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Advances and Hurdles in Solar Energy in Rajasthan

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***Abstract*—Renewable energy is a sustainable and clean source of energy derived from nature. These technologies have long been recognized as an important part of the solution to address energy security concerns and ensure economic growth in an environment friendly manner. Deregulation has changed the traditional mission and mandates of power utilities in complex ways, and had large impacts on environmental, social, and political conditions for any particular country like India. The renewable energy based power generating systems can play a major role towards the fulfilment of energy requirements of restructured electricity market. In this paper, efforts have been made to summarize the availability, current status, environmental effects, promotion policies and future potentials & strategies of renewable energy options in India.**

Keywords*— *renewable energy based power plants, renewable energy sources, renewable policy, renewable tariff.

I. INTRODUCTION

Rajasthan is a developing and fast-growing large economy and faces a great challenge to meet its energy needs in a responsible and sustainable manner.The installed capacity of solar power in India has crossed the milestone of 5,000 MW.The state of Rajasthan stands 1st in the country with 1264 MW, followed by Gujarat (1024MW), Madhya Pradesh (679 MW), Tamil Nadu (419 MW), Maharashtra (379 MW) and Andhra Pradesh (357 MW). The average intensity of solar radiation received over India is 200 MW/km^2 (megawatt per kilometer square) with 250–325 sunny days in a year. Solar energy intensity varies geographically in India, but Western Rajasthan receives the highest annual radiation energy. India receives the solar energy equivalent of more than 5000 trillion KWh/year (1TW = 1012 watt or 1 trillion watt). Depending on the location, the daily incidence ranges from 4 to 7 KWh/m^2, with the hours of sunshine ranging from 2300 to 3200 per year. Recent research has shown that India has a vast potential for solar power generation since about 58% of the total land area (1.89 million km^2) receives annual average Global in solation above 5 KWh/m^2/day. Indeed, given present efficiency levels, 1% of land area is sufficient to meet electricity needs of India till 2031.

Power industry is moving rapidly from regulated conventional setup to a deregulated environment. In the deregulation environment, generation, transmission, and distribution are independent activities. There is a competition among generators for managing different customers. Main benefits from the deregulation include cheaper electricity, efficient capacity expansion planning, cost minimization, more choice, and better service. During the nineties decade, many electric utilities throughout the world have forced to change their way of operation and business, from vertically integrated mechanism to open market system [1]. Rajasthan is on the path of rapid economic growth along with speedy overall development; simultaneously it has to face the global threat of climate change. India has unique renewable energy resources (RES) and development of country depends to a great extent on harnessing these sources. Rajasthan has unique RES and development of country depends to a great extent on harnessing these sources. Since conventional sources of energy pose significant threats to our current and future global security, environmental quality, health and society. So there is urgent need to promote renewable energy in present Rajasthan restructured power sector in sustainable and eco-friendly manner [2]. Restructuring in Rajasthan power sector started with the unbundling of Orissa state power utility, and soon followed by many other states throughout India [3]. Rajasthan also has followed the global change in power sector by establishment of the Regulatory Commissions in 1998 under the Electricity Regulatory Commissions Act 1998 (Central Law) to promote competition, efficiency and economy in the activities of the electricity industry and applied restructuring to Orrisa state electricity board firstly and after that to many other states. Central Electricity Regulatory Commission (CERC) has a key role in rationalizing tariff of generating companies owned or controlled by the Central Government in consultation with State Electricity Regulatory Commission (SERC) [4]. In the recent past, India has been growing at an average rate of 8.5%. Growth of economy is reciprocally linked to energy usage, and consequently the energy requirements of the country have increased phenomenally in the last couple of years. Growth of economy is reciprocally linked to energy usage, and consequently the energy requirements of the country have increased phenomenally in the last couple of years [5]. Over the years, Indian power sector has experienced a approx six-time increased in its installed capacity - it jumps from 30 GW in 1981 to over 187.5 GW by 31 January 2012 [6], but still there is a

