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Investment Decision on Renewable Energy with Reference to Rooftop Solar PV- Household Prospective

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Abstract: ***India in 21st century re-emphasized on generation of solar energy by using rooftop solar PV. Looking at global worming and increasing demand of electricity, government of India will be in compulsion to adopt this solar energy in place of existing electricity generation practices. So, by looking at county priority, an attempt has been made to study the perception of household users regarding investment made on rooftop solar PV in place of tradition system. A purposive sampling technique was used to select 100 responses in the city of Bhubaneswar, Odisha, India. The study applies descriptive statistics to know the perception of household user towards rooftop PV. This article suggests that there is ample scope in rooftop solar pv. If private players are being provided with good incentive, motivation and support from state govt. as well as central govt then there will be substantial growth Rooftop solar energy. This study will contribute to the existing knowledge base as well benefited to the practitioner of corporate houses in energy sector.***

Keywords: Renewable Energy, Rooftop, Solar Photovoltaic, Household, Investment Decision.

I. INTRODUCTION

Solar Photovoltaic is a technology-based system which can convert sunlight to direct electricity by the use of semiconductors. It is such a technology-based system of electricity generation, which can be employed through panel board. The same panel board can be attached to a Top of Wall or Roof, then it is called Roof TOP SPV. This process of electricity generation can help to produce the output without polluting environment in terms no carbon emissions. Solar PV products provides its usefulness for commercial, industrial and residential towards electricity application.

As per report of DUF (Distribution Utility forum) total solar power potential of India by NISE is around 749 GW, which included solar rooftop. Under scheme of JNNSM in year 2010, India should focus towards the growth of conservation and utilization of solar power in the country.

The tentative target had been fixed in the year 2015 that by end of 2022 minimum 100 GW should generated through solar power, among which 60GW utility from scale solar and rest 40 GW from solar rooftop [1]. For the upliftment and development lots of government of India programme and act had been amended, namely MNRE, MoP act, SECI, NISE etc. To promote the solar PV generation in India , lots of institutional support has been provided both state level (SERCs) and in center level (MNRE) (Fig 1)[2].

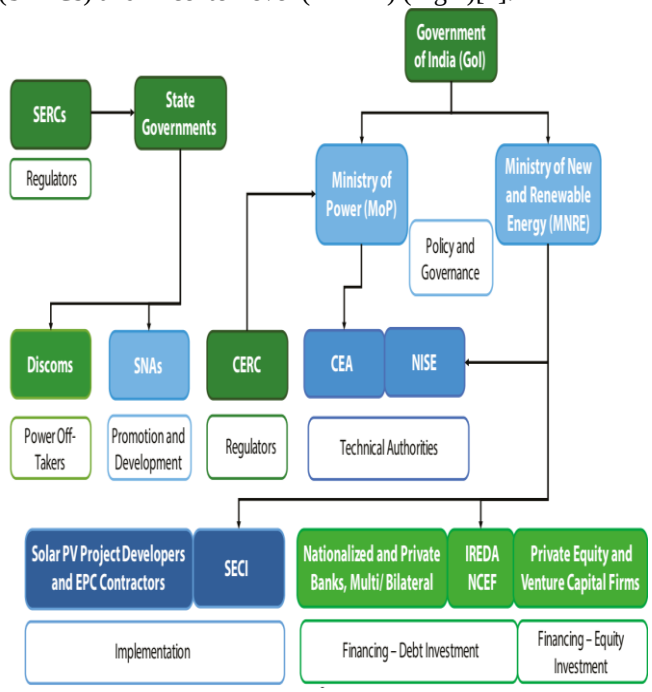

Fig 1: Institutional Arrangement for the Solar Rooftop Sector in India

Source: Statewise-Solar-Potential-NISE.pdf [2]

II. OBJECTIVES OF STUDY

To understand the investor perception towards installation of Rooftop Solar PV

III. REVIEW OF LITERATURE

3.1 Solar Energy -Solar PV:

Day by day population and pollution both increases very faster rate. According to their growth, it has it impact on the need and requirement of different sectoral services.

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Among these service provider electricity service providers one of the major areas of concern. By reducing green house effect different rules and laws are amend from time to time in power sector. The important of renewal energy has create its own space in between this. Power sector is at its cross road because of gap in between demand and supply [3].

Solar energy being produced through the use of solar photo voltaic [4].

