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Renewable Energy in Punjab: An Analysis

Abstract

In the twenty first century, climate change is one of the greatest challenges for developed and developing countries alike. Green development can stimulate economies create jobs and help to maintain critical eco system services and strengthen climate resilience of the poor. Renewable energy has a major part to play in the transition to Green economy. The main objectives of the paper are to study the source-wise estimated potential of renewable energy in Punjab as well as in India and to examine the year-wise installed capacity of renewable energy in Punjab as well as in India. In 2014, Punjab is at fourth place in terms of installed renewable power capacity of north-west India. In terms of capacity installation in north-west India, Punjab is at first place in bio power sector, at second place in small hydro power sector and at third place in solar power sector in 2014. Punjab is solar rich as well as agrarian state having huge potential of bio power and solar power. Capital investment should be attracted in order to harness the potential of these two sectors.

Keywords: Green Economy, Renewable Energy, Capacity Installation, Bio Power.

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Introduction

In the twenty first century, climate change is one of the greatest challenges for developed and developing countries alike. The problem of climate change has been aggravated due to the actions of developed countries but developing countries have to suffer more because of their vulnerability to extreme environmental events. In developing countries, poor people who rely on local natural resources, together with existing bad effects on health and scarce financial, human and institutional resources will be most vulnerable to the effects of climate change.

Green development can stimulate economies, create jobs and help to maintain critical eco system services and strengthen climate resilience of the poor. The new patterns of production, consumption and employment will emerge by mitigating the effects of climate change. It will provide various opportunities to create green jobs. Green jobs are the jobs which help in generating employment by not having any negative impact on the environment. Green jobs hold the promise of triple dividend i.e. sustainable enterprise, poverty reduction and a job – centered economic recovery. Green jobs are the middle skill positions in the various sectors of the economy – primary, secondary and tertiary.

Energy sector is the highest greenhouse gases emitting sector accounting for about 26 percent of overall carbon emissions. A key way to reduce this is to switch from fossil fuels to renewable energy which currently contributes only a very small share of total energy generation and usage. Renewable energy has a major part to play in the transition to green economy. Investment in renewable energy also offers considerable scope for generating employment opportunities, a key public concern in many countries. There is substantial employment potential associated with project development, construction and installation for all renewable energy technologies.

Review of Literature

For any research problem, it is quite necessary to review previous studies in the area of investigation. For execution of any research project, the time spent in such an activity is a fruitful investment. Here, some previous research studies relevant to the study are presented.

Pollin et al., (2008) have provided a snapshot of what kinds of jobs were needed to build a green economy in the United States which focus on six key strategies for attacking global warming. The six green strategies examined in the studies were cellulosic biomass fuels, building retrofitting, solar power, mass transit, wind power and energy-efficient

automobiles. In the study, data on employment conditions in 12 separate states has been taken. For each of the 12 states, study has analyzed the number of people who were employed in each of the occupations that will be affected by the six green economy strategies and what the average wages were in each state for each of these job types. In considering the six areas of green investments, this study has provided information on 45 representative occupations that, throughout the country employed over 14 million people in 2008. That was roughly nine percent of total U.S. workforce of 154 million people. It was clear from the report that millions of U.S. workers across a wide range of occupations, states, and income levels will all be benefitted from the project of defeating global warming and transforming the United States into a green economy.