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huge gap between generation and demand in India. Hence it needs to be establishing more generation plants preferably to be come from renewable sources by governmental as well as various private sectors. Electricity generation from renewable is assuming increasing importance in the context of large negative environmental externalities caused by electricity generation from fossil fuels based energy. Towards managing the environmental and social impacts; RESs have been drawing considerable attention in policy-making, project development, and operations [7]. The 33 percent of coal based plants generates large amounts of ash with other environmental harmful emission of gases such as carbon dioxide (CO2), sulphur dioxide (SO2), and nitrogen oxides (NOx). Immediate CO2 reductions driven by the early deployment of RE may cost more than other options today, but will reduce the costs of mitigating climate change in the future. The future economic development trajectory is likely to result in rapid and accelerated growth in energy demand and the growing energy consumption from conventional sources of energy is likely to leads increasing emissions of gases, compounding the pollution problems and increasing Green House Gas (GHG) emissions [2, 8]. Mainly, global warming caused by greenhouse gases and CO2 produced during the burning of fossil fuels, have been causing significant changes in the ecosystems and leading to nearly 150,000 additional deaths every year. On average, every 1 GW of additional renewable energy capacity reduces CO2 emissions by 3.3 million tons a year [5]. There is a great need to promote the renewable energy source in Indian power sector to meet future energy demand and remove GHG emission for environment protection. This paper emphasized the availability, current status, environmental effects, promotion policies and future potentials & strategies of renewable energy options in India. The Government has set the ambitious target of generating 100 GW of solar power by the year 2021-22 under the National Solar Mission.

II. ENERGY SCENARIO IN RAJASTHAN

In Rajasthan the power crisis increases rapidly, wind and solar of renewable energy sources plays important role to solve this problem. Although the net present cost is high but the running cost are low as compared to the Grid power. Its payback time is around 15 years. In south-west Rajasthan wind speeds and solar power availability are generally higher in summer months (April to August) as compare to other months but the average flow of wind and solar power in south-west Rajasthan is maximum as compare to other areas in Rajasthan an around march to November continues the average flow of wind and solar power so many companies are installed the wind power solar power plants in jaisalmer district. This comprises power generation from mainly the following resources.

- **Solar power**
- **Wind power**
- **Biomass power /Biogases Cogeneration**
- **Small hydro power**

In Rajasthan's context, only first three resources are being treated as Renewable resources of power.

A. Grid Connected

Rajasthan, total grid-connected renewable power generation capacity of 2173.20 MW has been achieved till 31 January 2012, which is about 11% of the total installed power generating capacity in the country. It includes wind power of 1921.4 MW, biomass power of around 106.80 MW, and around 145 MW Solar Power as shown in Table 1 [7].

A capacity addition of 14,000 MW is targeted during the 11th Plan period that would take the renewable power generating capacity to nearly 25,000 MW by 2012. This momentum is likely to be sustained and it is envisaged that the renewable power capacity in the country will cross 87,000 MW by 2022. The MNRES (Ministry of New and Renewable Energy Sources), Government of India (GOI), has under taken measures to facilitate the growth of both grid and off-grid RE
power through specific programs. Major programs in India for power generation from renewable include wind, biomass (cogeneration and gasifiers), small hydro, solar, and energy from wastes. The contribution of renewable to the total installed capacity of electricity generation has been rising after
private participation into generation and distribution due implementation of restricting of power sector [7].

B. Off-Grid Renewable Power

It needs to be underlined that for two major reasons Indian renewable energy priorities are different from that of the developed countries. Firstly, and most importantly, it provides energy access to large rural populations including those in inaccessible areas and meeting unmet demand in many other areas. Perhaps the remote areas can get electricity only through renewable sources [7]. Table 2 presents a summary of the achievements in off-grid/ distributed renewable power and decentralized renewable energy systems.

