A SURVEY OF SOLAR ENERGY POWER SYSTEMS

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ABSTRACT

Using the direct space SUN – RAY energy, the proposed solar energy power system is to links up Industrial to Domestic usage (I2D) such that each nations can identify an effective power generation, which brings development to a developing nation and also stability to the develop nation in every facet of her economy. This paper highlights the opportunities for sustaining the developed nations and the developing nations in the implementation of Renewable Energy Sources by taking the Free Gift of Nature (FGN) sun, details some possible architectural configuration and infrastructural requirements. Concerns over global warming are causing shifts in energy policy and energy sourcing around the world. Citizens and governments are carefully weighing their impacts on the environment; many begin to convert to clean renewable energy sources. The European countries are leaders amongst the continents of the world, as well as a nest for the minds of young independent thinkers and countries. Exploration of the renewable energy options will allow any country to understand its potential for reducing its impact on global warming, such that it can weigh the costs of Climate Change with those of upfront economic investment in renewable energy.

Categories and Subject Descriptors

[Energy Applications]: Resource Potential – Investors, Industrial to Domestic (I2D).

General Terms

Management, Documentation, Generation, Transmission

Keywords

Solar Energy, Free Gift of Nature (sun), Power Generation, Transmission, Environmental and Economic Importance of Solar Energy to Industrial and Domestic use.

1. INTRODUCTION

The study of renewable energy sources has been of global concern to the world, and has led many institutions like the European Commission and others to undertake research on sustainable approach to meet the challenges of sustainable energy generation. Renewable energy is a clean energy system that has no effect during or after generation on the environment and which this has led to continuous improvement on solar energy for a better way of reducing green house effect in the future. This has also helped developed and developing countries to take full advantage of this free gift of nature to promote ecological and social innovation which will ensure more sustainable economy growth, environmental conservation and social stability.

A critical challenge that continues to constrain the advancement of many developing countries is the prevalence of poverty. In spite of an abundance of solar energy most developing nations, lack stable power source, due to low technology advancement, poverty, and poor management of existence facilities.
It is widely accepted that access to electricity is essential to any nation's economy, and is a requirement for modern economic and social development. Electricity opens the door to a host of technologies that promote education, public health, and economic development, such as emissions-free light, refrigeration, and communication devices. Without electricity, communities are unable to participate in the benefits of modern advances and are left isolated and literally in the dark.

The overall objective of the solar energy power system is towards a stable power supply for developing and developed nations of the world. Hence, the sunlight that falls on the surface of a tropical country in one day contains more than twice of the energy the country can consumes in a year.

2. SOLAR RESOURCE

Solar resource is a process through which the sun emits energy at an extremely large and relatively constant rate, 24 hours per day, 365 days per year. Through this process, energy could be converted into usable forms on earth; it would be more than enough to supply the world's total energy demand. However, there are many effects of ionospheric scintillation on the environment that will make the days of the year for solar generation not to be effective: firstly, the earth intercepts only a small fraction of the energy that leaves the sun; secondly, the earth rotates such that a collection device on the earth's surface is exposed to solar energy for only about half of each 24-hour period; and finally, the conditions in the atmosphere, such as clouds and dust, sometimes significantly reduce the amount of solar energy reaching the earth's surface.

In this survey Nigeria will be taken as a case study for reference.
Located on the western part of Africa, Nigeria weather primarily features a tropical climate where the season is very humid and damp. There are two climatic seasons that prevail within Nigeria, namely the wet and the dry seasons. The weather of Nigeria is generally quite hot throughout the year, although there are variations in the climate in certain regions within the country. The southern part of Nigeria is relatively more humid and damp than the northern part of the country. In the southern areas of Nigeria the dry seasons begin from the month of November and lasts till the month of March. The northern regions are much drier in nature in comparison to the southern parts. The dry seasons begin from the month of October and last till the month of April. There are extreme weather conditions in the deserts of Sahara. It is scorching hot in the afternoons and freezing cold during the nighttime.