Ministry of New and Renewable Energy (MNRE), (2010) in its study "Human Resource Development (HRD) Strategies for Indian Renewable Energy Sector" has estimated the existing and future job opportunities and evolve HRD strategies in renewable energy sector. It explored trends in renewable energy Industry, quantification of existing job opportunities in different functional area and estimation of manpower requirements in renewable energy sector in short (5 years) and medium term (5-10 years). This study was based on the data collected through the questionnaire survey of stake holders, personal meetings, literature survey and relevant information collected from United Nations Environment Programme, International Labour Organisation etc. This study has revealed that the renewable energy (RE) sector had contributed about 10.4 percent of the total power generation capacity in India. In 2010, the wind sector had contributed a major portion of this capacity followed by the Small Hydro. The RE sector in India was estimated to employ 3, 50,000 people, which includes both direct and indirect employment in 2010. The employment was currently distributed across all the major RE sectors like bio-gas, solar photovoltaic (off-grid), solar thermal (both off-grid and on-grid), wind, bio-mass (on-grid) and bio-mass gasifier. In the case of India, the employment opportunities would increase manifold by the year 2015 (short term) and also by 2020 (medium term). This study suggested that there was need to strengthen the campus recruitment and also to organize job fairs once in a year at 6 metros, i.e. Delhi, Mumbai, Kolkata, Chennai, Hyderabad and Bangalore. There should be promotion of collaboration between Indian universities and universities abroad for adopting best practices in imparting Renewable energy skills.

Tripathi, (2012) has worked on three decades of renewable energy in India. In this study, he has tried to make an assessment of renewable energy use and its deployment over three decades in India. The strategies, programmes and development activities to envisage and optimize the future potential of renewable energy resources have also been discussed. This study was based on the information collected from Ministry of New and Renewable Energy and from Planning Commission. Findings of the study have shown that allocation to renewable energy in the five year plans had not increased significantly, its growth was due to the private sectors participation. The renewable energy implementation strategy has shifted from the demonstration and R & D phase in the sixth and seventh plan to the purely commercial strategy in the eleventh plan. Overall the renewable energy sector has grown substantially in the country and has contributed to about 11.5 percent of the country's energy demand. The study has concluded that renewable energy had carved a niche for itself within the mainstream of energy supply options in India and had penetrated the bastions of conventional energy supply systems. It was no longer 'alternate energy' but a key component of the solution to the nation's energy demand. The author has suggested that for an enhanced outreach and easy access of renewable energy to common man, the involvement of end-users should be increased. The retail of renewable energy products should be properly organized.

Pandey et al., (2017) in their study "India's Low Carbon Transition" have analysed challenges as well as opportunities for low carbon transition in renewable energy sector, coal sector, natural gas sector and nuclear energy sector in India. In this study, inefficiencies in transmission and distribution of power as well as its tackling has also been examined. This study is based on secondary data derived from various reports and studies of World Bank, Central Electricity Authority of India, International Energy Agency, Government of India, International Monetary Fund and International Renewable Energy Development Agency etc. The study has found that obtaining funds for renewable energy projects is the biggest challenge and policy framework in order to increase private capital funding for renewable energy projects is the biggest opportunity for low carbon transition in India.

The Council on Energy, Environment and Water (CEEW) (2017) in its study "Greening India's Workforce" has tried to examine the short term as well as long term manpower requirement in Indian renewable energy sector. The study is based on Primary data i.e. annual surveys of Indian wind and solar companies, manufacturers and developers in order to collect precise information regarding jobs generated and skills required in renewable energy sector. The study has found that in the next five years, more than 3,000,000 workers will get employment in achieving targets of India's solar and wind energy. More than 21,000 people have been employed in wind and solar energy during 2016-17 and are estimated to give employment to 25,000 people and more in the coming year. This study suggests that priority should be given to rooftop solar in government policies in order to generate more jobs in renewable energy sector. Moreover, government should encourage reporting of generation of employment from companies in renewable energy sector.

Objectives of the Study

The main objectives of the paper are:

1. To study the source-wise estimated potential of renewable energy in Punjab as well as in India.

2. To examine the year-wise installed capacity of renewable energy in Punjab as well as in India.

Methodology

Secondary data derived from various sources like Energy Statistics issued by Ministry of Statistics and Programme Implementation, Punjab Energy and Development Agency, Ministry of New and Renewable Energy, Confederation of Indian Industries, World Institute of Sustainable Energy, The Energy and Research Institute and various research articles, has been used in the paper. Renewable energy sector includes various sub-sectors i.e. wind power, solar power, small hydro power, biomass power, waste to energy and cogeneration-bagasse. The paper deals with estimated potential and installed capacity of grid interactive renewable power. The time period from 2007-08 to 2013-14 has been taken into consideration. Compound Annual Growth Rate (CAGR) for installed capacity of renewable power and various sub sectors of renewable power in India as well as in Punjab has been find out. Paper has been divided into two sections. First section deals with potential of renewable energy and second deals with growth of installed capacity of renewable energy.

