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2016-17

सत्यमेव जयते

Ministry of New and Renewable Energy
Government of India
www.mnre.gov.in

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300 kWp Solar Rooftop at ISBT, Sec-17, Chandigarh

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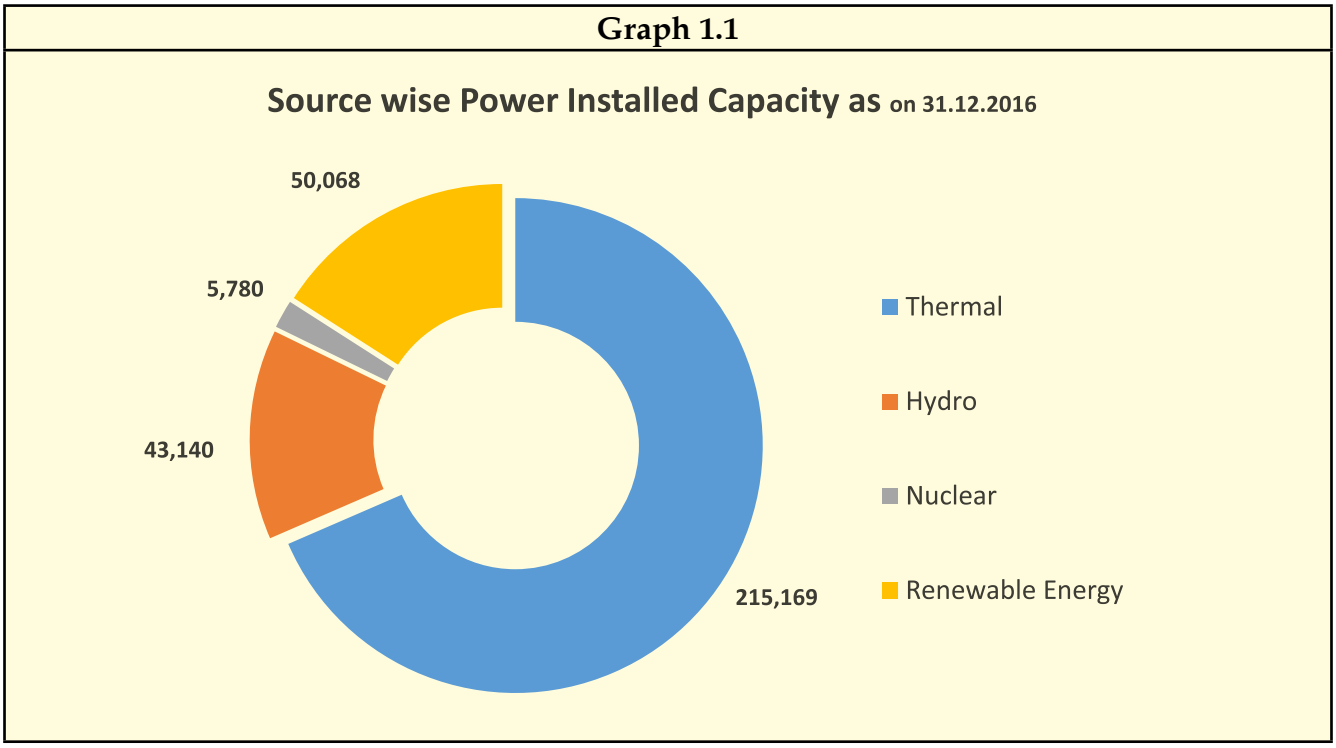
1 : OVERVIEW

OVERVIEW

1.1 While the global economy maintains its low level growth, the Indian economy continues on its high growth trajectory. The year 2016-17 has seen a paradigm shift in the way India's economy will function by focusing on laying the infrastructure for widespread inclusion of all economic activity on the digital platform. Power sector plays a vital role in the growth of Indian economy and it is growing at rapid pace. The total installed capacity has reached to 310 GW with generation mix of Thermal (69.4%), Hydro (13.9%), Renewable (14.8%) and Nuclear (1.9%). It is evident that the renewable power has secured 2nd position after Thermal and is spreading its wings rapidly in India. **(See Graph 1.1)**

