An Eextension Analysis of SRPV Generation at GNDEC Bidar: A Case Study

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***Abstract*--In present scenario, the electricity requirements are increasing at alarming rate and the power demand is ahead of supply. It is also now widely recognized that fossil fuels may not be either sufficient or suitable to keep pace with ever increasing demand of electricity. The recent severe energy crises has forced to develop alternative method of power generation. The solar PV system is one of the example and it has several benefits such as self-reliance in electricityin a cost-effective manner, environmental sustainability reduction in carbon foot print and minimize the payoffs. As a result, GNDEC Bidar has installed 100kw solar power plant on electrical science block to satisfy the college load. Since college connected load is 400kw and contract demand is 200kva, which accounts for expansion of existing SRPV generation plant. In this paper primary objective is to create a realistic plan for expansion of solar PV system at GNDEC, Bidar.**

Index terms: SRPV (solar rooftop photovoltaic), tilt angle, payback period.

I.INTRODUCTION

A solar photovoltaic system is a renewable energy power generation that uses photovoltaic module to generate electricity. The electricity generated can be stored, used directly, or fed back into grid. Solar photovoltaic is a reliable and clean source of electricity that can suit a wide range of power generation applications for residential, industrial, agriculture etc. success for power generation in recent year across the world. When it was first invented, each cell had a 6% efficiency rate, currently most cells have an efficiency rate of approximately 25%, still research is going on and efficiency may reach up to 40%.

In concern GNDEC Bidar has installed and commissioned a 100KWp solar photovoltaic rooftop plant. The plant consists of a total 400PV modules and generate more than 1.5 Lakh units every year, Average monthly power generated is

approximately 12600kWh. Since load is more and there is scope for extra generation as sanctioned maximum demand is 200kVA considering 0.8 power factor the real power will be 160kw, which will be a cap for maximum power generation using SRPV system at GNDEC, Bidar. Therefore, there a scope of extension of exiting 100kw SRPV by an extra 60kw SRPV. This paper presents survey of site selection and payback period and performance analysis is of 100KW SRPV plant.

TABLE 1

TECHNICAL SPECIFICATIONS

Number of modules	400
PV technology module manufacturer	Polycrystalline PV technology
Plant rated power	100kwp
Area	125m^2
Tilt angle	17
Tracking system	No (fixed)
Number of inverters	6
Connection	Series
Inverter	Inverter SMA IGBT based
Module manufacturer	ALFEX module manufacturer Himachal Pradesh

II. SITE SELECTION

A. Latitude and longitude of area

The district extent extends from latitude 17.35`N to 18.25`N and from the longitudes 76.42`E to 77.39`E, which is located on the northern maidens of Karnataka which provides a mountainous treeless expansive plateau landscape.

B. Tilt angle

To maximize the output of the solar power system, especially in PV solar array applications, the optimal tilt angle is typically specified for non-tracking systems and remains fixed. Structurally, higher tilt angles result in an increased wind load on the solar module which would require a larger ballasted footing. In addition, higher tilt angles may require an increase in distance between rows to eliminate adjacent-over shading

C. Shadow area

The site selection for a solar power plant is predominantly determined by solar insolationavailability and grid connectivity for exporting power.