Section I: Potential of Renewable Energy

Punjab is an agrarian as well as solar rich state having huge potential for biomass as well as solar power generation. Punjab also has considerable potential for small hydro power generation as it has extensive irrigation canal network due to its topographic location and agriculture base.

Estimated potential of India and Punjab for renewable power generation in 2014 has been shown in table 1. In 2014, renewable power generation potential of India is 1, 47,615 MW. Wind power has the highest share of 70 percent followed by small hydro power, bio power, cogeneration-bagasse and waste to energy with 13, 12, 3 and 2 percent share in India's potential of renewable power generation, respectively. Punjab's potential for renewable power generation is 3,958 MW in 2014. Bio power has the highest share of 80 percent followed by small hydro power, cogeneration-bagasse and waste to energy with 11, 8 and 1 percent share in Punjab's potential for renewable power generation, respectively. Punjab's potential accounts for 3 percent of Indian potential of renewable power generation.

Table 1: Estimated potential of India and Punjab for renewable power generation in 2014

(in megawatts)

Sectors	India	Punjab
Wind power	1,02,772 (70)	-
Bio power	17,538 (12)	3,172 (80)
Small hydro power	19,749 (13)	441 (11)
Cogeneration-bagasse	5,000 (3)	300 (8)
Waste to energy	2,556 (2)	45 (1)
Total	**1,47,615 (100)**	**3,958 (100)**

Source: Ministry of Statistics and Programme Implementation, 2015.

Installed capacity of India and Punjab for renewable power generation in 2014 has been shown in table 2. In 2014, installed capacity of renewable power in India is 31,703 MW. Wind power has the highest share of 67 percent followed by bio power, small hydro power, solar power and waste to energy with 13, 12, 8 and 0.33 percent share in India's installed capacity of renewable power generation, respectively. Installed capacity of renewable power in Punjab is 323 MW in 2014. Small hydro power has the highest share of 49 percent followed by bio power, solar power and waste to energy with 44, 5 and 3 percent share in Punjab's installed capacity for renewable power generation, respectively. Installed capacity of Punjab accounts for only 1 percent of total installed capacity of India for renewable power generation.

Table 2: Installed capacity of renewable power in India and Punjab in 2014

(in megawatts)

Sectors	India*	Punjab**
Wind power	21,132 (67)	-
Bio power	4,013 (13)	141 (44)
Small hydro power	3,804 (12)	156 (49)
Solar power	2,647 (8)	17 (5)
Waste to Energy	107 (0.33)	9 (3)
Total	**31,703 (100)**	**323 (100)**

Source: *Annual Report of Ministry of New and Renewable Energy, 2014.

**Ministry of Statistics and Programme Implementation, 2015.

Estimated potential and installed capacity of north-west India for renewable power generation in 2014 has been shown in table 3. Estimated potential of renewable power in north-west India is 58,797 MW. In north-west India, estimated potential is highest in Gujarat followed by Jammu & Kashmir, Rajasthan, Punjab, Himachal Pradesh and Haryana. Installed capacity for renewable power generation in north-west India is 9,304 MW. Installed capacity of renewable power in north-west India is highest in Gujarat, followed by Rajasthan, Himachal Pradesh, Punjab, Jammu & Kashmir and Haryana. Installed capacity of north-west India is just 16 percent of the estimated potential for renewable power generation. Installed capacity as percentage of estimated potential is highest in Rajasthan, followed by Himachal Pradesh, Gujarat, Punjab, Haryana and Jammu & Kashmir. Punjab's installed capacity is just 8 percent of the estimated potential for renewable power generation.