Adoption of PV helps to reduce emission of energy for future use.

This is best suitable in case of those type of energy, which can be easily decentralized [5]. Solar energy is a major contributor towards socioeconomic development of the particular area of state.[5].

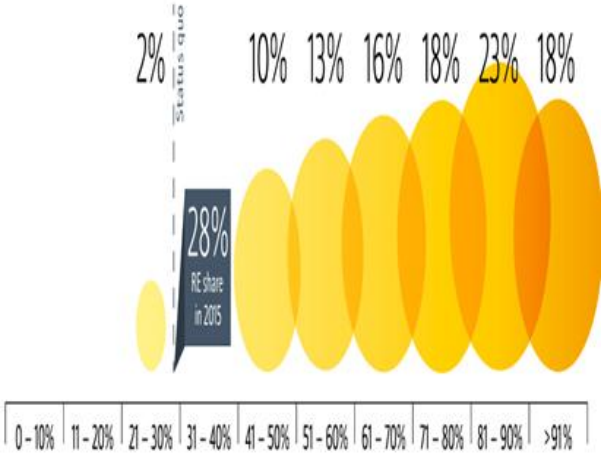

Fig 2: Development of Global Power generation @ 2050 – Forecasting

Source: GFR-Full-Report-2017[6]

3.2 Rooftop Solar:

Rooftop Solar are solar panel used on the top of the roof of different institution, commercial, residential buildings. In this panel solar light has been captured and subsequently converted into electricity. This entire system is known as Rooftop Solar PV [7]. From 2013-2016 energy generation through rooftop pv has been increased by 117 megawatt to 1250mwga watt as per the report of BTI (2017). Projection of growth of rooftop solar in India by 2021, presented in (Fig 3)

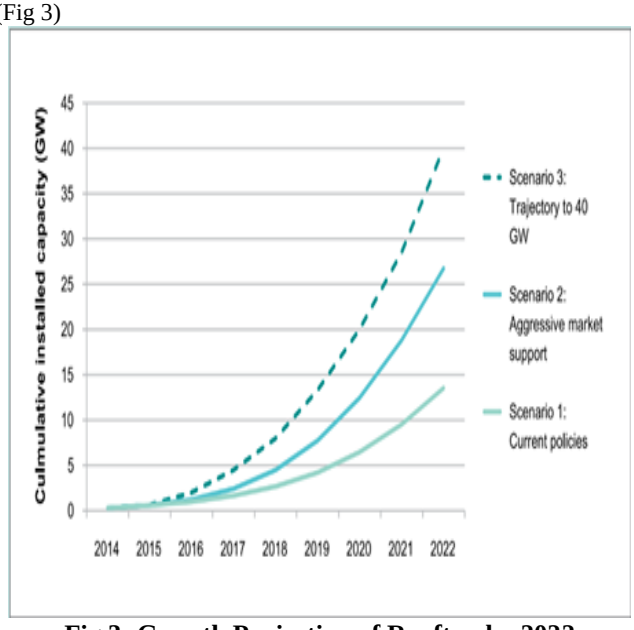

Fig 3: Growth Projection of Rooftop by 2022

Source: https://bridgetoindia.com/ report/ india- solar-rooftop- map-march-2017-edition/

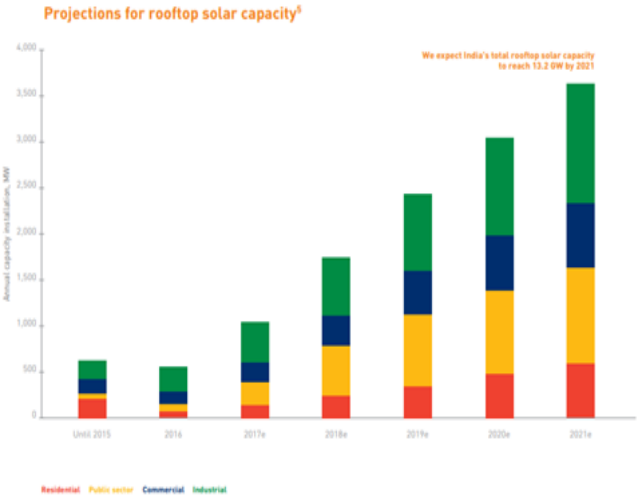

Fig 4 Overview of Installed Capacity of Rooftop SP- India By End of 2022

Source: Solar-Rooftop-Policy-Report_Low-Res.pdf 8]