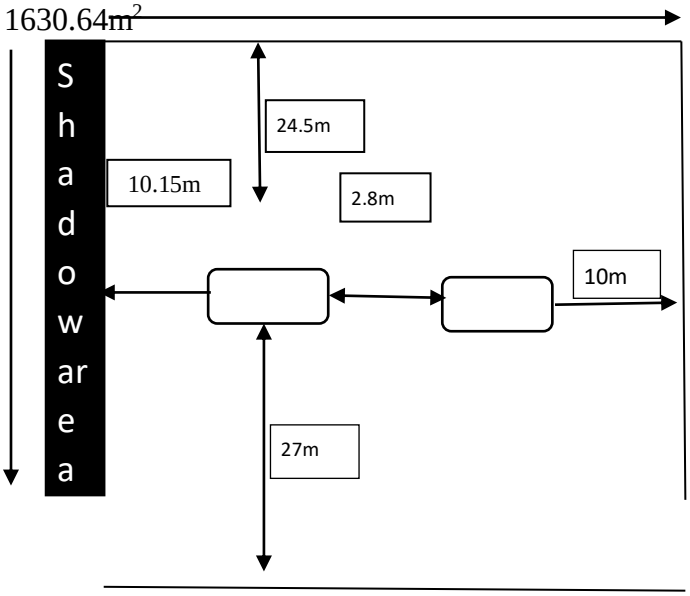


Figure 1: Aerial view of the building that considered as the location for solar panel system

TABLE 2

SHADOW AREA

Timing	Shadow area
10:30 AM	27.032m^2
11:00 AM	19.62m^2
11:30 AM	14.38m^2
12:30PM	10.02m^2
1:30 PM	13.95m^2
2:30PM	14.82m^2
3:30PM	18.31m^2

D. Wind

Winds are generally moderate in strength with some increase in force during the latter half of the summer season and during the monsoon. During the southwest monsoon season, winds mainly blow between the southwest and northwest directions. In the post monsoon season, winds blow predominant between north and east directions. During the winter season winds are variable in direction.

E. Temperature

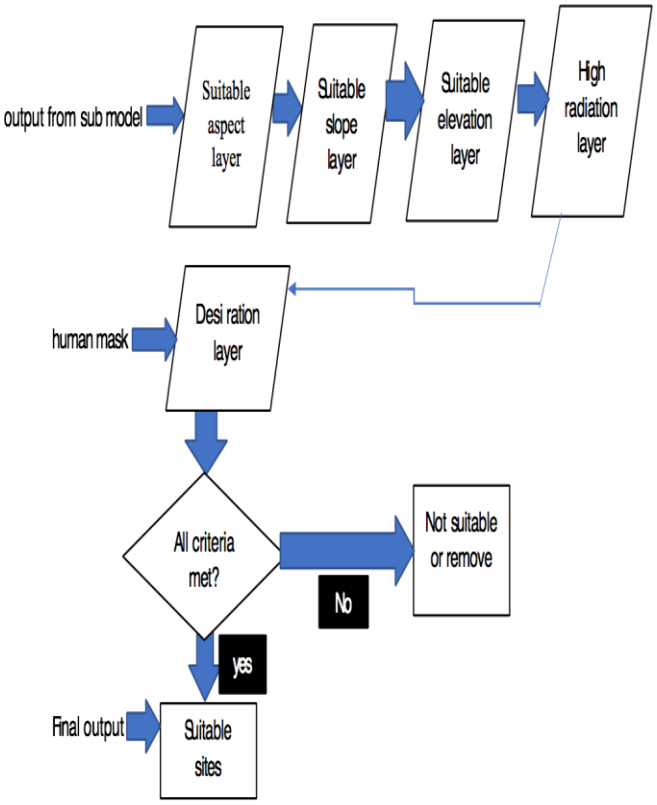
Coldest months are December and January. The temperature varies in the district between 20^{o}C and 42^{O}C. The summer season in Bidar starts in the first week of march and lasts until mid-June. The average annual precipitation at Bidar is 847mm with most of the rainfall received during the monsoon season. May is the hottest month with average daily maximum temperature of 38.8.

F. Rainfall

The average rainfall of Bidar is 885. 8mm.About 81% of annual rainfall is received during the