Table 3: Estimated potential and installed capacity of North-West India for renewable power generation in 2014

(in megawatts)

States	Estimated Potential	Installed Capacity	Installed capacity as percentage of estimated potential
Gujarat	36,956	4,430	12
Rajasthan	6,208	3,640	57
Himachal Pradesh	2,606	639	25
Punjab	3,958	323	8
Jammu & Kashmir	7,159	148	2
Haryana	1,910	126	7
Total	**58,797**	**9,304**	**16**

Source: Ministry of Statistics and Programme Implementation, 2015.

Section II: Growth of Installed Capacity of Renewable Energy

In the various fields of renewable energy power generation, five awards have been bagged by Punjab New and Renewable Energy Department. These awards have been given for achieving highest capacity addition in grid connected solar power in the country, highest cumulative grid connected solar rooftop power capacity, deployment of highest cumulative numbers of solar water pumps, achieving highest capacity addition in grid connected solar rooftop power in the country during the financial year 2014-15 and highest capacity addition of off-grid waste to energy plants.

Installed renewable power capacity of Punjab and India during the period 2007-08 to 2013-14 has been shown in table 4. In 2007-08, installed capacity is 12,403 MW in India which increased continuously and reached the level of 31,692 MW in 2013-14. In Punjab, installed capacity is 162 MW in 2007-08 which remained stagnant in 2008-09, after that it increased continuously and reached the level of 323 MW in 2013-14. In India as well as in Punjab, capacity installation for renewable power generation has shown rising trend over the period of time with Compound Annual Growth Rate (CAGR) of 14.34 and 10.36 percent, respectively.

Table 4: Installed renewable power capacity of Punjab and India during the period 2007-08 to 2013-14

(in megawatts)

Year	India	Punjab
2007-08	12,403	162
2008-09	14,486	162
2009-10	16,817	206
2010-11	19,971	241
2011-12	24,914	264
2012-13	28,067	298
2013-14	31,692	323
CAGR (percent)	**14.34**	**10.36**

Source: Ministry of Statistics and Programme Implementation (Various years).

Installed biomass power capacity of Punjab and India during the period 2007-08 to 2013-14 has been shown in table 5. In 2007-08, installed biomass power capacity is 1,407 MW in India which increased continuously and reached the level of 4,013 MW in 2013-14. In Punjab, installed biomass power capacity is 28 MW in 2007-08 which remained stagnant in 2008-09, after that it increased continuously and reached the level of 141 MW in 2013-14. In India as well as in Punjab, capacity installation for biomass power generation has shown rising trend over the period of time with CAGR of 16.15 and 25.98 percent, respectively. CAGR of installed capacity of biomass power in Punjab is higher than in India.

Table 5: Installed biomass power capacity of Punjab and India during the period 2007-08 to 2013-14

(in megawatts)

Year	India	Punjab
2007-08	1,407	28
2008-09	1,752	28
2009-10	2,200	63
2010-11	2,665	75
2011-12	3,135	91
2012-13	3,601	125
2013-14	4,013	141
CAGR (percent)	**16.15**	**25.98**

Source: Ministry of Statistics and Programme Implementation (Various years).

Installed waste to energy capacity of Punjab and India during the period 2007-08 to 2013-14 has been shown in table 6. In 2007-08, installed waste to energy capacity is 56 MW in India which increased continuously and reached the level of 107 MW in 2013-14. In Punjab, installed waste to energy capacity is 9 MW in 2007-08 which remained stagnant over the period of time. In India, capacity installation for waste to energy power generation has shown rising trend over the period of time with CAGR of 9.69 percent. In Punjab, installed capacity of waste to energy remained stagnant over the period of time.

Table 6: Installed waste to energy capacity of Punjab and India during the period 2007-08 to 2013-14

(in megawatts)

Year	India	Punjab
2007-08	56	9
2008-09	59	9
2009-10	65	9
2010-11	72	9
2011-12	90	9
2012-13	96	9
2013-14	107	9
CAGR (percent)	**9.69**	**0**

Source: Ministry of Statistics and Programme Implementation (Various years).

