

CLEAN AND RENEWABLE ENERGY INITIATIVES

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Renewable energy has been an important component of India's energy planning process for quite some time, especially since India seeks to make significant contributions towards climate change mitigation and emerge as a responsible global powerhouse. The Ministry of New and Renewable Energy (MNRE) in India has been facilitating the implementation of broad spectrum programmes including harnessing renewable power, renewable energy for rural areas for lighting, cooking and motive power, use of renewable energy in urban, industrial and commercial applications and development of alternate fuels and applications.

Renewable energy is bound to play an increasingly important role in future energy systems. India has a huge potential for generating green electricity from the renewable energy sources. To promote green energy, Government of India is launching many schemes for the renewable energy resources. India's renewable energy capacity has crossed the 80GW mark, which includes 29.55 GW of solar energy and 36.37 GW wind power. The Government has set an ambitious target of having 175 GW of clean energy capacity by 2022, including 100 GW solar and 60 GW of wind energy. A total of 80.46 GW of renewable energy capacity has been installed in the country as on June 30, 2019 which includes 29.55 GW from solar and 36.37 GW from wind power.

As per India's submission to the United Nations Framework Convention on Climate Change on Intended Nationally Determined Contribution (INDC), a cumulative electric power capacity of 40 per cent from non-fossil fuel-based energy resources is to be installed by 2030. India attained global 4th and 5th positions in wind and solar power installed capacities and 5th global position for overall installed renewable energy capacity in 2018. A total of 101.83 billion units of power were generated in the country during the year 2017-18 from renewable energy. The Government has declared the trajectory of bidding 60 GW capacity of solar energy and 20 GW capacity of wind energy by March 2020, leaving two years' time for execution of the projects. As per the Paris Accord on Climate Change, India made a pledge that by 2030, 40 per cent of installed power generation capacity shall be based on clean sources, it was determined that 175 GW of renewable energy capacity will be installed by 2022. This includes 100 GW from solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro power.

The solar radiation incident over India is equal to 4–7 kWh per square meter per day with an annual radiation ranging from 1200–2300 kWh per square meter. It has an average of 250–300 clear sunny days

and 2300–3200 hours of sun shine per year. India's electricity needs can be met on a total land area of 3000 km² which is equal to 0.1 per cent of total land in the country. Government of India is promoting solar energy through fiscal and promotional incentives, such as capital subsidy, tax holiday on the earnings for 10 years, generation-based incentive, accelerated depreciation, Viability Gap Funding (VGF), financing solar rooftop systems as part of home loan, concessional custom duty, exemption from excise duty, preferential tariff for power generation from renewables, and foreign direct investment up to 100 per cent under the automatic route.

Now, the world's energy leaders are looking to India for investment. The President and Global Head for a leading energy solutions business said in a media interaction recently that India has a huge solar power potential, this source of energy is intermittent and subject to fluctuations. We want to develop India as our headquarters for battery-storage business in Asia. India has a huge potential for solar power and the Government has taken up the biggest addition of solar power in the history of humankind. Recently, India achieved the third rank globally for solar installation capacity. A clean energy research organisation, has reported that the installed solar photovoltaic (PV) capacity has reached over 28 GW as of December 2018.

Last year, India and France have committed more than US\$2 billion to fund solar energy projects in developing countries. The announcement came on 11 March 2018 during the first summit of the International Solar Alliance (ISA) in New Delhi, which drew Heads of Government from more than 20 countries. In his opening address, Prime Minister pledged \$1.4 billion to support solar energy projects in Bangladesh and in developing countries in Africa. It would be used to support 27 new projects in 15 developing nations. Projects will range from setting up small solar photovoltaic power plants in several African countries to a 100 MW solar photovoltaic plant in Mollahat, Bangladesh, and an LED street-

lighting project in the Seychelles. French President Emmanuel Macron committed €700 million (US\$865 million) to the scheme. Macron told the summit that the alliance needed \$1 trillion to achieve its 1 TW target by 2030. Macron's pledge of €700 million brings France's total investment to €1 billion. The country committed €300 million in 2015. The World Bank has also pledged \$500,000, and other agencies, including the Green Climate Fund, have offered to support the scheme, but most of the investment is expected to come from the private sector.

