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GRID TIED & OFF GRID SOLAR ENERGY PRODUCTIVITY ANALYSIS OF PUNJAB Vs INDIA

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ABSTRACT

Indian economy has experienced a viable growth financially over the last decade. In India during the eleventh five years plan, nearly 55000 Mw of new generation capacity of energy was created. This study is divided into two parts: The first one is Grid tied Solar system which is tied into the power grid, electricity is pulled from the grid when needed, after that pushing the excess electricity back into the grid when the local customer using the full capacity that generated by PV panels (photovoltaic). The second one is off-grid which the systems that allows the storage of solar power in batteries for use when the power grid goes down. Hybrid systems provide power to offset the grid power when the sun is shining and will even send excess power to the grid for its later use. The Data collected from energy statistical reports of 2013, 2014, 2015 has been analyzed for the productivity of Grid & off-Grid by using Compound Annual Growth Rate (CAGR). After that we find the result to show the growth in productivity of Grid & off Grid in Punjab and India. The result also confirms proportionate change of Punjab as compared to India. This study helps policy makers, marketers and government to take the decisions for future energy policy in Punjab as well as in India.

Keywords: Solar Energy; Grid-tied; off-Grid; solar photovoltaic, Ministry of New and Renewable Energy, Compound Annual Growth Rates.

1.INTRODUCTION

1.1) SOLAR ENERGY

Solar energy is the energy available from the sun through sun rays. It is produced through two forms; one is a Solar Thermal Generator (Collector) and other Solar Photovoltaic (PV) modules (solar module) (Groot 2008) [1]. Solar thermal generator utilizes solar power by converting the sun rays into heat (Mecnaney 2010) [2]. Solar cells are also called as Photovoltaic (PV) as they convert sunlight directly into electricity (National Renewable Energy Laboratory 2006) [3]. According to the Solar Energy Industries Association 2013[4] Solar Photovoltaic device produces electricity directly from sunlight. An electronic process that occurs with two naturally indefinite types of metal is known as a semiconductor. The solar energy knocks electron losses from their atomic and allows the electrons to flow through metal to generate electricity. It activates through a circuit or electricity to the grid and supply power. Its main application is the PV for the household sector, Recreation, Agriculture, etc. According to Sun Water Solar 2012, [5] solar thermal systems utilize the energy of the sun to heat water for a variety of drives. Solar energy is absorbed by the collector that is specially designed to fire up the fluids moving through the collector, and these heat fluids transfer thermal energy to the water stored in solar storage tanks. Its long-term monetary profit is a reduction in monthly service bills and pollution free. It minimizes our dependence on fossil fuel and electricity and hence reduces carbon footprints.

1.2) SOLAR ENERGY STATUS

World's energy demand is expected to increase 35% by 2030, due to increase in population and economic growth. Total world's investment in solar technology is 140.4 Billion US $. Presently total global operating capacity of solar (PV) has reached 100 Gigawatt(GW) milestone. Their adoptions, run by Europe, are expanding to new markets of Africa and the Middle East North Africa, region in Asia to Latin America. Interest in community owned and a self-generated system were growing tremendously in 2012. While the number of large PV projects also increased; Solar thermal-by the end of 2012, global solar thermal capacity reached an estimated 282GW and water collection by 255GW. China and Europe capture 90% of the world market (Renewable Global Status Report 2013) [6]. India is ranked 7th in installed electricity that is 2.49% of the global energy. In term of electricity consumption, India is ranked 5th in the world. The market of India's renewable energy business is growing at an annual rate of 15% (Renewable energy in India 2012) [7]. India's fast economic growth comes with an upward demand of energy. It faces a real shortage of power, increasing cost and requires the delivery gap. So there is no other solution except to switch over to renewable energy especially solar energy. At present India has installed only 9% (12.6 GW) of world renewable energy. 10thFive year plan has provided

regulatory, plan and target to promote it (Prakash 2009) [8]. Punjab government faces the problem of lack of electricity. The demand of current year (2012) is annually 10890 Megawatt and availability is 7216 MW, and the deficiency is 33.7% (Punjab Solar Policy 2012) [9]. With growing energy demand and concern for the depletion of conventional fuel, there is an urgent need to develop alternate sources of energy in Punjab. The Punjab Energy Development Agency (PEDA) was set up in 1991 for promotion and development of renewable energy in the province of Punjab. The primary objective of PEDA is the development of Solar Engineering Program in the state and develops projects for future expansion with the guidelines of Ministry of New Renewable Energy and Government of India. It also facilities private sector to participate in this area (http://peda.gov.in/eng/Data/pdfs/ecap-report.pdf) [10].