Installed small hydro power capacity of Punjab and India during the period 2007-08 to 2013-14 has been shown in table 7. In 2007-08, installed small hydro power capacity is 2,181 MW in India which increased continuously and reached the level of 3,804 MW in 2013-14. In Punjab, installed small hydro power capacity is 124 MW in 2007-08 which remained stagnant in 2008-09, after that it increased to 155 MW in 2010-11, again remained stagnant in 2011-12, then again increased to 156 MW in 2012-13 and declined to 155 MW in 2013-14. In India as well as in Punjab, capacity installation for small hydro power generation has shown rising trend over the period of time with CAGR of 8.27 and 3.24 percent, respectively.

Table 7: Installed small hydro power capacity of Punjab and India during the period 2007-08 to 2013-14

(in megawatts)

Year	India	Punjab
2007-08	2,181	124
2008-09	2,430	124
2009-10	2,735	133
2010-11	3,043	155
2011-12	3,395	155
2012-13	3,632	156
2013-14	3,804	155
CAGR (percent)	**8.27**	**3.24**

Source: Ministry of Statistics and Programme Implementation (Various years).

Installed solar power capacity of Punjab and India during the period 2007-08 to 2013-14 has been shown in table 8. In 2007-08, installed solar power capacity is 2 MW in India which remained stagnant in 2008-09, after that it increased sharply and reached the level of 2,632 MW in 2013-14. In Punjab, installed solar power capacity is 0.32 MW in 2007-08 which remained stagnant in 2008-09, after that it increased continuously and reached the level of 9 MW in 2011-12, again remained stagnant in 2012-13 and again risen sharply to the level of 17 MW in 2013-14. In India as well as in Punjab, capacity installation for solar power generation has shown rising trend over the period of time with CAGR of 179 and 76.39 percent, respectively. In Punjab, installed capacity of solar power is very less as compared to India.

Table 8: Installed solar power capacity of Punjab and India during the period 2007-08 to 2013-14

(in megawatts)

Year	India	Punjab
2007-08	2	0.32
2008-09	2	0.32
2009-10	10	1
2010-11	35	2
2011-12	941	9
2012-13	1,686	9
2013-14	2,632	17
CAGR (percent)	**179**	**76.39**

Source: Ministry of Statistics and Programme Implementation (Various years).

Conclusion

Punjab's potential for renewable power generation is 3,958 MW in 2014. Bio power has the highest share of 80 percent followed by small hydro power, cogeneration-bagasse and waste to energy with 11, 8 and 1 percent share in Punjab's potential for renewable power generation, respectively. Punjab's potential accounts for 3 percent of Indian potential of renewable power generation. Installed capacity of renewable power in Punjab is 323 MW in 2014. Small hydro power has the highest share of 49 percent followed by bio power, solar power and waste to energy with 44, 5 and 3 percent share in Punjab's installed capacity for renewable power generation, respectively. Installed capacity of Punjab accounts for only one percent of total installed capacity of India for renewable power generation. Installed capacity of north-west India is just 16 percent of the estimated potential for renewable power generation. Installed capacity as percentage of estimated potential is highest in Rajasthan, followed by Himachal Pradesh, Gujarat, Punjab, Haryana and Jammu & Kashmir. Punjab's installed capacity is just 8 percent of the estimated potential for renewable power generation. In Punjab, capacity installation for renewable power, biomass power, small hydro power and solar power generation has shown rising trend during 2007-08 to 2013-14. Capacity installation for waste to energy power generation has remained stagnant over the period of time in Punjab.

Suggestions

Punjab has huge potential for renewable power generation. Capital investment should be attracted in order to harness this potential. Punjab is an agrarian economy having huge potential of biomass power generation, there is need to boost capacity installation in this sector as only 4 percent of biomass power potential has been used in Punjab. Capacity installation of waste to energy sector should also be increased in order to remove stagnation in this sector. To increase capacity installation in biomass as well as in waste to energy sectors, government should encourage private investment in these two sectors as government is encouraging private investment in solar power sector. Various incentives can be provided to private players which will attract them to invest in these sectors.

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