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Comparison of Solar Energy System with Conventional Power System : A Case Study of GZSCCET Bathinda

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Abstract - *Generation of electricity by conventional sources created a lot of pollution and it strained our natural resources like coal, etc. World's main focus is to somehow find an alternative to these conventional sources. There are numerous methods to extract energy from non-conventional sources like sunlight, wind, biomass, water and geothermal etc., but power generation from Sunlight has emerged as one of the most successful programs in the renewable energy sector and has started making meaningful contributions to the overall power requirements of some states. Solar power is good renewable, clean and free source of energy of power production. In this work, our main objective is to do the cost analysis of solar energy system and its feasibility to produce required quantity of electricity for GZSCCET Campus. The whole GZSCCET Campus like Boys hostel, girls hostel, cafeteria, lecture halls, workshops, labs etc. have been surveyed and the data of electrical utilities and electricity consumption per month is collected. Hence GZSCCET can produce its own electricity for its whole campus and can become a bold example in India's campaign for clean energy and development.*

***Key Words*: Solar Power, Sustainable Development, Location Selection, Solar Panels, Rooftop solar power plant.**

1 INTRODUCTION

The prime requirement to do any work is Energy. Till late 90's the world had been using conventional or non-renewable resource like coal, petroleum, etc., to fulfill their energy needs. But these resources posed a serious threat on the environment. The second drawback of conventional resources is that they may get extinct in a short time. So the only choice we are left with is to find an alternative. The substitution to the non-renewable resources is the promotion of renewable resources like solar energy. Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic cells, solar thermal energy, and artificial photosynthesis. Solar techniques used now a day's includes the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy of sunlight .Solar energy is an important renewable energy source for the country, both in the generation of PV electricity and as heat. Therefore, it is necessary to quantify the solar potential of an area, but to achieve this goal requires an adequate estimation of solar radiation incident on the Earth's surface. Generally, the spatial variability of solar radiation is determined by the interplay of chronological, geographical, atmospheric and surface conditions [1]. However, there are simple geometric formulas that allow a relatively reliable estimation, so the spatial modeling of this variable is crucial to quantify the availability of energy per area unit for its potential use. The solar radiation modeling has shown significant progress in recent decades, reaching at present integration in geographic information systems that allow quantification at its spatial distribution [2]. Solar power is set to play an increasingly significant part in future energy system of India. Solar energy is a free, renewable resource. So, no matter how much of it is used today, there will be still the same supply in the future. Solar energy is also a source of clean, non-polluting electricity. Unlike conventional power plants, solar plants emit no pollutants or green house gases. So today government as well as private sectors also prefers to produce large amount of electricity with its solar plants. Energy is a major input for overall socio-economic development. Use of fossil fuels is expected to raise the level of economic development process of a majority of the world population during the next two decades. However, up to 2020-2050, fossil fuels are likely to reach their maximum optimal potential, and the price of these fossil fuels will become too high than other renewable energy as they are limited and exhaustible energy resources. Therefore, renewable sources are expected to play a major role in accelerating sustainable growth and development in the second half of the next century, accounting 50-60% of the total global supply then. Solar plants are used for their mechanical power, solar power as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, and uses little land. Sunlight is an inexpensive source of electricity, competitive with or in many places cheaper than coal or gas plants.

1.1 SOLAR POWER SYSTEM STRUCTURE AND WORKING PRINCIPLE

We can change sunlight directly to electricity using solar cells. The sunlight hit solar panels on the roof with photons (particles of sunlight). The solar panel converts those photons into electrons of direct current ("DC") electricity. The electrons flow out of the solar panels and into an

inverter and electrical safety devices. The inverter converts that "DC" power (commonly used in batteries) into an alternating current or "AC" power. AC power is the kind of electrical that is used in television, computer, and toasters when plugged into the wall outlet. A net energy meter keeps track of the all the power that is produced by the solar energy system. Any solar energy which is not used simultaneous with production will go back into the electrical grid through the meter. At night or on cloudy days, when the system is not producing more than the building needs, then the electricity can be consumed from the grid as normal. Your utility will bill you for the "net" consumption for any given billing period and provide you with a Rupee credit for any excess during a given period. [3]

III. TYPES OF SOLAR PANELS

There are different types of solar panels which are used, some of them are listed below:

A. Monocrystalline Silicon (Single Silicon): Monocrystalline Silicon Cells are the most efficient type of solar panels. In other words, we can say that when sunlight strikes on panels, and is absorbed by the panels, most of it is converted into electricity than the other types of panels. Due to high silicon content, they're also more expensive, but need fewer in number than others. That's why they're ideal for roofs.