1.3) SOLAR ENERGY GRID

Grid-tied solar electric systems generate electricity for our home or business and route the excess power into the electric utility grid for compensation from the utility company (wholesale solar 2015)[11] . Electricity is generated from the solar cells whenever the sun shines. The inverter is connected to the grid which by converts the DC electricity produced by the solar panels into 240V AC electricity, which can then be used by the consumers. If a grid connected system is producing more power than is being consumed, the surplus is fed into the mains power grid. Some electricity companies will meter the electricity fed into the grid by your system and provide a credit on the bill. When the solar cells are not producing power, for example at night. The power is supplied by the mains power grid as usual. The energy retailer charges the regular rate for the power used.(Energy Matters 2015)[12]

1.4) SOLAR ENERGY OFF GRID

For off-grid, sunlight becomes the primary power source and forms the grid, converting solar energy and battery reserves to AC power for loads. SPV is also easily combined with a diesel generator to shorten generator run-time, reduce diesel fuel costs and extend autonomy of the solar installation. Using Solar Charge Controllers, the PV system is DC coupled to the battery bank, provide an efficient and economical method of storing PV power for overnight use. AC Coupling, the PV system with the inverter charger, has advantages when the solar PV array must be sited far away from the battery bank**s** (Schneider electric 2015) **[13].** Energy control plays a crucial role when it comes to an off-grid energy supply. SPV technology, therefore, ensures that all components are compatible with one another and that the storage system is optimally used. If more solar power is available than needed, then the batteries will be charged. If demand is greater than production, it is covered by the electricity stored in the batteries. (http://www.sma.de/en/home-systems/solar-system-off-grid.html)[14]

2. OBJECTIVE

1) To study the Grid & off Grid status of Punjab and India.
2) To analyses the grid and off-grid growth of Punjab.

3) To compare Grid & off Grid growth of Punjab and India

3. LITERATURE REVIEW

EPRI (2009) [15] discussed current incentives and polices with the focus on utility engagement in PV power and suggest that power companies will have a significant role in both distributed and utility scale application. **Mekhilif et al. (2012) [16]** discussed the present and future situation of solar power in Malaysia. Malaysia has strong potential to build large-scale solar power installation due to geographical region. However, there is the hurdle of the high cost of PV and solar electricity tariff rate. They concluded that to overcome these barriers more effort is required in research and development and induction program in both college and university to (or "intending to") the awareness and understanding solar technology. Mass media, active government policy, healthy competition, and new PV manufacturing should promote for future prospect of solar technology in Malaysia. **A.T Kearney (2014)[17]** reviews the market for solar off-grid lighting products & concludes that improved financing can promote industry and grant awareness of the opportunity & support finance professionals as they evaluate it. For doing this, we conducted depth literature research & desktop analysis, face to face workshops, Industrial professionals were interviewed for the purpose of data collection & validation. **IREN (2015)[18]** results show that renewable development in off-grid system is small percent of the total installed renewable power generation capacity. Where their rapid growth in many places and improve for cost decline & electricity storage techniques. **Key, and Peterson [19]** studied that many countries provide access to consumer capital for off-grid solar using digital finance. Solar home system (SHS) has progressed in the last decade by celebrating and reshaping off-electricity grid access by providing finance and income connectivity throughout supply chain.

4.RESEARCH METHODOLOGY

The present study is descriptive in nature, and it is based on secondary data collected from various journals, news paper reports, research articles, and website. Data about the arrivals of tourists in India were collected and compiled from the different issues of static energy report published by Ministry of New and Renewable Energy. In the given research tools

for analysis used were Compound Annual Growth Rate(CAGR) and data have been represented by tables, graphs, pie charts and summated scores. Data was analyzed using Ms-Excel intensively.

