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# Estimation of the Solar Energy Generation Potential on the Rooftop of the PTU College Campus

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**ABSTRACT: -**Due to the depletion of fossil fuels resources on a worldwide basis and to meet up the present day demands, it has necessitated an urgent search for alternative energy sources. Solar energy is clean, inexhaustible and environment-friendly potential resource among renewable energy options. But neither a standalone solar photovoltaic system nor a wind energy system can provide a continuous supply of energy due to seasonal Due to the depletion of fossil fuel resources on a worldwide basis and to meet up the and periodic variations. Therefore, in order to satisfy the load demand, grid connected energy systems are now being implemented that combine solar and conventional conversion units The objective of this work is to analyze of the grid connected rooftop solar photovoltaic power plant in campus and finally develop a system based potential estimations made. Cost estimation of grid connected rooftop SPV power plant to show whether it is economically viable or not.

**KEYWORDS**:-Grid connected Rooftop SPV, fossil fuels, depletion.

## I.INTRODUCTION

Photovoltaic offer consumers the ability to generate electricity in a clean, quiet and reliable way. Photovoltaic systems are comprised of photovoltaic cells, device that converted light energy directly into electricity. A successful integration of solar energy technologies into the existing energy structure depends on a detailed knowledge of solar resource. In recent years grid connected rooftop solar power generation system become viable and attractive. Available rooftop area on the building can be used for setting up solar PV plants. The rooftop solar PV systems are easy to install of maintain and have long life 25 years. However, the technical requirement form the both the utility power system grid side and the PV system side need to be satisfied to ensure the safety of the PV installer and the reliability of the utility grid. For this survey we have gone through journals, different books and papers to get its keen knowledge.

## II. LITERATURE REVIEW

S. Rosster et al. (2000) [1] presented a general terms, large modules are desirable because they improve installation efficiency by filling the roof faster. Large modules also reduce the number of electrical and mechanical connection in a system . M.H. Albadi et al (2014) [4]PV modules are judged on two basic factors; efficiency and economics. Poly crystalline modules are the most common type of the PV module whose efficiency is rated from 13% to 15%.
Vineet Singla et al 2013 [2] presented that solar radiation is the key factor determining electricity produced by photovoltaic (PV) system and finally develop a system design to possible plant capacity for available area which is usually obtained using geographical information system (GIS) . Hemakshi Bhoye et al (2014) [3] how to establish photovoltaic solar power plant design as well as calculation of power production base on that to further we find recommendation and techniques to optimized cost of the PV solar power plant.
Jontas M.Rodrigues et al(2015)[5] presented in his y Research work a technical and economical analysis of a grid connected photovoltaic system to be installed on the rooftop of an industry in the state of Goias, Brazil. Calculations were made to obtain Estimating energy production and selection of the PV module.

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Vinay Janardhan Shetly et al(2014)[6] The object of this work is to estimate the cost analysis of 500kw grid connected solar photovoltaic plant and then calculations are made on payback period and rooftop area for 500kw SPV installation. Rooftop system out of sight out of mind on of the best features of rooftop solar PV system is that they can permitted and installed faster and other types of renewable power plants. The are clean, quiet and visually unobtrusive .Mr Radhey Shyam Meena et al(2014)[7] presented the various advantages of the rooftop SPV systems.

## III. **METHODOLOGY**

To find out the possible solar photovoltaic Generation potential, the solar radiation over one year (jan-dec2015) is taken from NASA site. for calculation the output the efficiency of the PV module is taken as 14.3% finally a grid connected photovoltaic system is designed with estimated plant capacity on available area. The method of design is shown with the existing equipments available in the market.

To find out the possible solar photovoltaic Generation potential, the solar radiation over one year (jan-dec2015) is taken from NASA site. for calculation the output the efficiency of the PV module is taken as 15.54% finally a grid connected photovoltaic system is designed with estimated plant capacity on available area. The method of design is shown with the existing equipments available in the market.

## IV.RESULT AND DISSCUSION

Table 1 below shows the solar radiations for every month and their average value.

Table 1: Solar Radiation for Every Month

| **Month** | **Daily radiation in KWh/m$^2$/day** |
|---|---|
| January | 3.43 |
| February | 4.38 |
| March | 5.32 |
| April | 6.15 |
| May | 6.48 |
| June | 6.52 |
| July | 5.83 |
| August | 5.54 |
| September | 5.31 |
| October | 4.76 |
| November | 3.94 |
| December | 3.26 |
| Average Value | 5.07 |

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Mean Global solar radiant Exposure at Bathinda. So average annual solar insolation in Bathinda 5.07 KWh/m$^2$/day

Table 2: Power rating of various appliances of L type quarter

| S. No | Electrical Load | No.fo units | Operating load | Power consumption |
|---|---|---|---|---|
| 1. | Lighting load | 4×14=56 | 6 | 20 |
| 2. | Fans | 4×4=16 | 10 | 90 |
| 3. | TV | 4×1=4 | 2 | 150 |
| 4. | Refrigerator | 4×1=4 | 24 | 150 |
| 5. | Washing Machine | 4×1=4 | 1 | 200 |
| 6. | Air conditioner | 4×1=4 | 4 | 1500 |
| 7. | Exhaust Fan | 4×1=4 | 3 | 70 |
| 8. | Other load | 4×1=4 | 1 | 60 |