Table 1: Available lines of credit to support rooftop deployment

Credit extended for rooftop deployment				
Year	**Lender**	**Borrower**	**Line of Credit**	**Programme Objective**
2015	KfW Bank Germany	IREDA	340 million USD	To address the key barrier of financing in rooftop solar PV in India; IREDA launched a loan financing scheme @ interest rates of 9.9–10.75% with 9-year repayment and a 1-year moratorium
2016	World bank and CTF (Clean Technology Fund)	SBI	625 million USD	Programme for results (PforR) to support government strategy for enhancing and expanding its rooftop solar development targets; expand and incentivise the market for rooftop solar by way of low-cost financing
2017	ADB and CTF	PNB	500 million USD	Finance-large scale rooftop solar systems on industrial and commercial buildings throughout India; contribute to the government's plan to increase solar power and meet carbon emission reduction targets
2018	Green Climate Fund	Tata Cleantech Capital through NABARD	100 million USD	First private sector facility to support the rooftop solar segment — commercial, industrial and residential housing sectors; Itaims to provide concessional loan assistance to rooftop Solar PV.

Source: Rooftop_solar_pv_in_india_ctf_cpw[9]

3.3 Financial assistance provided /investment made by Govt. for generating energy:

There is long way to go in terms of adoption of technological development. By the end of 2018 only 10% rooftop had installed in PAN India. By the end of 2022 minimum capacity energy produces will be 40GW [9].

For development of rooftop solar installation, PV segment must include C&I, Govt. Residential user must take initiative for larger scale promote adoption. For promoting financial assistance had provided in the following manner, presented (Fig4)

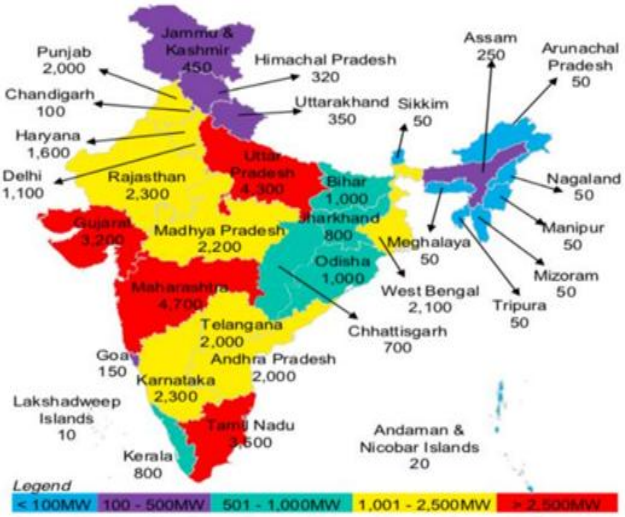

Fig 4: Financial Assistance to accelerate the installation process of Rooftop by March 2022

Vibhuti Garg 10] From above diagram it is clearly shown that highest amount MW generated among the states like Maharashtra (4700 MW), followed by Uttar Pradesh (4300 MW), Tamil Nadu (3600 MW) and Gujarat (3200 MW). These states are set a standard for medium and low MW producing state from Solar PV in India [10].

3.4 Global Trend of Investment made in Renewable energy:

The global investment trend shows sudden spurt in global investment in renewable energy since 2006-07. Between 2004 to 2009 the CAGR of investment is 31.7%.The corresponding figures from 2009 to 2014 is about 9%. This shows stagnancy in the growth investment especially in last three years. If considered over the decade the CAGR works out to a healthy 20%. The CAGR in investment in renewable energy in India between 2004-2014 works out to 10%.In recent years China has invested in a big way in renewables with amounts of 63.8 billion dollars, 63.6 billion dollars and 83.3 billion dollars during the years 2012, 2013 and 2014 respectively. The European Union has comparable figures pegged at 89.6 billion dollars, 57.3 billion dollars and 57.5 billion dollars respectively. The African countries have shown a CAGR in investment of 36% in clean energy during the last decade [11].

3.5 Household Adoption of Rooftop Solar PV:

Paper is based on the household adoption of PV in Bhubaneswar, Odisha India. By adopting rooftop solar pv in household, it reduces low consumption of electricity [5]. To know the perception of household users towards adoption rooftop solar pv, study focuses on comparing individual and collective psychological pattern of PV investment along with overall efficacy of the policies used for solar pv[12] Socio-psychological pattern of individual majorly affect the investment decision towards rooftop solar pv[13].