India's grid-connected solar power generation capacity has crossed the 5,000 Mw mark, with Rajasthan on top with 1047 MW Mw capacity followed by Gujarat.which is about 11% of the total installed power generating capacity in the state. It includes wind power of 3307.20 MW, biomass power of around 106.80 MW, and around 1047 MW Solar Power as shown in Table 1

TABLE 1
ESTIMATED POTENTIAL AND CUMULATIVE ACHIEVEMENTS OFFERS CONNECTED RAJASTHAN GRID (IN MW) [31]

Renewable Energy Program	Total Achievement During 2014-15 (MW)	Target For 2012-17 (MW)

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Wind Power	3307.20 MW	2215 MW
Solar Power	**1047** MW	400 MW
Biomass	106.8 MW	160 MW

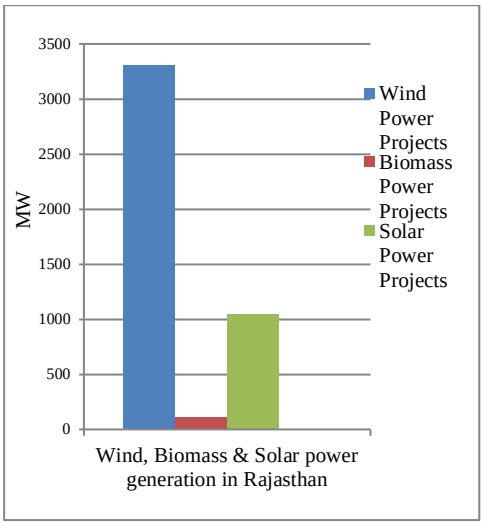

Fig.1 Present Installed Capacity of Power Generating (RES) In Rajasthan

In 2014, Rajasthan government had released its Solar Policy which aimed at installing 25000 MW of solar power in state. In this policy state government had introduced numerous investor-friendly measures to tap full potential of solar power. One of the key measure introduced was to installed solar plants was through State, Private Enterprises or Public-Private partnership (PPP). In this regard state government had inked agreements number of private companies to develop solar parks with a cumulative capacity of 26,000 MW. It should be noted that Rajasthan has all natural advantage for solar parks such as abundant barren land and high solar radiation (insolation) in the country. Rajasthan has become number one state in the country in terms of total installed capacity of solar energy.

TABLE 2
INSTALLED CAPACITY (IN MW)

S.No.	State	Installed Capacity on June 24, 2015
1.	**Rajasthan**	**1047**
2.	**Gujarat**	**1000**
3.	**Madhya Pradesh**	**563**
4.	**Maharashtra**	**363**
5.	**Andhra Pradesh**	**247**

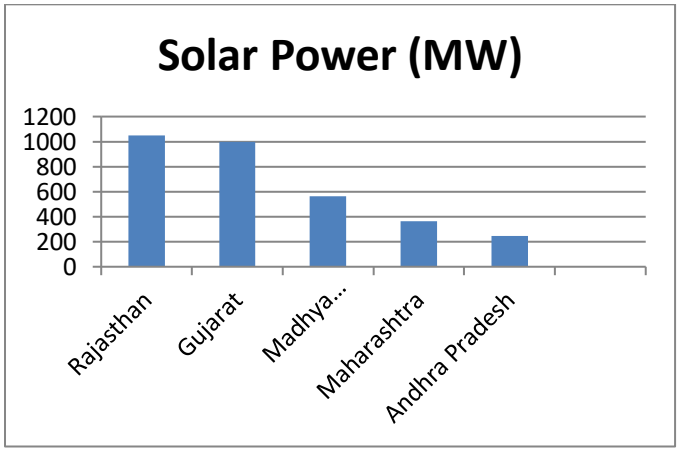

Fig.2 State Wise Installed Capacity of Solar Energy In India

DETERMINANTS OF SUCCESS FOR PROMOTING SOLAR ENERGY IN RAJASTHAN[13]

The potential of Rajasthan in solar energy and facilitating role of the Government of Rajasthan is now being acknowledged. Encouraged by new initiatives such as single window clearance, solar power producers have registered with Rajasthan Renewable Energy Corporation under renewable energy policy 2004 and now Solar Energy Policy 2011. About 722 reputed companies have registered for setting up of solar power plant in Rajasthan of 16900 MW capacities till date.

