

GE04

Solar Energy to Meet the Energy Crisis in Bangladesh

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Abstract— In this paper, the scope of renewable energy has been elucidated with practical applications in Bangladesh. Solar energy is the most influential for generating electricity for running the industrial and household consumption. Different kinds of solar cells with their effectiveness and efficiencies have also been discussed. It is evident that the multijunction solar cell is the promising candidate to get the better efficiency.

INTRODUCTION

Renewable energy is the energy, generated from natural resources such as sunlight, wind, rain, tides, geothermal heat etc which is renewable. The majority of renewable technologies are powered by the sun. The hydrosphere (water) absorbs a major function of the incoming radiation. Most radiation is absorbed at low latitude around equator, but the energy is dissipated around the globe in the form of winds and ocean currents. Solar energy is also responsible for the distribution of precipitation which is tapped by hydroelectric project and for growth of plants used to create bio-fuel. Renewable energy is derived from the natural processes that are replenished constantly. In its various forms, it derives directly from sun or from heat generated deep within the earth. Included in the definition is electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources, and bio-fuels and hydrogen derived from renewable resources. Wind power is the conversion of the wind energy into a useful form of energy; such as using wind turbines to make electricity, wind mills for mechanical power, wind pumps for pumping water or drainage, or sails to propel ship. It is renewable and produces no green house gases during operation. Energy in water can be harassed and used. Since water is about 800 times denser [1] than air; even a slow flowing stream of water or moderate sea swell, can yield considerable amounts of energy. Plants use photosynthesis to grow and produces biomass can be used directly as fuel or to produces bio-fuels. There is variously bio-fuel such as liquid bio-fuel, soil bio-mass, biogas etc. Geothermal energy is obtained by tapping heat of the earth itself both from kilometers deep into the earth crust in some places of the globe or from meters in geothermal heat pump in all the places of the planet. There are three types of power plants are used to generate power from geothermal energy such as dry stream, flash and binary. A solar energy comes from solar cell. Solar cell converts sunlight energy into electric energy and delivers power to a load. The total energy absorbed by the earth's atmosphere, oceans and land masses is approximately 3850000 exajoules (Ej) per year [2]. From the table of resources it would appear that solar, wind or biomass would be sufficient to supply all our energy needs; however the increased use of biomass has

had a negative effect on global warming and dramatically increased food prices by diverting forests and crops into bio-fuel production.

Table I. Yearly solar fluxes and Human energy consumption

Yearly solar fluxes and Human energy consumption	
Solar	3850000 Ej [2]
Wind	2250 Ej [3]
Biomass	3000 Ej [4]
Primary energy use (2005)	487 Ej [5]
Electricity (2005)	56.7 Ej [6]

Solar energy can harness in different levels around the world. Depending on a geographical location the closer to the equator the more "potential" solar is available. So we think, solar energy will be most influential for generating more electricity for running industries and household consumption.

SOLAR CELLS

We are trending to renewable energy because of the global warming and the gradual reduction of the fossil fuel. There are different types of solar cells. Organic solar cells and polymer solar cells are built from thin films of organic semiconductor. Energy conversion efficiencies achieved to date using conductive polymers are low compared to inorganic materials. However, it improved quickly in the last few years. These cells could be beneficial for some applications where mechanical flexibility and disposability are important. Dye-sensitized solar cells are considered to low-cost solar cells and it is extremely promising because it is made of low-cost materials and does not need elaborate apparatus to manufacture and its conversion efficiency is less than the best thin film solar cell. Single-crystal silicon solar cells are expensive and limited to approximately six inches diameter. A system powered by solar cells requires a very large array to generate the required power. Amorphous silicon solar cells provide the possibility of fabricating large area and relatively inexpensive solar cell systems. A cadmium telluride solar cell is a solar cell based on cadmium telluride, an efficient light-absorbing material for thin-film cells. Compared to other thin-film materials, CdTe is easier to deposit and more suitable for large-scale production. Copper Indium/Gallium Diselenide(CIGS) solar cell, a solid mixture of the semiconductors CuInSe₂ and CuGaSe₂. Unlike the conventional silicon based solar cell, these cells are best described by a more complex heterojunction model.

Higher efficiencies (around 30%) can be obtained by using optics to concentrate the incident light or by using multi-junction tandem solar cell. Some investors in solar technology worry that production of CIGS cell will be limited by the availability of indium. Multi-junction solar cell absorbs a large portion of solar spectrum by its various layers. There is a different combination of multi-junction solar cell. It is mostly used in extra-terrestrial purpose and the highest efficient solar cell but it is very expensive.