5. ANALYSIS AND INTERPRETATION

The present section deals with data analysis and interpretation. This section is divided in two parts . Installed Capacity of Grid Interactive Solar Power in Punjab

Table5.1 In (MW) Installed Capacity of Grid Interactive Solar power in Punjab & India 2011-2014
Source: Energy statistic 2015

States	2011	2012	2013	2014	CAGR
Punjab	2.33	9.33	9.33	16.85	0.93
India	35.15	941.24	941.24	1686.44	3.21

In Punjab, as the assessment for Installed capacity of grid interactive solar power table, 5.1 explains the growth of grid interactive solar power to Punjab in the period 2011-14. The installation capacity of Punjab has grown at a Compound Annual Growth Rate (CAGR) of 0.93%. In the year, 2012 growth rate as compared to 2011 was three times. In 2013, there was no change is productivity. It is the same as previous year. In 2014 growth rate was 0.80 times as compare to previous year. It is concluded that growth rate of Punjab declines from 2011 which is three times of 0.80 times. As compared the growth rate of India from 2011 to 2012 was 25 times. The growth rate of 2012 to 2013 was 0.79 time. The growth rate of 2013 to 2014 was 0.56 times. The growth is 25 times in 2011 & decline 0.56 times in 2014. When we compare the data from India & Punjab their growth that is 6.6 % in 2011, In 2012 its 0.99%, In 2013 growth was 0.55%. In 2014 0.64%. The result shows that there was decline in growth rate as compared to India from the year 2011 which was 6.6% decline to 0.64% in the year 2014. When we compare Compound Annual Growth Rate (CAGR) of Punjab and India which is 0.93% & 3.21 % shows that growth rate of India was greater as compared to Punjab.