1.2 The Government of India has upscaled the target of renewable power capacity to 175 GW which includes 100 GW from Solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro power to be achieved by 2022. The Ministry is implementing a wide range of schemes with fiscal and financial support and conducive policies to achieve this target. Largest ever wind power capacity addition of 3423 MW, exceeding target by 43% and solar power capacity addition of 3,019 MW, exceeding target by 116% was made in 2015-16 . For the first time the largest solar power projects capacity of 20,904 MW was tendered and 31,472 Solar Pumps were installed which is higher than total number of pumps installed during last 24 years in 2015-16 . The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry at the federal level for all matters relating to new and renewable energy. The Ministry has been facilitating the implementation of broad spectrum programs including harnessing renewable power, renewable energy to 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.

Graph 1.1



RENEWABLE ENERGY SCENARIO

1.3 Over the years, renewable energy sector in India has emerged as a significant player in the grid connected power generation capacity. It supports the government agenda of sustainable growth, while, emerging as an integral part of the solution to meet the nation's energy needs and an essential player for energy access. It has been realized that renewable energy has to play a much deeper role in achieving energy security in the years ahead and be an integral part of the energy planning process.

1.4 There has been a visible impact of renewable energy in the Indian energy scenario during the last five years. Renewable energy sector landscape in India has, during the last few years, witnessed tremendous changes in the policy framework with accelerated and ambitious plans to increase the contribution of solar energy. There is a perception that renewable energy can now play a significant role, as also, there is a confidence in the technologies and capacity to do so. Enlarging the scope of the National Solar Mission symbolizes both, and indeed encapsulates the vision and ambition for the future. This transformational change is, perhaps, the highlight of the last five years of activities under the Mission.

1.5 The Government of India has taken several initiatives during the last two years such as introduction of the concept of solar parks, organizing RE-Invest 2015—a global investors' meet, launching of a massive grid-connected rooftop solar programme, earmarking of Rs.38,000 crore for a Green Energy Corridor, eight-fold increase in clean environment cess from Rs.50 per tonne to Rs.400 per tonne, solar pump scheme with a target of installing 100,000 solar pumps and programme to train 50,000 people for solar installations under the Surya Mitra scheme, no inter-state transmission charges and losses to be levied for solar and wind power, compulsory procurement of 100 per cent power from waste to energy plants, and Renewable Generation Obligations on new thermal and lignite plants, etc. The other significant initiatives are launching of improved cook-stoves initiatives; initiating coordinated research and development activities in solar PV and thermal; second generation biofuels, hydrogen energy and fuel cells, etc.

1.6 The Ministry of New and Renewable Energy (MNRE) has taken several steps to fructify Government's dream of clean energy. The largest renewable capacity expansion programme in the world is being taken up by India. The government is aiming to increase share of clean energy through massive thrust in renewables. The core drivers for development and deployment of new and renewable energy in India have been Energy Security, Electricity shortages, Energy Access, Climate change etc.

RENEWABLE ENERGY POTENTIAL

1.7 India has an estimated renewable energy potential of about 900 GW from commercially exploitable sources viz. Wind – 102 GW (at 80 metre mast height); Small Hydro – 20 GW; Bio-energy – 25 GW; and 750 GW solar power, assuming 3% wasteland is made available. The Ministry had taken up a new initiative in 2014 for implementation of wind resource assessment in uncovered / new areas with an aim to assess the realistic potential at 100 m level in 500 new stations across the country under the National Clean Energy Fund (NCEF). National Institute of Wind Energy has used advanced modelling techniques and revised the estimate the wind power potential at 100 metre at 302 GW. Preliminary estimates of offshore wind energy potential indicate potential in Tamil Nadu and Gujarat. Under off-grid applications, there exists significant potential for meeting hot water requirement for residential, commercial and industrial sector through solar energy and also for meeting cooking energy needs in the rural

areas through biogas. **Table 1.1** provides details on state-wise renewable energy potential in the country.

