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Cost–Benefit Analysis of Solar Power Generation at New Paryavaran Bhavan

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Abstract*—for growth of any country availability of electricity is very much important factor. In growing country like India the population is increasing day by day so that there is also increasing the need of energy in India. In India Electricity generation is mainly done by Thermal power stations. Thermal Power Plants affect the Environment very badly. This power plant require not only huge capital investment but also various natural resources like, fossil fuels and water, thus create an immeasurable & everlasting impacts on the environment and generate tremendous stress in the local eco-system. To reduce this effects of thermal power plants on environment we have to generate the electricity by renewable resources of energy like Solar sources, Wind, Hydro-power, Geothermal and Biomass. Nowadays renewable resources of energy like Solar sources is very much used to generate the electricity in India. Solar power generation in India is increasing day by day with knowing various benefits of solar energy. Gujarat is currently the top solar power generating state in India. Gujarat has commissioned Asia's biggest solar park at Charanka village. With a view to make Gandhinagar a solar city, the State government has launched a roof-top solar power generation scheme. Under this scheme, the State plans to generate five megawatt of solar power by putting solar panels on about 50 state government buildings and on 500 private buildings. This paper discusses the Financial Analysis of solar plant installed on one of the government building of Gandhinagar.*

Keywords*-solar power, financial analysis, cost, income, payback period*

I. INTRODUCTION

In year 2011 Shri Narendra Modi, Honourable Chief Minister of Gujarat initiated a drive to make the State Capital Gandhinagar- A Clean, Green and Solar City. with this on 6th April 2012, Hon'ble CM inaugurated first Government Building running on Solar Power, set up by Gujarat Pollution Control Board (GPCB) in Gandhinagar [1].

Gujarat Pollution Control Board's New Paryavaran Bhavan has installed 80 kw grid connected solar power plant on the terrace. This is online solar power system which is directly connected to the grid. Generated power is being used by this building & surplus goes to grid directly. the complete installation was funded by GPCB. Till the month of December 2012, the total generation of solar energy 28MWh (27904 kWh) has been recorded which is helping to reduce the pressure on natural resources. This power plant is also feeding the grid system of the state.

II. OBJECTIVES

- To show the economical benefits from solar plant.
- To compare the power cost with the conventional building.
- To find the payback period of this solar plant.
- To encourage the people to use solar power.

III. SOLAR PLANT DETAILS

Following are the details of Solar Power Plant of New Paryavaran Bhavan [1].

- Project surface area – 1200 m^2
- Solar plant – 80kw
- Date of completion – march 2011
- Annual energy output – 80 mw
- Length of construction – 4 week
- Number of workers – 15
- Topsun solar modules – 230 wp
- Number of modules – 360

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- Number of solar cell – 21,600
- Number of watt per panel – 230
- Number of inverters – central inverters 100kw
- Total cost – Rs.98,40,000/-
- Single axis solar tracking system
- Feed to torrent power AEC limited

IV. SOLAR POWER GENERATION

There is a 10% depreciation in the power generation after every 10 year [2]. It means 1% depreciation in the power generation every year.

Table 1. Total units generated from solar plant per month

Month	Total Units Generated from Solar power plant	Month	Total Units Generated from Solar power plant
	units(kWh)		units(kWh)
Sep-12	3457	Nov-13	9167
Oct-12	8223	Dec-13	9060
Nov-12	7935	Jan-14	9208
Dec-12	8289	Feb-14	9768
Jan-13	9696	Mar-14	8971
Feb-13	7904	Apr-14	2323
Mar-13	7899	May-14	572
Apr-13	7394	Jun-14	701
May-13	7877	Jul-14	2939
Jun-13	6825	Aug-14	9285
Jul-13	5272	Sep-14	8141
Aug-13	5625	Oct-14	10082
Sep-13	6772	Nov-14	8756
Oct-13	7361	Dec-14	9317

Table 2. Total units generated from solar system

Year	Total Units Generated from Solar System
	units(kWh)
1	86396
2	76126

V. FINANCIAL ANALYSIS OF UNITS GENERATED

This is online solar power system which is directly connected to grid. Generated power is being used by this building and surplus goes to grid directly. Surplus power is bought by torrent power Ltd. at a rate of 9.47/ kWh [1]. TPL subtract the 2% from the amount claimed by GPCB for Surplus power.