B. Polycrystalline Silicon (Multi-silicon): "Poly" panels have lower silicon levels than "mono" panels. That makes them less expensive to produce, but they're also slightly less efficient. The good thing is that their overall construction design can often make up for the efficiency loss, so they're also good for roofs. These can be recognized by their groovy mélange of silicon woven through thin rectangular conduit wires.

C. BIPV (Building Integrated Photovoltaic's): BIPV's may look like real roofing tiles (solar shingles are an example). Which gives pleasant appearance but are expensive solar panels. Second, they are less efficient than conventional PV, as it needs a shade free roof to set and make a cut in electric bill. Finally, they may not lasts as regular panels could.

D. Solar Thermal Panel: This is the type of solar panel that has nothing to do with electricity. These types of solar panels are used to produce hot water for homes. Some systems can even provide heat and air conditioning.

1.1 SITE SELECTION FOR SOLAR POWER PROJECT

A. IDENTIFICATION OF SITE

The first task towards project development is the identification of a suitable site. The project developer needs to identify a site and check its availability.

B. SOLAR INSOLATION AND SHADOW ASSESSMENT

Site specifications including level of solar irradiation at site, temperature and obstacles which may cast shadows need to be checked initially.

C. GEOLOGICAL DUE DILIGENCE

Preferred land orientation is flat; the same must be assessed at this stage. Other criteria include state of drainage system, dust percentage in air and soil strength to support structures.

D. SOCIAL AUDIT OF THE SITE

Along with availability of labor at site, the security and local social support for power plant are important factors and shall also need to be assessed.

E. FINANCIAL PRE-FEASIBILITY

Preliminary calculations on the overall cost and generation would be assessed to establish project financial viability. This activity is a go/no-go assessment for the project.

1.2 SITTING OF SOLAR PANELS ON ROOFTOP IN COLLEGE CAMPUS

The sitting of the solar systems considered is Giani Zail Singh Campus College of Engineering and Technology, Bathinda. All the aspects and physical features are studied well and the climate varying conditions of Bathinda are attached. By using the google maps, the main areas of concern in the campus have been marked. The placement or 'sitting' of solar power systems is extremely important. In order to make solar power system effective, relatively consistent sunlight isolation is required. Obstructions such as trees or hills can interfere reaching the direct sunlight to the panels. Because of this, the solar panels are usually placed on roof tops or on a shading free area (i.e. space free from shading) to take advantage of the stronger sun radiation. Furthermore, daily solar irradiance varies with season, and time of day. All these factors must be considered when choosing a site for a solar powered generator. The amount of solar energy available at any location depends on two sets of factor:

a. Climate factors including: Time of day, Geographic location, Topography and Local weather.

b. Mechanical factors including: Type of Solar panel, and size of the panels.

1.3 INTENSITY OF SOLAR POWER

Retscreen plus software is used in this project to find out the intensity of solar power that is being received by Bathinda. In this software the data is empowered by NASA. The

meteorological data can thus be obtained. Data is considered from 2012 to 2014. The information can be retrieved by using Retscreen plus which directly extracts the data from NASA. RETScreen : RETScreen is Canadian Software which holds a complete database for any location in the world, optimised for using the best available data at each location from about 20 sources, the main ones being th WRDC and the NASA irradiance data. Temperatures and Solar radiations are also provided probably with good reliability. NASA and WRDC data are available free of cost, and hence RETScreen data is also free.

Daily Solar Radiation received by Bathinda is 5.08kwh/m2/d on an average basis whereas the Solar Radiation required for effective working of Solar Panels is 3.0 kwh/m2/d , thereby making the project workable.

2. COMPARISON BETWEEN SOLAR PANELS OF VARIOUS COMPANIES

Table -1: Analysis of Various Companies Price

	Tata (Ts 250)	Exide	Kirloskar Solar	Su-Kam Solar
Nominal Power Output(W)	250	300	300	300
Voltage at P_{Max} V_{Mpp} (V)	38.1	44.5	44	44.64
Current at P_{Max} I_{Mpp} (A)	8.58	8.72	8.66	8.75
Open Circuit Voltage V_{OC} (V)	30.7	36.83	36	35.93
Short Circuit Current I_{SC} (A)	8.16	8.32	8.34	8.35
Module Efficiency (η%)	15.00	15.58	15.52	15.54
Cost per Module (250wp/300wp)	Rs. 17400	RS. 20880	Rs. 20900	Rs. 23500
Cost Per 1 KW (4 no.)	Rs. 69600	Rs. 83520	Rs. 83600	Rs. 94000
Power Output (1 KW)	1000 W	1200 W	1200W	1200 W
Maintenance Cost	Rs. 5000-10000	Rs. 5000-10000	Rs. 5000-10000	Rs. 5000-10000

According to the above analysis between various Solar Panel Companies, It is found that the best suited solar module used is Module provided by Tata Solar Pvt. Ltd. as the Efficiency of the Module is maximum amongst others and also it is economical amongst others.