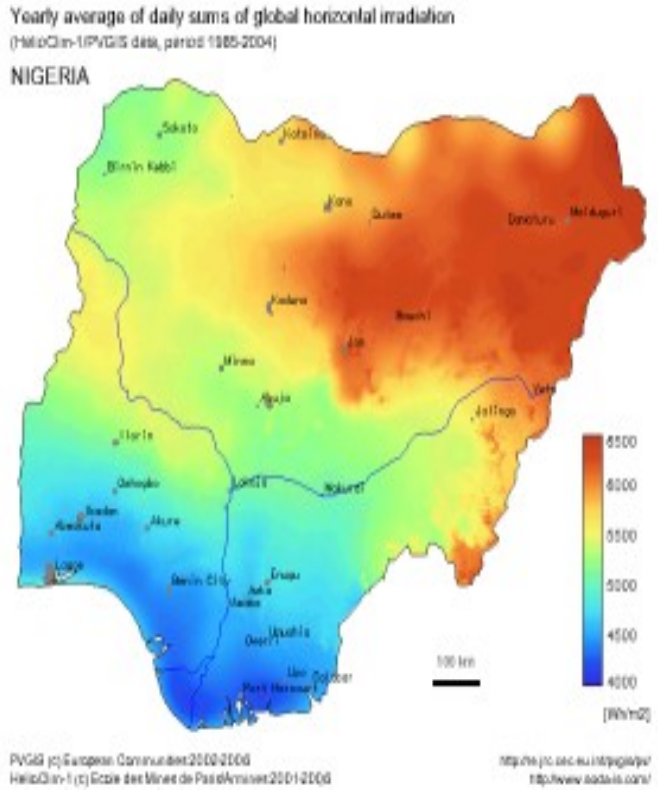

Fig. 1: Map of Nigeria

2.1 Yearly Irradiation in Nigeria

The following map displays the quantity of energy that reached the ground in Nigeria for the whole year. This yearly irradiation is expressed in kWh/m². This map is computed from observations made by meteorological satellites from 1985 to 2004. © European Commission 2002-2006 and HelioClim-1 copyright Mines ParisTech / Armines 2001-2006.

2.2 Climate of Nigeria

Climate is the average weather condition of a place over a given period of years. It is determined primarily by distance from the coast and secondly by evaluation (Bradley 1995). The climate of Nigeria is tropical in nature, which is occasionally subjected to variations, depending on the rainfall. During summers, major portion of the country comes under the influence of moisture-laden tropical maritime air. Temperatures are high throughout the year, averaging from 25° to 28°C. In the higher elevations of the Jos Plateau north central area of Nigeria, temperature is at an average of 22°C. Northern Nigeria experiences greater temperature extremes than the south. Rainfall varies widely over short distances from year to year. Nigeria's electrical energy consumption in the year 2001 is 15×10^6 KWh and the tropic of cancer. It's climate varies from tropical to subtropical. There are two major seasons; the dry season lasting from October to March and rainy season lasting from April to October. In the north, it is hot and dry, rainy season extends between April and September. In the south, it is hot and wet season extends between March and December. From December to March, there is a long dry season (Ojo 2000). Therefore, the Temperature range between 32^0 and 42^0 humidity is about 95% (Falade 1995).

3. SOLAR POWER

3.1 What is solar power?

Solar power is produced by photovoltaic, or "PV", solar panels and other devices that capture the energy in sunlight and convert it to electricity. This electricity can then be fed directly to a consumer, an electric power grid, or a storage device. Typically, solar panels are installed on the roof of residential or domestic buildings, and use the power generated to meet the owner's energy needs and provide surplus electricity to the grid. Other applications include heating water and providing power in areas where electricity connections are not available, such as on road signs, cellular phone towers, and satellites.

3.2 Environmental and Economical Importance

Solar energy has both the environmental and the economical importance to every nation. Hence, the solar power play a key role in cost effectiveness of any nations economy, create a direct employment of labor force and to foster the development of micro – industries.
The most important factor driving solar energy system generation process is whether the energy it produces is economical. Although there are factors other than economics that enter into a decision of when to use solar energy; i.e. no pollution, no greenhouse gas generation, security of the energy resource etc., design decisions are almost exclusively dominated by the 'level of energy cost'. This similar economic

parameter, gives the expected cost of the energy produced by the solar energy system, averaged over the lifetime of the system. Hence, solar energy power system is a very clean energy that if given financial support by the government and industrialist to reduce the cost of implementing the solar panels for industrial, commercial and residential consumers to afford.

