charge controller, inverter, and load make up the bulk of the developed stand-alone SPV system. Ordinarily, little solar cells are put together into larger structures called solar modules. A standalone solar PV system's basic block diagram is shown in Figure 1. The solar panels are initially installed on the top roof of the structure. When loaded, an array of twenty of these panels may produce 24 volts. Each panel's specs are 200 Watts and 22 Volts of open circuit voltage. Photovoltaic company Seemac Pvt. Combining two sets of five panels is accomplished. To make use of all 20 of these PV panels and achieve the recommended 4 kW load capacity, two networks of them are built. Then, two different sets of 24 V and 40 Amp battery banks, charge controllers, and inverter circuits are connected to these two networks (rated 2KVA). A battery bank for both systems is created by connecting two batteries in series to provide 24 Volts of operating voltage for the charge controller. The next objective is to develop a low-cost technique for measuring, logging, and monitoring different solar power system data. Measurements of current and voltage come first in this process. The Allegro® ACS712 Hall Effect Based Current Sensor is used to monitor the output current data from solar panels, battery banks, and inverters. To measure voltage, the voltage divider concept is utilized.



Block diagram of an isolated solar PV system

Conclusion:

The suggested system consists of a thermal storage tank that holds 1200 litres of water and 80 evacuated tube solar collectors. Through the use of system simulation in the TRNSYS environment, the optimal solar field configuration was examined. The results of the simulation for a year show that the system can generate up to 69.5% of the energy needed for desalination and up to 93% of the heating load for space heating. When a PV station's production and consumption are equal, there is a chance that self-consumption will rise. To simultaneously satisfy NS consumption, WT energy needs, and B consumption, energy is obtained from the PV station. The battery then transmits the extra energy to the grid. If there is a power outage, the battery will function. Solar energy usage has a lot of potential in Pakistan. Instead of converting solar energy into electricity and utilizing electrical air conditioners, it is recommended that employing solar absorption chillers for domestic applications may be more cost-effective. The peak load on the UTs would drop as a result. It was successfully created and installed to support the intended standalone solar-powered system's 4kW loads. The computer lab for the hobby club of the EN Department has been powered by its independent solar system. Preliminary testing for the project was successful in August 2018. providing it has energy, and powers the NS. A study is done on the solar field. The computer lab for the hobby club of the EN Department has been powered by its independent solar system. Preliminary testing for the project was successful in August 2018.

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