The vision and mission of the International Solar Alliance is to provide a dedicated platform for cooperation among solar resource-rich countries that lie completely or partially between the Tropics of Capricorn and Cancer, the global stakeholders, including bilateral and multilateral organisations, corporates, and industries to make a positive contribution to assist and help achieve the common goals of increasing the use of solar energy in meeting energy needs of prospective ISA member countries in a safe, convenient, affordable, equitable and sustainable manner. The Alliance has three main programmes: promoting the use of solar water pumps instead of diesel pumps for irrigation; affordable financing for solar technology; and promoting solar mini-grids in the least-developed countries and small island nations.

The intergovernmental International Solar Alliance was launched by the Prime Minister of India and former French President François Hollande at the United Nations Climate Conference in Paris in 2015. The Alliance seeks to lower the cost of solar technology so that it can meet the energy needs of 121 sunshine-rich developing countries. It aims to create 1 TW (1,000GW) of solar energy by 2030. So far, 61 countries have joined the Alliance and 32 have ratified its framework agreement.

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significant contributions towards climate change mitigation and emerge as a responsible global powerhouse. The Ministry of New and Renewable Energy (MNRE) in India has been facilitating the implementation of broad spectrum programmes including harnessing renewable power, renewable energy for rural areas for lighting, cooking and motive power, use of renewable energy in urban, industrial and commercial applications and development of alternate fuels and applications.

India's ambitious mission on solar energy, the National Solar Mission (NSM) was launched in 2010 with active collaboration from states to promote ecologically sustainable growth while addressing India's energy security challenges. The first phase of the mission was completed in 2013, which was focused on promoting scale-up in grid-connected solar capacity addition of 300 MW through a scheme of bundling with thermal power. In the second phase during the 2013–17, capacity addition of 3,000 MW under the central scheme was envisaged through various schemes. In the third phase, 2017–22, the target up to year 2022 of 20,000 MW or more was to be decided dependent on the experiences and learning of the first two phases. Further, on 17 June 2015, the Government of India revised the NSM target of grid-connected solar power projects from 20,000 MW to 100,000 MW by year 2022. The Government has planned to achieve the target of 100 GW by setting up of distributed rooftop solar projects and medium and large scale solar projects.

Under the scheme for development of solar parks which was launched in December 2014, a total of 42 solar power parks with an aggregate capacity of around 23.40 GW have been approved by the Government so far to facilitate achievement of 100 GW target by March 2022. Out of approved capacity of 23.40 GW, power purchase agreements (PPAs) have been signed for around 9.20 GW and out of this, around 6.40 GW of capacity has been commissioned in various solar parks as on 30 June 2019.

The total capacity of solar parks will generate more than 64 billion units of electricity per year which will lead to abatement of around 55 million tonnes of carbon dioxide per year over its life cycle. It would also contribute towards the long-term energy security of the country and promote ecologically sustainable growth by a reduction in carbon emissions and carbon footprint, as well as generate large direct and indirect employment opportunities in solar and allied industries, such as glass, metals, heavy industrial equipment, etc.