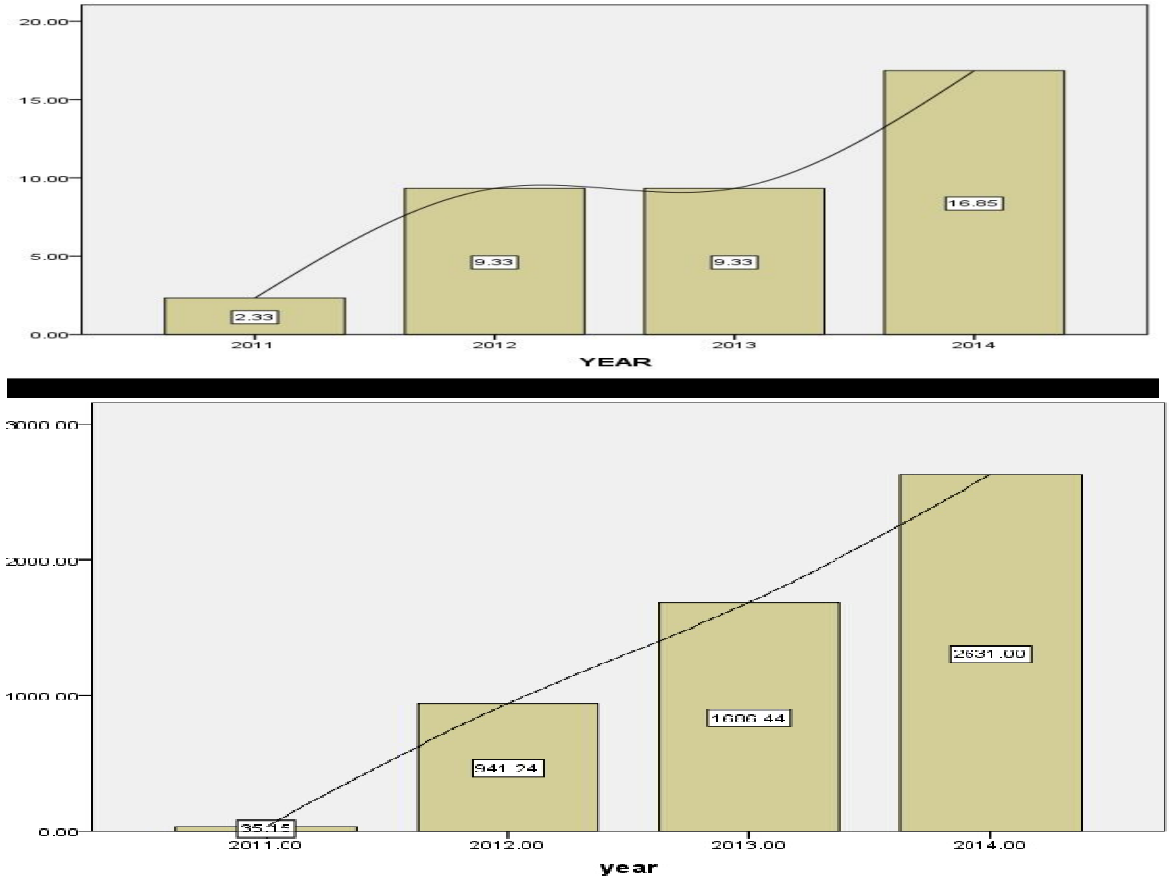

Fig 5.1 Installed Capacity of Grid Interactive Solar power in Punjab 2011-2014

Installed Capacity of Grid Interactive Solar Power in India

Table 5.2 Installed Capacity of off grid Solar Devices in India 2011-2014

SOLAR DEVICE	STATE	2012	2013	2014	CAGR
SPV pumps (No's)	Punjab	1857	1857	1857	0.50
	India	8792	11626	11626	0.34
Solar cooker(MW)	Punjab	9.33	9.33	9.33	0.50
	India	1221.26	1221.26	1221.26	0.50
SLS (No's)	Punjab	5354	5354	10.000	0.07
	India	226,506	255,879	270000	0.40
HLS(No's)	Punjab	8620	8620	10,000	0.42
	India	892,974	993,595	11,0000	O.92
SL (No's)	Punjab	17495	17495	20,000	0.43
	India	930,813	939,862	96000	O.48

Source: Energy statistic 2015
SLS=Street Light System, HLS=Home Light Systems, Sl=Solar Lanterns, SPV=Solar Photovoltaic, Mw=Mega watt

In Punjab as a Installed capacity of off-grid solar power table 5.2 explains the growth of SPV pumps in Punjab over the period of 2011-14 was same in last three year. As compared to India growth rate of 2013 to 2012 was 3.22 times and next year it's same. When we compare growth rate of SPV pumps from Punjab to India its 21.1 % in year 2012, 15.9% in year 2013 and same 15.9% in 2014. Compound Annual Growth rate (CAGR) of SPV pumps of Punjab and India was 0.50% and 0.34 %. Which is the same. When we compare solar cooker (MW) in Punjab it is constant from last three. Same constant growth from India also. Compound Annual Growth rate (CAGR) was 0.50% and 0.50% which is most provably the same. When we compare SLS growth in Punjab it is constant for 2012, 2013 and 2014 its growth rate was 0.86 times as compared to 2013. When SLS compared growth in India from 2012 to 2013 to 2014 was 0.12 time & 0.05 times. We compared growth from Punjab to India from year 2012, 2013, 2014 was 2.3 %, 2.0%, 3.7%. Compound Annual Growth rate (CAGR) was 0.07% & 0.04% of Punjab and India. We compared Compound Annual Growth rate of HLS which was 0.42 % & 0.92% of Punjab and India respectively . Growth rate of year 2012 2013 & 2014 of Punjab & India was 0.96 %, 0.86 %, and 9.09 % which was faster in last year. SL Compound Annual Growth rate (CAGR) of Punjab and India was 0.43 & 0.48 that shows growth almost the same.

6.RECOMMENDATIONS

India and Punjab government have the potential to promote various forms of solar energy like solar grid and solar off grid etc. India and Punjab need to develop a new hub to tap the potential of this upcoming form of solar power. MNRE at India level and PEDA at Punjab level may promote solar energy. Private companies should also participate in solar Grid and off Grid under guidelines of MNRE. Indian Government and Punjab government receive a fair share of people. A significant number of these people are not aware of solar energy. Hence the services provided to these people

may be improved by providing information in their local area through government, private agencies and NGO's at their information centre. The website of MNRE and PEDA may also provide information related to awareness of solar energy. Apart from this, different trainings to Experts may also help in ensuring more pleasant experience to these experts. With growing number of users in Punjab as well as India, year after year, there is an immense potential for investor to build good quality budgets. India and Punjab need significant trained personnel to achieve its targeted growth in solar energy. This would require training programs for Grid and Off Grid installation. With the number of users in Punjab and India increasing consistently every year, the centre and state offers growing potential to the investors .

7. CONCLUSION

With this conviction and resolve, the Ministry of New and Renewable Energy is undertaking several studies in important Solar destinations in the country. They all relate to various aspects of solar energy with a goal of increasing Grid and off-Grid installation in Punjab as well as India. To achieve this apart from all the infrastructural requirements, the centre and state will need a lot of skilled labor to provide services to the solar user. The past initiative undertaken by the Union and Punjab government have yielded a strong impact on the Grid and Off Grid in the center and state. Solar energy is a highly competitive industry as multitudes of people destination options are available to the potential users. So to promote its distinct image the centre and state needs to catch the potential user's attention, thereby influencing one's decision. Ministry of New and Renewable Energy therefore should focus on advertising in print media and television advertising. In order to improve installation Grid and Off Grid, a strong presence of internet and social mass media is necessary. For attracting more users, Ministry of New and Renewable Energy should focus on increasing participation in seminar awareness programs in different parts of India.

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