1.8 Renewable energy has a great potential to usher in universal energy access. In a decentralized or standalone mode, renewable energy is an appropriate, scalable and viable solution for providing power to un-electrified or power deficient villages and hamlets. Over 1.2 million households are using solar energy to meet their lighting energy needs and almost similar numbers of the households meet their cooking energy needs from biogas plants. Solar Photovoltaic (PV) power systems are being used for a variety of applications such as rural electrification, railway signalling, microwave repeaters, mobile towers, TV transmission and reception and for providing power to border outposts.

1.9 Renewable energy database is updated regularly in the country. The National Institute of Wind Energy (NIWE), formerly known as Centre forWind Energy Technology, has developed the Wind Atlas of India. NIWE also collects data from Solar Radiation Resource Assessment stations to assess and quantify solar radiation availability and develop Solar Atlas of the country. National Institute of Solar Energy has assessed the State wise solar potential by taking 3% of the waste land area to be covered by Solar PV modules. The Indian Institute of Science, Bengaluru has developed Biomass Atlas of India, and the Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee has assessed small hydro potential in the country.

RENEWABLE ENERGY INFRASTRUCTURE

1.10 Every State/UT has a nodal agency/department, for implementation of renewable energy programmes/schemes of the Ministry, besides their own programmes of renewable energy. In addition, institutions namely National Institute of Solar Energy, National Institute of Wind Energy, national Institute of Bio-Energy, Solar Energy Corporation of India and Indian Renewable Energy Development Agency have been established to provide technical support to the renewable energy sector in the country. The reputed technical institutions i.e. IITs, NITs and Universities provide support for research and development work, capacity building of stakeholders, potential assessments, monitoring and evaluation etc.

A 90.3 MW Wind Farm in Madhya Pradesh

1.11 A large domestic manufacturing base has been established in the country for renewable energy systems and products. Companies investing in these technologies are eligible for fiscal incentives, tax holidays and accelerated depreciation apart from the remunerative returns for the power fed into the grid. Further, the government is encouraging foreign investors to set up renewable power projects with 100 percent foreign direct investment. The Indian

Table1.1 : State wise Renewable Energy Potential (in MW)								
Sl. No.	States/UTs	Wind Power	Small Hydro Power	Bio-Energy			Solar	Total
				Biomass Power	Bagasse Cogeneration	Waste to Energy		
1	Andhra Pradesh	14497	978	578	300	123	38440	54916
2	Arunachal Pradesh	236	1341	8			8650	10236
3	Assam	112	239	212		8	13760	14330
4	Bihar	144	223	619	300	73	11200	12559
5	Chhattisgarh	314	1107	236		24	18270	19951
6	Goa		7	26			880	912
7	Gujarat	35071	202	1221	350	112	35770	72726
8	Haryana	93	110	1333	350	24	4560	6470
9	Himachal Pradesh	64	2398	142		2	33840	36446
10	Jammu & Kashmir	5685	1431	43			111050	118208
11	Jharkhand	91	209	90		10	18180	18580
12	Karnataka	13593	4141	1131	450		24700	44015
13	Kerala	837	704	1044		36	6110	8732
14	Madhya Pradesh	2931	820	1364		78	61660	66853
15	Maharashtra	5961	794	1887	1250	287	64320	74500
16	Manipur	56	109	13		2	10630	10811
17	Meghalaya	82	230	11		2	5860	6185
18	Mizoram		169	1		2	9090	9261
19	Nagaland	16	197	10			7290	7513
20	Orissa	1384	295	246		22	25780	27728
21	Punjab		441	3172	300	45	2810	6768
22	Rajasthan	5050	57	1039		62	142310	148518
23	Sikkim	98	267	2			4940	5307
24	Tamil Nadu	14152	660	1070	450	151	17670	34152
25	Telangana						20410	20410
26	Tripura		47	3		2	2080	2131
27	Uttar Pradesh	1260	461	1617	1250	176	22830	27593
28	Uttarakhand	534	1708	24		5	16800	19071
29	West Bengal	22	396	396		148	6260	7222
30	Andaman & Nicobar	365	8				0	373
31	Chandigarh					6	0	6
32	Dadra & Nagar Haveli						0	0
33	Daman & Diu	4					0	4
34	Delhi					131	2050	2181
35	Lakshadweep						0	0
36	Puducherry	120				3	0	123
37	Others					1022	790	1812
	Total	102772	19749	17536	5000	2554	748990	896602