Out of a total 1100 MW new project allocations, Rajasthan received the maximum share of 873 MW (i.e., 79.36% of all India allocations) through competitive bidding in the first phase of Jawaharlal Nehru National Solar Mission (JNNSM), Govt. of Rajasthan has taken an initiative in 2008 and approved 2 Solar Projects each of 5 MW under Generation Based Incentive Scheme (GBI)[13]. To provide encouragement in solar sector, Rajasthan Electricity Regulatory Commission (RERC) issued orders on 2nd April 2008, first time in India, imposing solar specific renewable procurement obligation (RPO) for Discom in Rajasthan. To meet out RPO requirement, the State Government approved Solar Projects of 11 private sector developers for setting up of 66 MW capacities utilizing all available technologies in solar photovoltaic and concentrated solar thermal. After announcement of Jawaharlal Nehru National Solar Mission, Government of Rajasthan permitted these proposals to be migrated to the National Solar Mission. The Seven solar Power plants, each of 5 MW, having Photovoltaic technology are already commissioned under the migration scheme of National Solar Mission, while the Solar Thermal Plants of 30 MW are under implementation. The Rajasthan Electricity Regulatory Commission (RERC) has also notified the RERC (REC and RPO Compliance Framework) Regulations, 2010 on 23rd December, 2010. Further, Rajasthan Electricity

Regulation Commission has also issued from time to time the RPOs and feed-in tariff for Renewable Energy Projects.

III.RENEWABLE ENERGY POLICY INITIATIVES

To promote the renewable energy sector in general and solar energy in particular, Government of Rajasthan has taken several important initiatives. To begin with "Policy for Promoting Generation of Power through Non-Conventional Energy Sources" was enacted on 11th March 1999, which was updated in year 2000, 2003 and 2004. Also, Government of Rajasthan on April 19, 2011, issued Rajasthan Solar Energy Policy, 2011 to promote Solar Energy [25]. The main objectives of this policy include everage maximum benefit from National Solar Mission, develop Solar Power Plants for meeting renewable purchase obligation of Rajasthan as well as other States, promote off-grid applications of solar energy, and the development of solar parks. Other important policy initiatives of Government of Rajasthan embodied in the Climate Change Agenda of Rajasthan, Rajasthan Environment Mission, Rajasthan Environment Policy 2010, and State Action Plan on Climate Change, recognize the role of solar energy for sustainable development and energy security. With various policy initiatives including allotment of government land at 10% of District Level committee (DLC) rate, 1766 MW Wind Farms and 106 MW of Biomass Plants are already in operation.

RAJASTHAN SOLAR ENERGY POLICY, 2014 [25]

In 2014, Rajasthan government had released its Solar Policy which aimed at installing 25000 MW of solar power in state. In this policy state government had introduced numerous investor-friendly measures to tap full potential of solar power. One of the key measure introduced was to installed solar plants was through State, Private Enterprises or Public-Private partnership (PPP). In this regard state government had inked agreements number of private companies to develop solar parks with a cumulative capacity of 26,000 MW. It should be noted that Rajasthan has all natural advantage for solar parks such as abundant barren land and high solar radiation (insolation) in the country.

The recent significant growth of renewable energy is mostly a result of more favourable policies amid increasing concerns about climate change and energy security. The India now has the opportunity to build a sustainable energy future by engaging and stimulating the tremendous innovative and entrepreneurial capacity of the private sector [14]. Most countries like India that have undertaken recent electricity sector and market reforms now provide conditional access to the grid for independent power producers, including small scale renewable energy producers. Different strategies are being used for promotion of renewable energy sources for power generation in India. A number of fiscal and financial incentives are being provided for promotion of renewable. Foremost amongst them is the Electricity Act (2003) which de-licensed stand-alone generation and distribution systems in rural areas. The National Rural Electrification Policy, 2005 and National Rural Electrification Policy, 2006 also stresses the need for urgent electrification. The New Tariff Policy (2006) stated that a minimum percentage of energy, as specified by the Regulatory Commission, is to be purchased from such sources [9-13]. A comprehensive RE Policy for all round development of the sector, encompassing all the key aspects, has been formulated by MNRES. The policies targeting of 10% of additional grid power Generation capacity [19] to come from RE by 2012. Some of the policies and fiscal incentives in India for renewable energy developments are discussed in later sections.