From tables 3 & tables 4 we can consider average income from solar plant than conventional building = Rs. 740000 per year

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Table 3. Total income from solar power plant in 1st year

Month	Total Units Generated from Solar System [A]	Total Units feed into the Grid of TPL [B]	Total Units Utilized by GPCB [C]	Amount Paid by TPL to GPCB [D]	Estimation of Solar Utilisation Cost (Considering RS.9/unit) [E]
	units(kWh)	units(kWh)	(A-B)units(kWh)	in Rs. ((B*9.47)-2% of (B*9.47))	in Rs. (C*9)
Sep-12	3457	1362	2095	12640	18851
Oct-12	8223	2304	5919	21383	53274
Nov-12	7935	4454	3481	41336	31329
Dec-12	8289	5064	3225	46997	29029
Jan-13	9696	6256	3440	58059	30957
Feb-13	7904	3830	4074	35545	36666
Mar-13	7899	2934	4965	27229	44687
Apr-13	7394	2072	5322	19229	47896
May-13	7877	1638	6239	15202	56149
Jun-13	6825	1394	5431	12937	48878
Jul-13	5272	948	4324	8798	38915
Aug-13	5625	1492	4133	13847	37199
			Income	313202	473830
		Total income		787032	

Table 4. Total income from solar power plant in 2nd year

Month	Total Units Generated from Solar System [A]	Total Units feed into the Grid of TPL [B]	Total Units Utilised by GPCB [C]	Amount Paid by TPL to GPCB [D]	Estimation of Solar Utilisation Cost (Considering RS.9/unit) [E]
	units(kWh)	units(kWh)	(A-B)units(kWh)	in Rs. ((B*9.47)-2% of (B*9.47))	in Rs. (C*9)
Sep-13	6772	1926	4846	17874	43612
Oct-13	7361	3294	4067	30570	36599
Nov-13	9167	4556	4611	42282	41495
Dec-13	9060	5832	3228	54124	29052
Jan-14	9208	5990	3218	55591	28958
Feb-14	9768	6704	3064	62217	27575
Mar-14	8971	3856	5115	35786	46038
Apr-14	2323	654	1669	6070	15021
May-14	572	176	396	1633	3564
Jun-14	701	20	681	186	6129
Jul-14	2939	1332	1607	12362	14463
Aug-14	9285	2882	6403	26747	57627

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			Income	345442	350132
		Total income		695575	

VI. PAYBACK PERIOD

Payback period means the period of time required to recover the funds expended in an investment [3]. Due to 1% depreciation in the power generation every year, total income will also reduced by 1% every year.

Table 5. Approximate income from solar power plant per year

Year	Depreciation rate (assumed 1%/year)	Approximate Total income/year
1	1	787032
2	2	695575
3	3	763421
4	4	755551
5	5	747680
6	6	739810
7	7	731940
8	8	724069
9	9	716199
10	10	708329
11	11	700458
12	12	692588
13	13	684718
14	14	676848
	Total	10124218

Total cost of solar power plant – Rs.98,40,000/-

From table 5 we can see that Total cost of solar power plant will be recovered in Approximate 14 years. After that the solar power is free of cost.

So the payback period of this solar power plant = 14 years

VII. BENEFITS OF SOLAR POWER

Following are the benefits of solar power [4].

- The energy and heat from the sun is free and unlimited.
- Solar power is perfect for power generation in remote areas or where the cost of expansion utility grid is high.
- Solar power is versatile. It can be used for low-power purpose as well as larger ones - from hand-held calculators, watches, and solar powered garden lights to water heaters, cars, buildings and satellites.
- Operational cost is almost negligible.
- Renewable clean power that is available every day of the year.
- Can be installed virtually anywhere; in a field to on a building.
- Solar power system requires very little maintenance and last for many years.

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VIII. CONCLUSION

From above financial analysis of this solar power plant we can conclude that the initial cost of any solar power plant is very high but after recovering that cost the solar power is free of cost. Nowadays the gujarat government is working on a rooftop electricity generation policy in Gandhinagar. This will enable Gandhinagar residents to produce electricity on their rooftops and the government will be there to buy it, from that the people of Gandhinagar can earn extra income [5]. So that we will suggest every people to install solar power plant of any capacity on their rooftop. This will very much beneficial to every people. This will also reduce the load on conventional thermal or hydro power plant. This analysis will become helpful to people in understanding the financial benefits from solar power plant.

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