Renewable Energy Programme has received wide recognition internationally in the recent years. Many countries have evinced interest in cooperation with India for promotion of new and renewable energy. India has considerable expertise and experience in promoting renewable energy, both grid interactive and off-grid/stand-alone applications for meeting electrical energy needs. India has been interacting with several developed and developing countries and have established bilateral and multilateral cooperation frameworks for cooperation in new and renewable energy sector.

RENEWABLE ENERGY TARGETS

1.12 The Government has up-scaled the target of renewable energy capacity to 175 GW by the year 2022 which includes 100 GW from solar, 60 GW from wind, 10 GW from bio-power and 5 GW from small hydro-power. The target of 100 GW capacity set under the National Solar Mission (NSM) will principally comprise of 40 GW Rooftop and 60 GW through Large and Medium Scale Grid Connected Solar Power Projects. With this target, India will become one of the largest Green Energy producers in the world, surpassing several developed countries. Government of India in its submission to the United Nations Framework Convention on Climate Change on Intended Nationally Determined Contribution (INDC) has stated that India will achieve 40% cumulative Electric power capacity from non-fossil fuel based energy resources by 2030.

1.13 The Secretariat of International Solar Alliance is being hosted by Government of India. The Government has provided land and $30 million (Rs.175 crore) for this secretariat, and also to support it for five years. The participants, mostly in Latin America and Africa including the US, China, and France, would work together to increase solar capacity across emerging markets. The Framework Agreement of the ISA was opened for signature on 15 November, 2016 in Marrakech, Morocco on the side-lines of 22nd Conference of Parties to the UNFCCC. So far 24 countries including India have signed the Framework Agreement. With Cabinet approval on 28 December, 2016, India has become the first country to ratify the ISA treaty.

1.14 A target of 16660 MW grid renewable power (wind 4000 MW, solar 12000 MW, small hydro power 250 MW, bio-power 400 MW and waste to power 10 MW), has been set for 2016-17. Besides, under off-grid renewable system, targets of 15 MW eq. waste to energy, 60 MW eq. biomass non-bagasse cogeneration, 10 MW eq. biomass gasifiers, 1.0 MW eq. small wind/ hybrid systems, 100 MW eq. solar photovoltaic systems, 1.0 MW eq. micro hydel and 100,000 nos. family size biogas plants have been set for 2016-17.

NEW INITIATIVES

1.15 In continuation of the new initiatives launched in the previous year, the Government has taken up the following new projects/schemes during the current financial year:

Green Energy Corridor

- A Rs.38,000 crore Green Energy Corridor is being set up to ensure evacuation of Renewable Energy. Power Grid Corporation of India Limited (PGCIL) has sought a Loan assistance of US$ 1,000 million from the Asian Development Bank (ADB) comprising of Sovereign guaranteed loan of US$ 500 million and Non-Sovereign loan of US$ 500 million.The loan would be utilized for funding of the following transmission projects including a project under Green Energy Corridor projects in next 3-4 years:

100 kW_p grid connected solar rooftop power plant established at District Court Complex, Chandigarh

i. HVDC Bipole link between Western Region (Raigarh, Chhattisgarh) and Southern Region (Pugalur, Tamil Nadu) - North Trichur (Kerala)- Scheme 1: Raigarh-Pugalur 6000 MW HVDC System.

ii. HVDC Bipole link between Western Region (Raigarh, Chhattisgarh) and Southern Region (Pugalur, Tamil Nadu) - North Trichur (Kerala)- Scheme 3: Pugalur- Trichur 2000 MW VSC based HVDC System.

iii. Real Time Measurement/ monitoring scheme.

iv. Inter State Transmission System (ISTS) associated with Green Energy Corridor as under:

a) Ajmer(New) – Bikaner (New) 765 kV D/C

b) Bikaner(New) – Moga (PG) 765 kV D/C

c) LILO of one circuit of 400kV Bhadla- Bikaner (RVPN) line at Bikaner (New)

d) Establishment of 2x1500 MV A, 765/400 kV S/s at Bikaner (New)

Renewable Purchase Obligation

- Pursuant to the revised tariff policy, the Ministry of Power on 22nd July 2016 has notified the long term growth trajectory of RPO for solar and non-solar energy for next 3 years 2016-17, 2017-18 and 2018-19 as given in **Table 1.2**

Table 1.2 Growth Trajacetory of RPOs			
Long term trajectory	**2016-17**	**2017-18**	**2018-19**
Non-solar	8.75%	9.50%	10.25%
Solar	2.75%	4.75%	6.75%
Total	**11.50%**	**14.25%**	17.00%

Net Metering Policy

- The consistent follow-up by the Ministry resulted into the notification by State Electricity Regulatory Commissions (SERCs) of thirty four States on net-metering and feed-in-tariff to encourage rooftop solar plants. Net-metering scheme has been rolled out in all States/ UTs which will help in meeting 40 GW rooftop grid connected solar projects. So far, 20 States namely Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Manipur, Punjab, Puducherry, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand and West Bengal have come out with Solar Policy supporting grid connected rooftop systems.

Wind Power

- Comprehensive Guidelines for Development of On-shore Wind Power Projects in the country have been formulated and issued.
- Guidelines for implementation of "Scheme for Setting up of 1000 MW Inter-State Transmission System (ISTS) - connected Wind Power Projects" issued.
- The Policy for Repowering of the Wind Power Projects has been released on 5th August, 2016 to promote optimum utilization of wind energy resources by creating facilitative framework for repowering.

Solar Rooftops

- All major sectors i.e. Railways, Airports, Hospitals, Educational Institutions, Government Buildings of Central/State/PSUs are being targeted besides, the private sector.
- Ministry has tied up with ISRO for Geo tagging of all the Rooftop plants using ISRO's VEDAS Portal.

Raising of Bonds

- Ministry of Finance approved raising Rs. 4000 crore bonds for renewable energy sector by IREDA during 2016-17.

New Office Building of MNRE

- Foundation Stone of 'Atal Akshay Urja Bhawan', an integrated headquarters building for the Ministry of New and Renewable Energy was laid on 19th October, 2016 by Shri Piyush Goyal, Hon'ble Minister of State (Independent Charge) for Power, Coal, New and Renewable Energy and Mines.

The Minister of State for Power, Coal, New and Renewable Energy and Mines (Independent Charge), Shri Piyush Goyal laying the foundation stone of "Atal Akshay Urja Bhawan", in New Delhi on October 19, 2016. The Secretary, Ministry of Power, Shri P.K. Pujari, the Secretary, Ministry of Mines, Shri Balvinder Kumar and the Secretary, Ministry of New & Renewable Energy, Shri Upendra Tripathy are also seen.

Solar Tariffs Attaining Grid Parity

- Solar tariffs have fallen to an unprecedented low of Rs.4.34 / kWh through reverse auction for one of six projects of 70 MW each to be put up in Rajasthan under the National Solar Mission. This trend is continuing and is moving towards grid parity.