IV. METHODOLOGICAL FOUNDATION

The present study is based on descriptive survey design and data were systematically collected through structured questionnaire. The responses were collected from household of Bhubaneswar city by using convenience sampling. A *Five-point Likert* scale is used as instrument to collect the data from 100 respondents, out of which 80 responses were found suitable for analysis in the present study. Descriptive statistics have been used to analysis the data.

V. ANALYSIS AND INTERPRETATION

In this 21st century the concept of rooftop solar pv is not used concept of power generation, even if lots of initiative taken government but it just touches 25-30% installation in pan India by the end of 2019. So, this study is made an attempt to know the responses and perception of the household user regarding use of rooftop solar pv in their respective houses and buildings. The respondent was asked to rate to what extent household perceived to make Investment in rooftop solar PV in their house through use a five-point Likert scale (5- Very effective, 4- Effective, 3- somewhat at, 2-Not Effective, 1- Not at all effective). Total no of questions used to know the perceptions of household user was 12 nos.

Table 2: Household User perception on investment Decision for installing rooftop solar

Items of Investment Decision	Mean	Std. Deviation	Rank	Skewness	Kurtosis
	Statistic	Statistic		Statistic	Statistic
Are you aware of the fact that solar PV can be set up as an additional source of power in the house.	4.41	.793	1	-1.658	2.956
Installation of rooftop solar PV in house is useful	4.38	.805	2	-1.560	2.496
On grid rooftop solar PV with net metering is a good investment.	3.95	1.036	3	-.747	-.553
Giving the roof on lease to operators for on grid rooftop solar PV power can be a good investment.	3.10	1.438	6	-.261	-1.420
Off grid rooftop solar PV of 5KVA at Rs 400,00 can be reliable source of power and a good investment..	3.06	1.471	8	-.236	-1.487
The 30% subsidy for rooftop solar PV is easily available..	1.79	1.089	11	1.380	.711
Income tax rebate on the amount of investment on rooftop solar PV can be a better alternative to the subsidy.	3.47	1.107	5	-.557	-.955
Income tax rebate on the amount of investment on rooftop solar PV can be a better alternative to the subsidy	3.01	1.225	9	-.111	-1.361
The cost of battery and its replacement cost in off grid rooftop solar PV is too high to encourage its large scale public use.	3.10	1.438	/	-.261	-1.420
The rooftop solar PV should be installed by public to save the planet from global warming.	1.68	1.069	12	1.380	.711
Some minimum rooftop solar PV should be made compulsory in future in all urban buildings including private buildings above a certain value by public to save the planet from global warming	2.28	.733	10	2.117	4.641
The efforts by the Government and incentives available for rooftop solar PV are encouraging enough for people to use the technology	3.53	1.153	4	-.594	-.806

From the analysis it is clear that household user are aware about the solar PV system , which shows from the 1st factor - solar PV can be used additional source of power in the house (M-4.41 , S.D.-0 .793), highest mean score indicate that people are agree to this statement, followed by its usefulness in house from 2nd factor- Installation of rooftop solar PV in house is useful (M-4.38 , S.D.- 0. 805) lastly it was also revealed that , investment made on solar panel for electricity generation is good option in recent times from 3rd factor response - Solar PV with net metering is a good investment (M-3.96, S.D.- 1. 036),

But the study is also highlighting some interesting point regarding householder's response to 2 factors, i.e Factor 6 which is about 30% subsidy for rooftop solar PV is easily available (M-1.79, S.D.- 1. 089), people are not aware about this information which was reflecting from mean score (1.79) and from 10th factor it shows people awareness on global warming and relation with use of solar energy is very less.

They are not conscious about this fact regarding that the rooftop solar PV should be installed by public to save the planet from global warming, which reflected by lowest mean score (M-1.68, S.D.- 1. 069).(Table 2).

