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Experimental Study on Installation of Solar Panel above Industrial Junction House

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Abstract: ***For promoting Renewable Energy (RE) sources, Government (state and / or central) has set targets of Renewable Power called as RPO (Renewable Power Obligations) to be fulfilled by all obligated entities. Steel industry is also an obligated entity as it consumes power from its own captive sources. To meet the RPO set targets as per Odisha Electricity Regulatory Commission (OERC) Gazette circular (2015), obligated entities will be required to generate and consume RE power from solar source and non-solar renewable sources a fixed percentage of total annual consumption in kilowatt-hours (kWh) generated from captive power sources (CPP). In case, they are not able to meet this requirement, they have to purchase Renewable Energy Certificate (REC) as traded open in the Indian Energy Exchange (IEX) with floor price of solar REC, Rs. 3.5 per kWh.***
Keywords: Odisha Electricity Regulatory Commission (OERC), captive power sources, Indian Energy Exchange (IEX), etc

I. INTRODUCTION

Solar energy is radiant light and heat from the Sun that is harnessed using a range of technologies such as solar power to generate electricity, solar thermal energy including solar water heating, and solar architecture. The Earth receives 174 petawatts (PW) of incoming solar radiation the upper atmosphere. Approximately 30% is reflected back to space while the rest is absorbed by clouds, oceans and land masses. Solar radiation is absorbed by the Earth's land surface, oceans – which cover about 71% of the globe – and atmosphere. Warm air containing evaporated water from the oceans rises, causing atmospheric circulation or convection. When the air reaches a high altitude, where the temperature is low, water vapor condenses into clouds, which rain onto the Earth's surface, completing the water cycle.

Solar technologies are characterized as either passive or active depending on the way they capture, convert and distribute sunlight and enable solar energy to be harnessed at different levels around the world, mostly depending on the distance from the equator. Although solar energy refers primarily to the use of solar radiation for practical ends, all renewable energies, other than Geothermal power and Tidal power, derive their energy either directly or indirectly from the Sun.

II. LITERATURE REVIEW

For promoting Renewable Energy (RE) sources, Government (state and / or central) has set targets of Renewable Power called as RPO (Renewable Power Obligations) to be fulfilled by all obligated entities. Steel industry is also an obligated entity as it consumes power from its own captive sources.

To meet the RPO set targets as per Odisha Electricity Regulatory Commission (OERC) Gazette circular (2015), obligated entities will be required to generate and consume RE power from solar source and non-solar renewable sources a fixed percentage of total annual consumption in kilowatt-hours (kWh) generated from captive power sources (CPP). In case, they are not able to meet this requirement, they have to purchase Renewable Energy Certificate (REC) as traded open in the Indian Energy Exchange (IEX) with floor price of solar REC, Rs. 3.5 per kWh. Present Scope of study on solar power Latest technologies Solar power is typically converted into usable energy in 2 forms

Use of light radiation from sun- Use of Photo Voltaic (PV) cell Use of heat from sun – Use of steam turbine generator. Use of solar PV (SPV) for generation of electricity is most popular for non-complexity of use.

A. Wafer Based (1st Generation PV)

1) Mono-crystalline Silicon PV (m-CSi)
2) Poly-crystalline Silicon PV(p-CSi)
3) Multi-Junction / Hetero-Junction PV (GaAs & III-IV single Junction)
4) Conventional Thin Film (2nd Generation PV)

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5) Amorphous Si (A-Si)
6) Cadmium Telluride (CdTe)
7) Copper Indium Gallium di-Selenide (CIGS)
8) Copper Zinc Tin Sulfide (CZTS)

B. Emerging Thin Film (3rd Generation PV)
1) Dye-Sensitized Solar Cells (DSSC)
2) Organic PV (OPV)
3) Perovskite
4) Quantum dot (QD) PV Other options available are Solar Paint / Conductive Ink

C. Emerging Thin Film (3rd Generation PV)
Last five Solar PV technologies are at emerging / research Stage and not yet commercialized at large level manufacturing. However two of them, DSSC & OPV are available for small level demo.

III. DATA PERTAINING TO THE SOLAR TECHNOLOGY WORLDWIDE

1.0. Power scenario and Renewable energy (RE) There has been a significant growth worldwide in the area of RE and most significantly in solar power generation. In India the growth of solar power generation has been more significant in last 5 years.