Table II. Best Research-Cell Efficiencies [7]

Solar cell	Efficiency	Institution
Organic cells	7.9(%)	Solarmer
Dye-sensitized cells	11.1(%)	Sharp
Amorphous Si:H(stabilized)	12.5(%)	UnitedSolar
CdTe	16.7(%)	NREL
Cu(InGa)Se ₂	20.0(%)	NREL
Multicrystalline Si	20.4(%)	FhG-ISE
Single crystal Si	25.0(%)	UNSW
Three junction (2-terminal monolithic)	41.6(%)	Boing-Spactrolab (lattice matched)

The main four approaches for increasing efficiency of solar cells. Multi-junction cells use multiple solar cells that selectively absorb different regions of the solar spectrum. Intermediate-band cells use one junction with multiple bandgaps to interest efficiencies. Hot-carrier cells convert the excess energy to above-bandgap photons into electrical energy. Spectrum conversion solar cell convert the incoming polychromatic sunlight into a narrower distribution of photons suited to the bandgap of the solar cell [8].

CURRENT ENERGY STATUS IN BANGLADESH

In Bangladesh most of the electricity generated from natural gases. Electricity also generate from other sources such as Diesel, coal etc. A little portion of electricity is

Table III. Current energy status in Bangladesh [9]

Source	Electricity production in MW	Fraction of total production in %
Hydro	230	4.19
Steam Turbine	2638	48.03
Gas Turbine	997	18.15
Combined cycle	1359	24.74
Diesel	269	4.89
Total	5493	100

generated from the renewable sources. The reserved gas is gradually reduced, but no more gas field is discovered here. At the same time, the demand of energy is gradually increased. The different fractions of total production from various sources are given in Table III.

In Bangladesh, the use of solar energy is increased gradually. The Solar Home System (SHS) dissemination program in Bangladesh is considered to be one of the most

successful of its kind in the world, bringing power to rural areas where grid electricity supply is neither available nor expected in the medium term. The following diagram is illustrated the increasing order of installed solar home system.

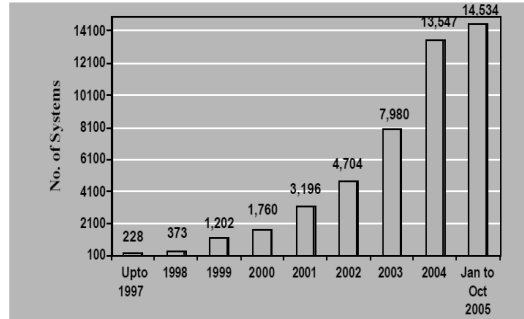


Fig. 1. Progress of Grameen Shakti (installed solar home System) [10]

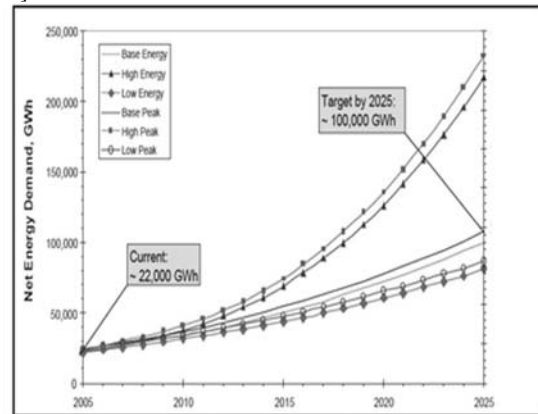


Fig.2. Electricity demand forecast power system master plan 2006 [13]

Between January 2005 and July 2009, nearly 350,000 SHSs have been installed in the country. Supported by grants and soft loans from the World Bank, GTZ, and the Asian Development Bank, installation rates have increased to a rate of more than 15,000 per month [11] IDCOL has made an upward revision in its target of financing 300,000 SHSs by 2009 as over 295,000 SHSs have already been installed[12]. The contribution of renewable energy is really small in corresponding to the other sources moreover its installation cost is high. So technologies must be developed. So its' efficiency would be increased and cell size should be reduced. In Bangladesh, most solar panel is first generation bulk growth wafer base silicon solar cell. And silicon solar cell is very much costly. Moreover it generates low efficiency. To solve this problem second generation thin film solar cell such as amorphous silicon (a-Si), CdTe, CIGS would be the alternative solar cell because of its' low cost material.. So the solar energy can play the vital role to solve the energy crisis. The demand of electricity will gradually increase. The following diagram illustrates this.

The grid connected solar system also very effective way to solve the energy crisis and to earn money. Different

countries in the world also use grid connected solar system. Bangladesh can easily use this system to solve its energy crisis. Multijunction solar cell is the highest efficiency solar cell but growth cost is very high. However by using low cost III-V with concentrated system the cost would be tradeoff.

CONCLUSION

The requirement for energy could be met by renewable sources with proper plan and management. Bangladesh definitely requires photovoltaic power generation and it has been seen that multijunction solar cells contribute not only for the extra-terrestrial but also for domestic and industrial sectors. A complete applicable design for solar home system is immediately required for Bangladesh which would be the best choice for the introduction of renewable energy. So green energy, especially solar energy is the ultimate solution of energy crisis of Bangladesh and the world.

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