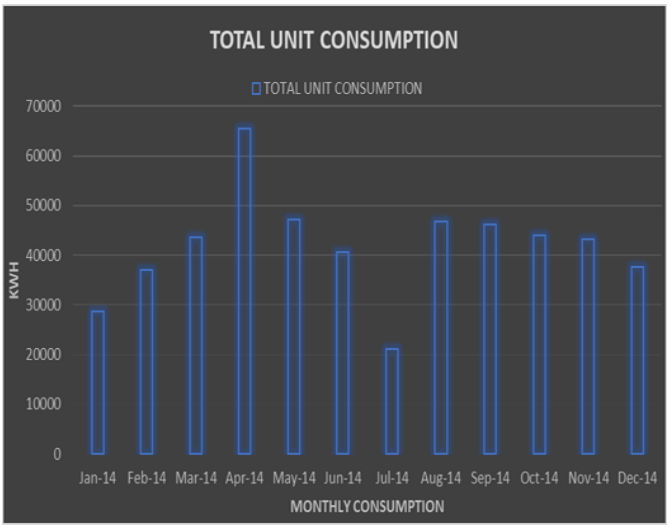
period from June to September. Maximum rainfall is recorded in the month of September. The variation in rainfall from year to year is large and the district is drought-prone. The average number of rainy days in the district are 52.

III. FLOW CHART SHOWING SELECTION PROCESS



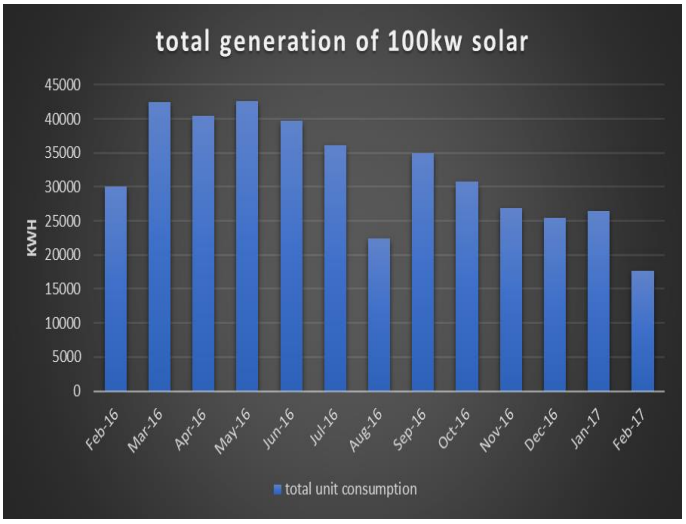
IV RESULTS

The graph 1 shows total consumption in the year 2014 in which, maximum consumption of electricity is in the month of April due to summer and minimum consumption is in the of July due to college holidays.