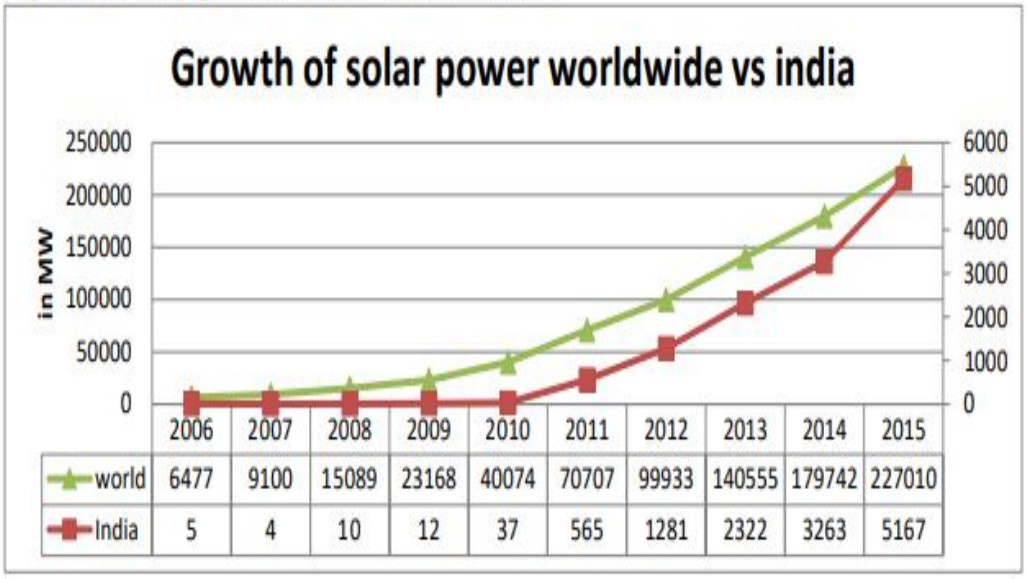


Fig 1 Growth worldwide and in India.

As on 31st March 2016 total installed capacity in India is around 302 GW out of which 43
GW is from renewable energy sources. With current emphasis on the renewable energy sources two main RE sources are getting major boost i.e. wind and solar energy. As on 31st March 2016 the installed capacity of solar is around 6.7 GW which constitute 15% of the total RE. (8.6 GW in Sep'2016) GOI has set an ambitious plan to have total of 175GW from RE sources out of which around 100MW will be from solar alone by 2022
As per media reports, most recently a reverse bidding has been won with unit price of Rs 4.64 / unit which indicates that Cost of solar power plants is also becoming competitive as
compared to the previous years.
Considering the growth it becomes worthwhile to consider using solar power as supplementary source of energy in industries too. An integrated steel plant would have many areas for installing solar panels & energy to that extend will be reduced from highest cost element of power that is GRID.

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A techno-commercial comparison of the three major technologies for sample of approximate 100 sq.mm. Solar panel area is summarized below.

Table 1. Summary of A techno-commercial comparison of the three major technologies for sample of approximate 100 sq.mm. Solar panel area.