3. ELECTRICITY CONSUMPTION DETAILS

Table -2: Power Consumption of Building Section-I

Building Section-I	Power Consumption (Kwh/Day)	Solar modules (KW)
Academic Cell	114 Kwh/Day	29 KW
A- Block	398 Kwh/Day	100 KW
Library	212.9 Kwh/Day	53 KW
Conference Hall	100.4 Kwh/Day	25 KW
Architecture Department (Ground Floor)	226.4 Kwh/Day	57 KW
Campus Director's Office and Adjoining Offices	161.35 Kwh/Day	40 KW
Architecture Department and Account Section (Ist Floor)	73.84 Kwh/Day	19 KW
Electronics Department	395 Kwh/Day	99 KW
Architecture Department (2nd Floor)	42.2 Kwh/Day	10 KW
Computer Department	457.5 Kwh/Day	120 KW
Total	2181.59 Kwh/Day	552 KW

Table-3: Power Consumption of Building Section-II

Building Section-II	Power Consumption (Kwh/Day)	Solar modules (KW)
Applied Department	295.7 Kwh/Day	74 KW
Civil Department	263 Kwh/Day	66 KW
Lecture Halls	150.6 Kwh/Day	38 KW
Total	709.3 Kwh/Day	178 KW

Table- 4: Power Consumption of Building Section-III

Building Section-III	Power Consumption (Kwh/Day)	Solar modules (KW)
Textile Department	312.2 Kwh/Day	78 KW
Mechanical Department	255.6 Kwh/Day	64 KW
Workshops	186.4 Kwh/Day	47 KW
Total	754.2 Kwh/Day	189 KW

Table- 5: Power Consumption of Building Section-IV

Building Section-IV	Power Consumption (Kwh/Day)	Solar modules (KW)
Bank	58.3 Kwh/Day	15 KW
Dispensary	14.08Kwh/Day	4KW
Shops	27.9 Kwh/Day	7 KW
Total	100.28 Kwh/Day	26 KW

Table- 6: Power Consumption of Building Section-V

Building Section-V	Power Consumption (Kwh/Day)	Solar modules (KW)
Girls Hostel 1	406.4 Kwh/Day	100 KW
Girls Hostel 2	406.4 Kwh/Day	100 KW
Total	812.8 Kwh/Day	200 KW

Table- 7: Power Consumption of Building Section-VI

Building Section-VI	Power Consumption (Kwh/Day)	Solar modules (KW)
PG Hostel Boys	440.6 Kwh/Day	100 KW
Hostel No. 1	408.4 Kwh/Day	100KW
Hostel No. 2	408.4 Kwh/Day	100 KW
Hostel No. 3	441.4Kwh/Day	110 KW
Hostel No.4	441.4 Kwh/Day	110 KW
Hostel No.5	494 Kwh/Day	120 KW
Total	2634.2 Kwh/Day	640 KW

1 KW Solar Modules can produce 4-8 KWH power per day Thus, for 7192.37 units, 1785 KW solar modules are required.

1785 KW Solar Power Plant for 7192.37 KWH consumption For this installation charges = Rs. 150000 @ 1 KW Solar Modules including maintenance
For 1785 KW Solar Power Plant = 1785 x 150000 = Rs. 26, 77,50,000 /-

But we are paying current bill @ Rupee 7 per unit (KWH) Therefore, paying current bill = 7192.37 x 30 x 12 x 7.0 = Rs. 1, 81, 24,772.4

So, 14.7 years paying current bill will be equal to initial installation cost. But turbines lifespan is 20-25 years.
Thus, Amount saved will be equal to 10.7 years current bill = Rs 18, 66, 85,156

3. CONCLUSIONS

I. Sunlight in Northern India is also capable of producing clean electricity. Solar energy is pollution free and nature friendly. Solar energy has a very high potential to fulfill power demands of our country. By using this alternative, not only pollution can be reduced, but also the stress on conventional sources is lowered.

II. Although initial installation cost is high, but the results obtained will be very effective. GZSCCET campus was surveyed and as per the power consumption details 1785 KW Solar power project can satisfy the electricity needs of the campus. Similarly wind turbines can be installed for whole of the GZSCCET Campus.

III. As per proposed project, if Solar Power Plant is installed in GZSCCET Campus, management can save more than 19.2 crore of Rupees in 25 years.

IV. According to the website www.mnre.gov.in in which it tells that the installation of solar powered plant will be equivalent to planting the 81475 teak trees over the lifetime and the carbon dioxide emission is also mitigated will be 50922 tones.

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