A. Electricity act 2003

The Electricity Act 2003 is having a significant impact on the renewable power because it recognized the role of renewable energy technologies in the National Electricity Policy and in stand-alone systems. Some of the important provisions for renewable in this act include various incentives to the producers of renewable energy. According to Section 3 (1) of the Electricity Act 2003, the central government shall, prepare the National Electricity Policy and tariff policy from time to time, in consultation with the State Governments [13]. The 'Electricity Act 2003' also has made the state electricity regulatory commissions (SERCs) crucial players in the context of state level policies for renewable energy. Under the Section 86(1) of the Act, it is mandatory for the SERCs to "promote co–generation and generation of electricity through renewable sources of energy by providing suitable measures for connectivity with the grid. The E Act-2003 allow sale of electricity from renewable generation to any persons. It also specifies the purchase of electricity from renewable generation [9].

B. National electricity policy 2005

The National Electricity Policy 2005 stipulates that progressively the share of electricity from non-conventional sources would need to be increased; such purchase by distribution companies shall be through competitive bidding process; considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the commission may determine an appropriate deferential in prices to promote these technologies [15].

C. The national tariff policy 2006

The National Tariff Policy mandates each State Electricity regulatory commissions (SERC) to specify a Renewable energy Purchase Obligation (RPO/RPS) by distribution licensees in a time-bound manner. The Central Commission should lay down guide lines within three months of its establishment for pricing nonfarm power, especially from nonconventional sources, to be followed in cases where such procurement is not through competitive bidding [10-11]. The main aim of this policy is reducing the cost of power through competitive process and capacity development.

D. National rural electrification policies (NREP), 2006

According to NREP to achieve the 10% Renewable energy target through Renewable Purchase Obligations RPO set by the various SERCs in there respective states, cognizant of its role in the promotion of RE, SERCs in many states have had been formulating encouraging policies to promote renewable energy. SERCs include preferential tariffs, RPO, reduction in contract load, banking and wheeling arrangements and guidelines for evacuation arrangement. Some SERCs have applied the RPO on the Open Access Consumers (OAC) and Captive Power Plant (CPP) consumers. Along with specifying a minimum RPO, certain SERCs have also set a ceiling for maximum power that can be purchased by the distributed companies (Disco's) from the RE sources in order to keep a check on increase in retail tariff due to higher power purchase costs. As per this policy for villages, where grid connectivity would not be feasible or not cost effective, off-grid solutions based on standalone systems may be taken up for supply of electricity based upon renewable so that every household gets access to electricity. Moreover where neither standalone systems nor grid connectivity is feasible then only alternative is to use isolated lighting technologies like solar photovoltaic may be adopted [16-18].

E. Feed-In tariff policy

Feed-in tariffs are a form of support for renewable electricity production. The term feed-in tariff is used both for a regulatory, minimum guaranteed price per unit of produced electricity to be paid to the producer, but also for a premium on market electricity prices. They are sometimes called Renewable Tariffs, Advanced Renewable Tariffs, Renewable Energy Payments, and more generally, feed laws Renewable tariffs are the world's most successful policy mechanism for stimulating the rapid development of renewable energy [14]. Feed-in tariffs vary in design from country to country. The policies should establish different tariffs for different technologies, usually related to the cost of generation, for example distinguishing between off-shore and onshore wind power. Tariffs for a given plant may decline over time, but typically last for 15–20 years. However, the level of the tariff need not have any direct relation with either cost or price, but can be chosen at a level to motivate investors for green power production [21].