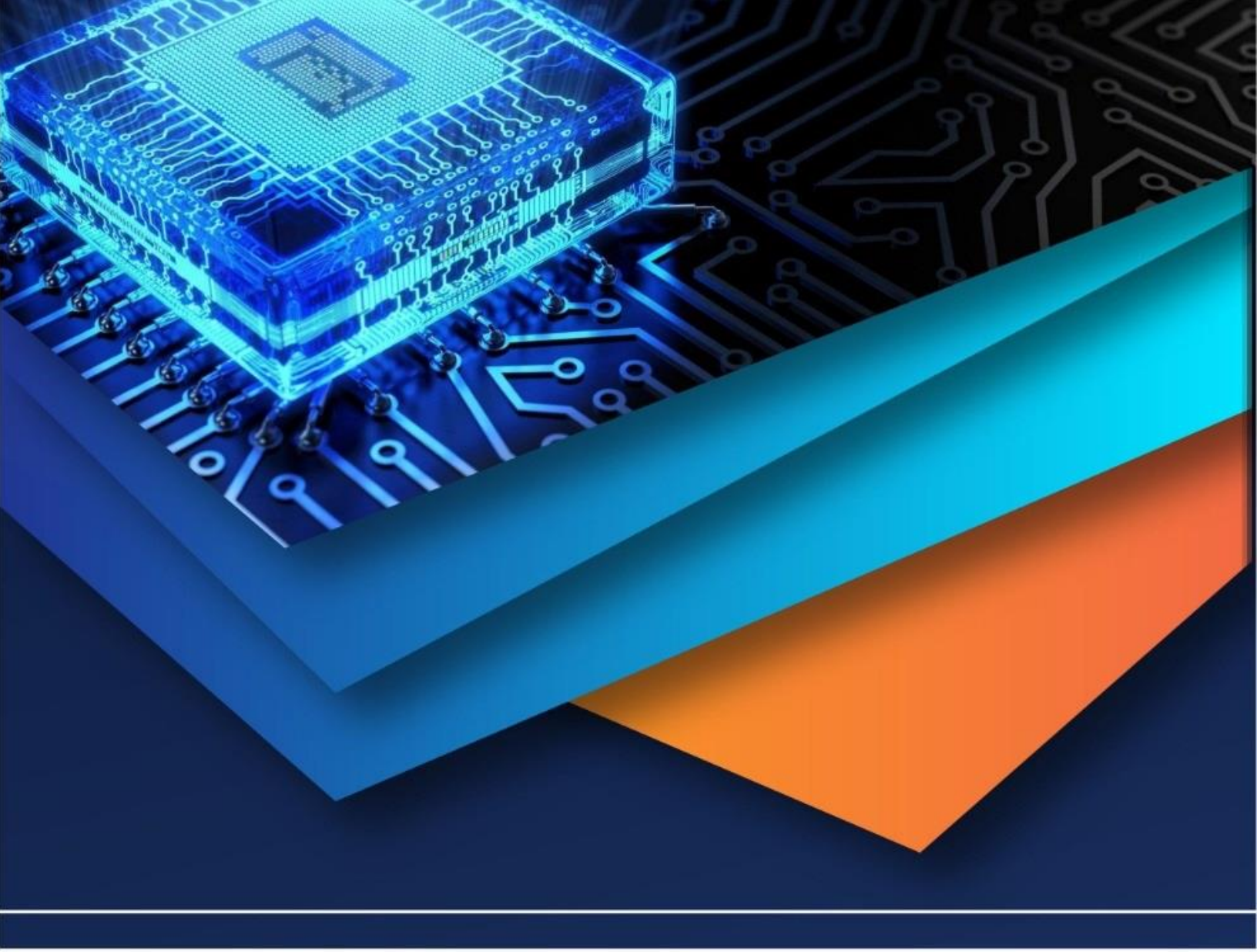
Parameters	**Si Mono**	**Si Poly**	**Thin Film**
Benefits / Limitations	High efficiency, costly, relatively less used in India	Relatively high efficiency & cheaper, mostly used in India	very low efficiency, cheaper, limited used in India
Module area	99.1M^2	99.0M^2	94.4M^2
Power capacity	12.75 kWp	12.75 kWp	5.51 kWp
Annual Energy injected into grid	17610 kWh	17128 kWh	8522 kWh
Capital cost in Rs. Lakh	@ Rs. 0.686 x 12.75 = 8.746	@ Rs. 0.624 x 12.75 = 7.956	@ Rs. 0.436 x 5.51 = 2.402
Annual Savings (in Rs.) in electricity bill @ Rs. 5.20/ kWh	@ Rs. 5.20 x 17610 = 91,572.00	@ Rs. 5.20 x 17128 = 89,065.60	@ Rs. 5.20 x 8522 = 44,314.40
Annual Savings (in Rs.) in RPO tariff @ Rs. 3.50/ kWh	@ Rs. 3.50 x 17610 = 61,635,.00	@ Rs. 3.50 x 17128 = 59,948.60	@ Rs. 3.50 x 8522 = 29,827.40
Payback period (in Years)	5.71	5.33	3.24

Considering Peak Solar Power Generation Potential and low capital cost per unit annual energy generations, it becomes evident from above comparisons that to Poly-crystalline solar PV modules are best option available commercially for installation, However due to low cost, low weight and lesser payback period, Thin Film solar PV can be also be taken as second alternative. However to meet RPO obligation, approximately double area will be required for installations for same annual solar units generations in compare to poly or mono crystalline silicon based PV panels.

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