The share of renewable energy in overall installed capacity in the country as on 31 October 2018

Source	Installed Capacity (GW)	Percentage
Thermal	221.76 GW	(63.84%)
Nuclear	6.78 GW	(1.95 %)
Hydro	45.48 GW	(13.09 %)
Renewable	73.35 GW	(21.12 %)
Total	347.37 GW	(100%)

(Source: PIB)

Solar Parks in India as on 31 May 2019

Sl. No.	State	Solar Park	Capacity (MW)
1	Andhra Pradesh	Ananthapuramu-I Solar Park	1500
2		Kurnool Solar Park	1000
3		Kadapa Solar Park	1000
4		Ananthapuramu-II Solar Park	500
5		Hybrid Solar Wind Park	160
6	Arunachal Pradesh	Lohit Solar Park	30
7	Gujarat	Radhnasada Solar Park	700
8		Harsad Solar Park	500
9		Dholera Solar Park	5000
10	Jharkhand	Floating Solar Park	150
11	Karnataka	Pavagada Solar Park	2000
12	Kerala	Kasargod Solar Park	105
13	Madhya Pradesh	Rewa Solar Park	750
14		Neemuch-Mandsaur Solar Park	700
15		Agar Solar Park	550
16		Shajapur Solar Park	500
17		Morena (Chambal) Solar Park	250
18	Maharashtra	Sai Guru Solar Park (Pragat)	500
19		Patoda Solar Park (Paramount)	500
20		Dondaicha Solar Park	500
21		Latur Solar Park	60
22		Washim solar park	170
23		Yavatmal Solar Park	75
24		Kacharala solar park	145
25	Manipur	Bukpi Solar Park	20
26	Meghalaya	Solar park in Meghalaya	20
27	Mizoram	Vankal Solar Park	20
28	Nagaland	Solar Park in Nagaland	23
29	Odisha	Solar Park in Odisha	275
30		Solar Park by NHPC	100
31	Rajasthan	Bhadla-II Solar Park	680
32		Bhadla-III Solar Park	1000
33		Bhadla-IV Solar Park	500
34		Phalodi-Pokaran Solar Park	750
35		Fatehgarh Phase-1B Solar Park	421
36		Nokh Solar Park	980
37	Tamil Nadu	Kadaladi Solar Park	500
38	Uttar Pradesh	Solar Park in UP	440
39		UP Kanpur Dehat Solar Park	50
40		UP Jalaun Solar Park	50
41		UP Kanpur Nagar Solar Park	30
42	West Bengal	Solar park in West Bengal	200

(Source: MNRE website)

KUSUM: Recently, the Government of India has launched Kisan Urja Suraksha evam Utthaan Mahabhiyan – KUSUM with the objective of providing financial and water security to farmers. This scheme has three components which include 10,000 MW of decentralized ground-mounted, grid-connected renewable power plants; installation of 17.50 lakh standalone solar-powered agriculture pumps and solarisation of 10 lakh grid-connected solar powered agriculture pumps. The scheme aims to add a solar capacity of 25,750 MW by 2022. The total central financial support provided under the scheme would be Rs. 34,422 crore.

This is a unique scheme in terms of direct employment potential. Besides increasing self-employment, this scheme is likely to generate employment opportunity equivalent to 6.31 lakh jobs for skilled and unskilled workers. Renewable power plants of capacity 500 KW to 2 MW will be set up by individual farmers, cooperatives, panchayats or Farmer Producer Organisations (FPO) on their barren or cultivable lands. The power generated will be purchased by the distribution company at feed in tariffs determined by respective State Electricity Regulatory Commission. The scheme will open a stable and continuous source of income to the rural land owners. Performance based incentives at Rs. 0.40 per unit for five years to be provided to distribution companies.

The scheme will have substantial environmental impact in terms of savings of carbon dioxide emissions. All three components of the scheme combined together are likely to result in saving of about 27 million tonnes of carbon dioxide emission per annum. One component of the scheme on standalone solar pumps may result in saving of 1.2 billion litres of diesel per annum and associated savings in the foreign exchange due to reduction of import of crude oil.