Table 2 Shows load connected and power consumption of one L-type quarter of PTU Campus. From the power consumption demands, following calculations are done that are shown in Table-3,4,5,6,7and 8

Table 3: Calculated size of PV Panel size

| | | |
|---|---|---|
| **Total PV Panels Energy needed** | 62600×1.3= 81380<br>81.3 | WH/day<br>KWH/day |
| **Size of the PV Panel** | | |
| Total WP of PV Panel capacity needed | 81380/5.07 = 16051.28 | Wp |
| | 16.05 | KWp |
| So Estimated plant Capacity Would be | 16 | KWp |
| Number of PV panels of needed | 16000/180=88.8 | Modules |
| Actual Requirement | 90 | Modules |

So this system should be powered by at Least 90 Modules of 180Wp PV modules

Table-4: Calculation of required rooftop area for 16 KWp SPV installation

| Module size for 180Wp | | |
|---|---|---|
| Length of module | 1593 | mm |
| Breadth of module | 790 | mm |
| Area covered by one module= | 1593×790mm$^2$=<br>1258470mm$^2$ =1.259 | mm$^2$<br>m$^2$ |
| Number Of Panels Required For 16 Kwp Approximately | 90 | Modules |
| Area Covered By 90 Panels | 113262300 | mm$^2$ |
| Extra Area Added For Clearance | 25 | mm$^2$ |
| Actually Area Covered By 90 Panels | 2250 | mm$^2$ |
| Now Area Covered By 90 Panels | 113262300mm2+<br>2250mm2=113264550=113.26=115 | mm$^2$<br>m$^2$ |
| Roof Top Area Of L Type Quarter of one unit | 185.80 | m$^2$ |
| Effective Area | 185.80×70%=130 | m$^2$ |

An inverter is used in the system where AC power output is needed. The input rating of the inverter should never be lower than the total watt of appliances. The inverter must have the same nominal voltage as your battery. Table 5 shows the calculated inverter size for L-type Quarter of PTU Campus For grid tie systems or grid connected systems,

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the input rating of the inverter should be same as PV array rating to allow for safe and efficient operation .Inverter size= 1MW×1.3 = 1.3MW.

Table 5: Calculated Inverter size

| | | |
|---|---|---|
| For grid connected roof top system the size of the inverter would be same or more than the plant capacity so the size of the inverter would be | 16KWp×1.3=20.8=21 | KW |

Battery Capacity (Ah) = Total Watt-hours per day used by appliances × Days of Autonomy (0.85 × 0.6 ×nominal battery voltage)

Table 6: Calculated Size for Battery

| | | |
|---|---|---|
| Daily Power Consumption | 62600 | WH /day |
| Nominal battery voltage | 12 | V |
| Days of Autonomy | 1 | Days |
| Battery capacity | $\frac{6200 \times 1}{.85 \times .6 \times 12} = 10228$ | AH |

According to standard practice, the sizing of solar charge controller is to take the short circuit current (Isc) of the PV array, and multiply it by 1.3Solar charge controller rating = Total short circuit current of PV array x 1.3

Table 7: Calculated Size for Solar charge controller

| | | |
|---|---|---|
| Solar charge controller sizing | (90×7.5A)×1.3<br>= 877.5A=878 | A |

The energy produced by the modules in each roof surface was estimated by studying the average solar radiation data, the module area and the conversion efficiency, as it was calculated With: Ep=Es×Am× $\eta M$ ×$\eta i$ Where, *EP* is the daily produced energy by module (Wh),Es is the daily irradiation on the inclined surface (Wh/m$^2$/day),Am is the module area (m²), $\eta M$ is the module efficiency(%)and $\eta i$ *the* inverter efficiency (%). It is possible to calculate the energy produced by one module during one day. The total energy produced by a photovoltaic system can be obtained by multiplying by the total number of modules as shown in Table 8.

Table 8: Estimating Energy Production

| | | |
|---|---|---|
| EP=Es×Am×Nm×N:i | Ep=5070×1.259×0.143×0.945= 862.58 | WH/day |
| No of modules | 90 | Modules |
| Total daily production in KWH | 77.6KWh=78 | KWH |
| Monthly production in KWH | 2340 | KWH |
| Total annual production | 28470 | KWH |

## V.CONCLUSIONS

Solar photovoltaic generation potential during the period Jan – Dec 2015 is assessed for BATHINDA district of PUNJAB in PTU campus It is found that the month of December produced the lowest solar radiation. With greater available area higher capacity plant can be set up. Had calculations been available for the months of May and June which offers the highest solar radiation, the result would have been far more accurate and yielded higher capacity plant. The methodology adopted seems satisfactory for determining the possible plant capacity for chosen area. The design

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described is based on the potential measured. System sizing and specifications are provided based on the design made. Environmental impact of this photovoltaic plant can be taken up as one the important issue in near future

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