The survey is a pointer to the fact that a lot has to be done to attract people to invest in off grid/on grid solar PV installations. The investment decisions of both individuals and realty developers are based on pure economic considerations. The current economic scenario and poor business prospects have deflated the spirit of real estate developers more than home buyers. People are unlikely to be swayed by slogans like "Reduce global warming "if they find the investment uneconomic. While legislations like making it compulsory to install certain % of rooftop solar PV in commercial structures can be considered, the emphasis should be to make the investment attractive through use of better technology. In fact things are moving towards a stage where solar PV will be a cheaper option of power and no compulsion will be required.

VI. CONCLUSION

While the world is worried about global warming and adopting renewable to replace fossil fuel related power generation in a big way India is doing quite well in this regard. The Country remains one of leading investors in renewable energy.35% of its energy come from renewable. In the Paris Agreement India has committed to the target of achieving 40% of its total electricity generation from renewable sources by 2030. The target was made more ambitious to 57% of the total electricity capacity from renewable sources by 2027 as per Central Electricity Authority's strategy blueprint. The Government is giving maximum priority to Solar energy. Through competition the tariff of solar energy has come down from Rs17.91in 2011to 5.68 in 2017. The study can be concluded with a remark that House hold sector has a lot of potential for solar PV installation this needs to be explored and regarding awareness level, study shows that household users (M-4.41) are about the use of rooftop solar pv , but it not well convinced them to adopt it. Lots of private players with more incentive scheme may create positive impact on successful adoption of solar energy through Rooftop Solar PV. This study is an eye opener for the researcher as well executives of energy produces to focus on and prepare plan accordingly so that it will achieve the target growth by end of 2022.

REFERENCES

1. CEA, All India Installed Capacity, March 2019, available online: http://www.cea.nic.in/reports /monthly/installedcapacity/ 2019 /installed capacity-03.pdf (accessed on December,2019)
2. State wise Estimated Solar Power Potential in the Country, Available online- https://mnre.gov.in/file-manager/UserFiles/Statewise-Solar-Potential-NISE.pdf, (accessed on December,2014)
3. Dawn, S., Tiwari, P. K., Goswami, A. K., & Mishra, M. K. (2016). Recent developments of solar energy in India: Perspectives, strategies and future goals. Renewable and Sustainable Energy Reviews, 62, 215-235.
4. Soni, M. S., & Gakkhar, N. (2014). Techno-economic parametric assessment of solar power in India: A survey. Renewable and Sustainable Energy Reviews, 40, 326-334.
5. Del Río, P., & Burguillo, M. (2008). Assessing the impact of renewable energy deployment on local sustainability: Towards a theoretical framework. Renewable and sustainable energy reviews, 12(5), 1325-1344.
6. GFR-Full-Report-2017_webversion_3.pdf available online: https://www.ren21.net/wp-content/uploads/2019/06/GFR-Full-Report-2017_webversion_3.pdf, (accessed on 2017)
7. Trivedi, S., Ray, I., Vulturius, G., Goldar, A., Prakash, J., Paul, S., & Sagar, A. (2018). Scaling up rooftop solar power in India: The potential of municipal solar bonds (No. 353). Working Paper.
8. Solar-Rooftop-Policy-Report_Low-Res.pdf, 2015, available online https:// www. The climate group. org/sites/default/files/archive/files/Solar-Rooftop-Policy-Report_Low-Res.pdf (accessed on June,2015)
9. Rooftop_solar_pv_in_india_ctf_pwc._v8pdf_0.pdf available online: https:// www. Climate investment funds.org/ sites/cif_enc/files/rooftop_solar_pv_in_india_ctf_pwc._v8pdf_0.pdf(accessed on June,2018)
10. Vibhuti Garg, Tim Buckley (2019) 'Vast Potential of Rooftop Solar in India', Institute for Energy Economics and Financial Analysis (IEEFA)
11. Global_trends_in_renewable_energy_investment_2015-201515028nefvisual8-mediumres.pdf.pdf available online:https://wedocs.unep.org/bitstream/handle/20.500.11822/9403/Global_trends_in_renewable_energy_investment_2015-201515028nefvisual8-mediumres.pdf.pdf?sequence=3&isAllowed=y (accessed on December,2019)
12. Braito, M., Flint, C., Muhar, A., Penker, M., & Vogel, S. (2017). Individual and collective socio-psychological patterns of photovoltaic investment under diverging policy regimes of Austria and Italy. Energy Policy, 109, 141-153.
13. Rode, J., Gómez-Baggethun, E., & Krause, T. (2015). Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. Ecological Economics, 117, 270-282.

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