The Ministry of New and Renewable Energy has introduced a new scheme Sustainable Rooftop Implementation for Solar Transfiguration of India - SRISTI, to incentivize the installation of rooftop solar projects in India. SRISTI scheme aims to achieve a national solar rooftop target of 40 GW till 2021-2022. Central financial assistance will be provided only for installation of rooftop solar plants in residential sectors. The residential users may install the plant of capacity as per their requirement and the respective State Electricity Regulatory Commission regulation. But, the subsidy support will be limited

Status of Renewable Energy Projects as on October 2018

Sector	Target (GW)	Installed capacity (GW) as on 31.10.2018	Under Implementation (GW)	Tendered (GW)	Total Installed/ Pipeline (GW)
Solar Power	100	24.33	13.8	22.8	60.93
Wind power	60	34.98	7.02	2.4	44.4
Bio Energy	10	9.54	0	0	9.54
Small Hydro	5	4.5	0.73	0	5.23
Total	175	73.35	21.55	25.2	120.1

(Source: PIB)

up to 5 kWp capacity of plant. The incentive towards subsidy to the residential sector is capped at Rs.18,000 per kW calculated at benchmark cost of Rs.60,000 per kW. The incentive to distribution companies for social, institutional, government sectors, commercial and industrial sector is capped at Rs. 5,500 per kW calculated at benchmark cost of Rs. 55,000 per kW. The total incentive for the residential sector stands at Rs. 9,000 crore for 5000 MW of installations. The incentive to distribution companies is capped at Rs. 14,450 crore for 35,000 MW of rooftop solar installations. The total outlay is Rs. 23,450 crore for 40,000 MW of rooftop solar installations. Residential, social and the institutional sector will set up 5,000 MW each.

In another initiative of clean energy, a National Wind-Solar Hybrid Policy has been launched recently to provide a framework for promotion of large grid connected wind-solar PV hybrid system for efficient utilization of transmission infrastructure and land. It also aims at reducing the variability in renewable power generation and achieving better grid stability. On technology front, the Policy provides for integration of both the energy sources i.e. wind and solar at AC as well as DC level. The Policy also provides for flexibility in share of wind and solar components in hybrid project, subject to the condition that, rated power capacity of one resource be at least 25 per cent of the rated power capacity of other resource for it to be recognised hybrid project.

The Policy seeks to promote new hybrid projects as well as hybridisation of existing wind/solar projects. The existing wind/solar projects can be hybridised with higher transmission capacity than the sanctioned one, subject to availability of margin in the existing transmission capacity. The Policy provides for procurement of power from a hybrid project on tariff-based transparent bidding process for which the Government entities may invite bids. The Policy also permits use of battery storage in the hybrid project for optimising the output and further

reduce the variability. It mandates the regulatory authorities to formulate necessary standards and regulations for wind-solar hybrid systems. With significant capacity additions in renewables in recent years and with Hybrid Policy aiming at better utilisation of resources, it is envisaged that the Hybrid Policy will open-up a new area for availability of renewable power at competitive prices along with reduced variability. A scheme for new hybrid projects under the policy is also expected shortly.

Green Energy Corridor is another initiative of Government of India for evacuation of large scale renewable energy for which Intra State Transmission System (ISTS) was proposed. ISTS is being implemented by eight renewable rich states of Tamil Nadu, Rajasthan, Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Himachal Pradesh and Madhya Pradesh. The project is being implemented in these states by the respective State Transmission Utilities (STUs). The project includes about approximately 9400 ckm transmission lines and Substations of total capacity of approximately 19000 MVA to be completed by March 2020. The purpose is to evacuate approx. 20,000 MW of large scale renewable power and improvement of the grid in the implementing States. The total project cost is approximately Rs. 10141 crores. The Central grant is disbursed in two installments to the STUs: a) 70 per cent advance on the award of contract, and b) Balance 30 per cent after successful commissioning and three months performance testing.

In this way, the Government of India is implementing variety of schemes so that maximum clean energy can be tapped in the country and uninterrupted power supply can be ensured in remote areas. Today, in this direction, more and more research and technological developments need to be done in the research institutes to conserve the clean and renewable energy for the interests of the country and a safe future.

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