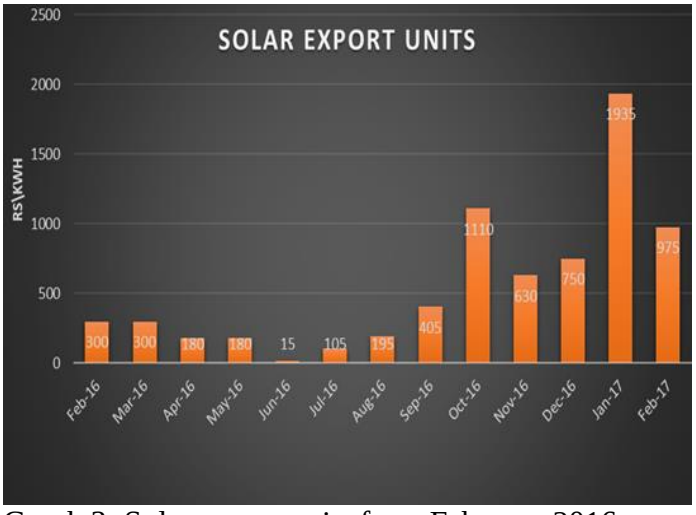


Graph 1: Total consumption of one year before installation of solar

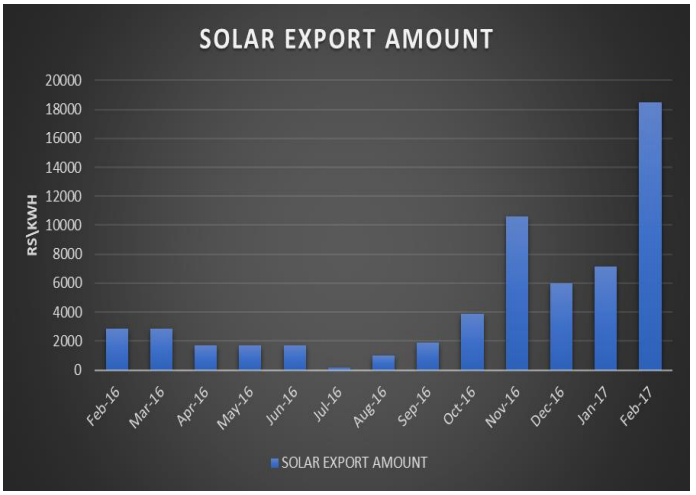
The graph 2 shows total generation of 100kw solar plant and graph 3 shows maximum export unit's in the month of January and the minimum export unit's in the month of June. Graph 4 shows solar export amount in which the maximum exported amount is in the of the month of February at the rate of 9.56 per unit and minimum amount exported in the month of July



Graph 2: total generation of solar from February2016 to February 2017



Graph 3: Solar export units from February 2016 to February 2017



Graph 4: solar export amount from February 2016 to February 2017

TABLE 3

TOTAL CONSUMPTION AND GENERATION WITH AND WITHOUT SOLAR

Total Unit Consumed before solar	501534.00
Total Unit Consumed after solar	361500.00
Solar Generation per Year of 100 KWp	140034.00
Solar Generation per Monthof 100 KWp	11669.50
Solar Generation Per Day	388.9833333
Solar Generation Per KW	3.889833333

TABLE 4

SAVING AMOUNT OF ONE YEAR WITH EXITING 100KW SRPV

Saving amount			
After 100 KWp Solar Saving amount			
	Bill Amount	Saving in Month	Saving inYear
Average Of one Year Before Solar	332300.92	118074.17	1416890.00
Average Of one Year After Solar	214226.75		

The estimated saving amount of one month and one year is shown in table 4, for one month it is Rs118074.17 and for one year it is Rs 1416890.

TABLE 5

EXPECTED SAVING AMOUNT AFTER EXTENSION OF 60KWP SOLAR

Saving amount		
Addition of 60 KWp Solar		
Per KW Saving amount per month as per site condition	After 60KWp solar saving amount per month as per site condition	Annual Saving Amount after 60 KWp Solar
1180.741667	55895.75	670749

PAYBACK PERIOD: The total estimation for extension of 60kw solar plant will be 40 lakhs. As rated above in table 5 the annual saving will be 670749.

$$PayBackPeriod = \frac{TotalInvestmentfor60kWp}{TotalExpectedSavingby60kWp}$$

$$PayBackPeriod = \frac{4000000}{670749}$$

$$PayBackPeriod = 5.9Years$$

TABLE 6

EXPECTED TOTAL SAVINGS AFTER EXTENSION OF 60KWP SOLAR

100KWp+60KWp	IN MONTH	IN YEAR
Total Saving	149055.33	1788664.00

After extension of 60kw solar plant the estimated saving amount is shown in table 6.

V ADVANTAGES AND DISADVANTAGES

A. Advantages

1. Solar power reduced dependence on foreign oil and fossil fuels.
2. Excess power can be sold back to the power company if grid intertied.
3. Solar energy reduces electricity bill.
4. Low maintenance cost.

B. Disadvantages

1. When the sun goes down or heavily shaded, solar PV panels stop producing electricity.
2. Large Space is required for installation of solar PV plant

VI. CONCLUSION

By extension of solar power plant at GNDEC, Bidar significantly lowers the energy bills and means more savings over time. If college consumes a lot of diesel for power generation, rooftop solar can abate up to 15% of diesel bills, subject to timing of load shedding i.e. rooftop solar power has levelized cost of 4.5-5 per kwh considerably lower than diesel power at Rs 18 per kwh. students will also gain practical, hands on knowledge of solar plants and college will be seen as a trendsetter for early solar adoption.

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