F. Quota/ Renewable portfolio standard (RPS/RPO)

An instrument that is commonly expected to gain momentum in the future is the quota system, or a Renewable Portfolio Standard. The government sets the framework within which the market has to produce, sell, or distribute a certain amount of energy from renewable sources. An RPS is a policy instrument that ensures that a minimum amount of renewable energy is included in the portfolio of resources serving the country. Many SERCs, including those of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Orissa, have already fixed this quota. RPS, fixed tariff by various SERCs, tariff validity duration and subsidy for Third party for transmission of renewable power in India [21]

G. Industrial policy

In industrial policy, MNRES is promoting medium, small, mini and micro enterprises for manufacturing and servicing of various types of RE systems and devices. For setting-up of an RE industry, industrial clearances as well as no clearance is required from Central Electricity Authority (CEA) for power generation projects up to Rs 1,000 million. For RE power generation projects government is allowed five year tax holiday and for RE equipment manufacturing, Soft loans are available through Indian Renewable Energy Development Authority (IREDA) .Financial support is also available to RE industries for R&D projects in association with technical institutions [17].

H. Joint ventures policies

Joint ventures are a financial as well as technical collaboration and they are used by foreign investors as it provides maximum visibility and presence in the country. A foreign investor can enter into a joint venture not only for manufacturing RE products and systems, but also in setting up RE-based power generation projects. Usually joint ventures are in the form of takeovers or strategic alliances with the
existing reputed companies with a niche market. A foreign investor can set up a liaison office as an intermediate step before entering into a joint venture [22].

I. Foreign investment policy

Government also encourages foreign investors to set up power projects based on other nonconventional energy sources also. Investors are required to enter into a power purchase agreement with the concerned state government. There is No prior approval of the government is required to set up an industrial undertaking with Foreign Direct Investment (FDI) by Non-Resident Indians (NRIs). The Reserve Bank of India (RBI) has permitted Indian companies to accept investment under the 'automatic route' without obtaining prior approval from RBI [20] to set up such renewable based projects.

J. Auctions/ Bidding procedures

A competitive bidding process is organized to buy a given quantity of renewable energy, and winners are selected based on the lowest price offered. Bidding procedures can be used to select beneficiaries for investment support or production support (such as through feed-in-tariffs), or for other limited rights- such as sites for wind energy. Potential investors or producers have to compete through a competitive bidding system. The criteria for judgments of the bids are set before each bidding round [21]. SERCs in other States are determining tariffs for the sale of electricity based on renewable energy. Some states are also awarding the projects based on competitive bidding process for the rate for purchase of electricity
[22]. The bidding is accompanied by an obligation on the part of electricity providers to purchase a certain amount of electricity from renewable sources at a premium price.

K. Research & development (R&D) initiatives

The "MNRE" also encourages the combination of the solar energy using systems and the buildings, in order to provide the necessary conditions for solar energy utilization during the

design and construction. For technology development, the R&D strategy would comprise five categories, via [23].

- Basic research having a long term perspective for the development of innovative and new materials, processes and applications.
- Applied research aimed at improvement the existing processes, materials and the technology for enhanced performance, durability and cost competitiveness of the systems/ devices.
- Technology validation and demonstration projects aimed at field evaluation of different configurations, including hybrids with conventional power systems for obtaining feedback on performance, operability and costs.
- Development of R&D infrastructure in private public partnership (PPP) mode, and
- Support for incubation and start ups, a 3-tier R&D institutional framework, including high level research council, National Centre of Excellence and a network of centres of excellence.

L. Investment support

Investment subsidies can help overcome the barrier of a high initial investment. This type of subsidy is commonly used to stimulate the sales of less economical RE technologies. Investment subsidies are usually 20-50% of eligible investment costs. These schemes may take different forms. These forms range from rebates on general energy taxes, rebates from special emission taxes, proposals for lower VAT rates, tax exemption for green funds, to fiscal attractive depreciation schemes. The government also provides various types of fiscal incentives for the RE sector, which include: (a) Direct taxes - 100 per cent depreciation in the first year of the installation of the project (b) Exemption/reduction in excise duty (c) Exemption from Central Sales Tax, and customs duty concessions on the import of material, components and equipment used in RE projects Under Income Tax Rules following concessions are available to the nonconventional energy sector [23].