Abundant Supply: Solar power could meet today's total electricity demand by PV systems covering only 0.4% of the nation in a high-sunlight area such as the Southwest — an area about 100 square miles. These panels, in reality, will be installed across the country on roofs and other structures close where it is consumed. Technologies such as PV roof shingles, windows, and flexible fabrics that are easily and cheaply integrated into new and existing buildings are emerging.

Secure and Stable Supply: Because solar power is generated domestically, often at the site where it will be consumed, prices and supplies are immune to blackouts, international uncertainty and do not rely on long-distance supply networks.

Cleaner Air: Solar power does not pollute air or water. It replaces electricity generated from facilities powered by coal, natural gas and other non-renewable fuels, eliminating threats to public health such as carbon monoxide, particulate, and toxic chemical emissions from those facilities. Additionally, when a solar power replaces electricity from a coal-fired power plant it also eliminates a potential source of sulfur emissions - a major component of acid rain.

Reducing Global Warming: Solar power does not produce CO_2 or any other greenhouse gases, thus helping to reduce the risk of climate change.

4. HOW SOLAR ENERGY WORKS

The solar energy technology is the absorption of sun's energy directly converted into electrical. Hence, the solar energy works through the aid of combining solar panel which is also known as photovoltaic cells, solar cells and solar panels. The solar panel is basically used in generating 12Volts DC (Direct Current) and the number of photovoltaic cells used determines the amount of electricity to be generated.

The solar panels absorb sun ray and then convert it to provide DC power to the power center, where a centralized battery bank, or individual home batteries are charged. The energy from the battery bank can then be used directly in DC appliances or can be converted to AC power with an inverter for use in standard AC appliances. The solar panels can only work during daylight hours. The solar production system compliments each other well because it tends to be windy on cloudy, rain days and sunny on calm clear days.

5. GENERATION OF SOLAR POWER

Solar power generation directly converts solar energy into electrical energy through a chemical action taking place in solar cells. These operate based on the photo-voltaic effect, which develops an electromagnetic force (emf) on absorption of ionizing radiation from sun.

Solar energy (Photovoltaics), the direct conversion of sunlight to electricity, is now the fastest growing technology for electricity generation. Present 'first generation' products use the same silicon wafers as in microelectronics. 'Second generation' thin films, now entering the market, have the potential to greatly improve the economics by eliminating material costs. Martin Green, one of the world's foremost photovoltaic researchers, argues in his book that 'second generation' photovoltaics will eventually reach it's own material cost constraints, engendering a 'third generation' of high performance thin films. The book explores, self – consistently, the energy conversion potential of advanced approaches for improving photovoltaic performance and outlines possible implementation paths.

Fig. 2: Solar Power Generation Diagram

6. TRANSMISSION OF SOLAR RAY

When solar ray strikes an object, there are two possible occurrences: the object may reflect the solar energy, or the object may absorb it. Most objects are applicable for this process, to a greater or lesser extent. It is useful knowledge to understand how different materials transmit, reflect, and absorb solar radiation. For instance, in the case of a solar cell, it is important to coat the surface with a material that is a poor reflector—we want as much light as possible to enter the cell. Accordingly, creating comfortable, well-lit homes, schools, and offices requires an understanding of which building materials transmit, reflect, and absorb solar radiation.

Fig. 3: Solar Panel Diagram

7. CONCLUSION

The survey has gathered resource potential of solar energy and how the solar system development in developed countries and some developing countries (China, South Africa, Gambia, Kenya, Tanzania, Uganda and many more) and it's implementation in Nigeria.
The most important factor driving the solar energy system design process is whether the energy it produces is economical. Although there are factors other than economics that enter into a decision of when to use solar energy; i.e. no pollution, no greenhouse gas generation, security of the energy resource etc., design decisions are almost exclusively dominated by the 'level of energy cost'. This similar economic parameter, gives the expected cost of the energy produced by the solar energy system, averaged over the lifetime of the system. Hence, solar energy power system is a very clean energy that should be given support by the government and industrialists to reduce the cost of implementing the solar panels for industrial, commercial and residential consumers to afford.

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