IV.SOCIAL, ECONOMIC AND ENVIRONMENTAL BENEFITS

A sustainable energy economy offers not just ecological benefits, but social and economic benefits too. This is in direct contravention to the huge social, economic and environmental externalities created by conventional power projects. The foremost benefit of deployment of RE technologies is employment generation. The renewable energy industry offers a variety of highly skilled and semi-skilled jobs and the sector is highly employment intensive. In India, if we sincerely implement the 15% RE target set by National Action Plan on Climate Change (NAPCC), we would have to add 90,000 MW of additional renewable power up to 2020. At an average of 20 jobs per MW (both direct and indirect) addition of 90,000 MW of renewable capacity can create 1.8 million jobs. Energy security and autonomy would be the major economic benefit due to freedom from fossil fuels. Import dependency exposes us to major price risks since fossil fuels are globally traded commodities [24].

V. FUTURE PERSPECTIVES

The MNRE has set aggressive targets for renewable energy, with projections approaching 1,00 GW by 2022. The National Solar Mission, established under the NAPCC, has set a goal of generating at least 10% of India's power from solar energy. It envisages increasing the production of solar photovoltaic panels to 1,000 MW per year from the current 235 MW per year and generating 1,000 MW of grid-connected solar power, up from the current 10 MW, by 2017 [7].India has set a very ambitious goal to increase the RE production. By 2012 10% of added electricity capacity should be renewable. Besides direct RE targets, India has also set targets concerning access to electricity. By "Eleventh Five Year Plan-2007-11"; planning commission (GOI) targeted the future development of total RES in India, which is shown in Table 3. The Committee has placed emphasis on higher use of renewables in all forms of services. It is expected that the contribution from renewables in power generation alone can be of the extent of 60,000MW in the year 2031-2032. In the present Indian power sector with maturing technologies, promotion policies in renewable energy business, and suitability of various new renewable projects is likely to be improve, resulting in higher utilization of available government funds and faster market growth. India has experience with many technologies and their implementation. Worldwide India ranks fifth in installed wind energy installed capacity, fourth in annual PV production capacity and second with biogas plants [23]. India possesses a very large solar energy resource which is seen as having the highest potential for the future. The first, recently announced, the very ambitious Jawaharlal Nehru National Solar Mission (JNNSM) with a target of 20,000 MW grid solar powers, 2000 MW of off-grid capacity including 20 million solar lighting systems and 20 million square meters. Solar thermal collector area by 2022 is under implementation. The main objectives of the mission are to help reach grid parity by 2022 and help set up indigenous manufacturing capacity. The deployment across the application segments is envisaged as follows By addition of RE capacity via creation of the National Clean Energy Fund; India is contributing more renewable power through grid. The target of 15% RE by 2020 announced by NAPCC by helping the National Solar Mission. Many states recognising by RE as a grid-connected option; and entry of major corporate groups into manufacturing of RE devices

VI. CONCLUSION

Only renewable are eligible for support from within their country of origin and count towards that Governments renewable and carbon targets. Increased recognition of the contribution renewable energy makes to rural development lower health costs (linked to air pollution), energy independence, and climate change mitigation is shifting

renewable energy from the fringe to the mainstream of sustainable development. For renewable development in India, the renewable energy program has been in existence for more than three decades, but a market for renewable energy technologies still need to be exists. Renewable energy strategy needs to be integrated with liberalization of energy markets and withdrawal of direct government interventions in energy sector. Need to construct market-based energy policies that provide a competitive market framework, and may internalize externalities in terms of energy security, environmental protection and economic efficiency for effective promotion of renewable. India's rural areas and in reducing consumption of fossil fuels which is essential for future energy security of the country. It outlines the policies that have been followed to foster the growth of this sector and also indicates the targets and the future pathway.

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