Skill Development

- Surya Mitra Scheme has been launched for creating 50,000 trained solar photovoltaic technicians by March 2020. A total number of 7500 Surya Mitra'swould be trained by 31.03.2017. A network of over 200 Institutions, spread all over the country, have been created for implementing Surya Mitra scheme. In addition, short term training programmes for small hydro, entrepreneurship development, operation & maintenance of solar energy devices and boiler operations in co-generation plants, have been organised.
- Shri Piyush Goyal, Minister of State (IC) for Power, Coal and New & Renewable Energy launched "Surya Mitra" mobile App at National Workshop on Rooftop Solar Power on 07.06.2016. The GPS based mobile app has been developed by National Institute of Solar Energy (NISE). The Surya Mitra Mobile App is currently available in Google play store, which can be downloaded and used across India. This App is a high end technology platform which can handle thousands of calls simultaneously and can efficiently monitor all visits of Suryamitra's. The trained Suryamitra's who opts for entrepreneurship have joined in the Mobile App in several states. These Suryamitras are once again sensitized by NISE on soft skills Customer Relations Management, Punctuality and are now ready to deliver the services.

The Minister of State for Power, Coal, New and Renewable Energy and Mines (Independent Charge), Shri Piyush Goyal and Mr. Richard Verma, US Ambassador in India witnessing the exchange of instrument for the launch of US-India Clean Energy Finance Facility (IFEF) Initiative

International Solar Alliance

- International Solar Alliance was launched as a special platform for mutual cooperation among 121 solar resource rich countries lying fully or partially between Tropic of Cancer and Tropic of Capricorn at COP21 in Paris on 30th November, 2015 to develop and promote solar energy, with its headquarter in India. On 25th January, 2016, the Foundation Stone for the proposed Headquarters of the ISA was laid at Gurgaon, Haryana (India) and its interim Secretariat was inaugurated. The International Steering Committee (ISC) of the ISA has held four meetings so far. The Framework Agreement of ISA has been finalized after discussions with various stakeholders. It was presented in the fourth meeting of the ISC of ISA. The Framework Agreement of ISA has been signed by 20 member countries including India, France, Brazil and others on 15th November, 2016 at Marrakech, Morocco on the side-lines of COP-22.

CURRENT ACHIEVEMENTS

1.16 The main activities/achievements under different programmes of the Ministry during the year 2016-17 are highlighted as under:

Renewable Power Installed Capacity

1.17 The gross installed capacity of grid interactive renewable power in the country stood at about 50 GW as on 31st December 2016 as shown in **Table 1.3.** As of December 2016, solar, wind, biomass and small hydropower contribute about 16 per cent of the total installed capacity for

Table 1.3 Cumulative Deployment of Various Renewable Energy Systems and Devices as on 31st December, 2016)		
Sector	**Achievement during 2016-17 (up to December, 2016)**	**Cumulative Achievements (31.12.2016)**
I. GRID-INTERACTIVE POWER (CAPACITIES IN MW)		
Wind Power	1922.99	28700.44
Solar Power	2249.81	9012.66
Small Hydro Power	59.92	4333.85
BioPower (Biomass & Gasification and Bagasse Cogeneration) #	151.40	7907.34
Waste to Power	7.50	114.08
Total	**4391.62**	**50068.37**
II. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN MWEQ)		
Waste to Energy	4.47	163.35
Biomass(non-bagasse) Cogeneration	0.00	651.91
Biomass Gasifiers		
-Rural	0.00	18.34
-Industrial	4.30	168.54
Aero-Generators/Hybrid systems	0.38	2.97
SPV Systems	98.50	405.54
Water mills/micro hydel	0.10 MW + 100 Water Mills	18.81
Total	**81.99**	**1403.70**
III. OTHER RENEWABLE ENERGY SYSTEMS		
Family Biogas Plants (in Lakhs)	0.35	49.40

 # Progress of Biopower has been revised to installed capacity from exportable power capacity.

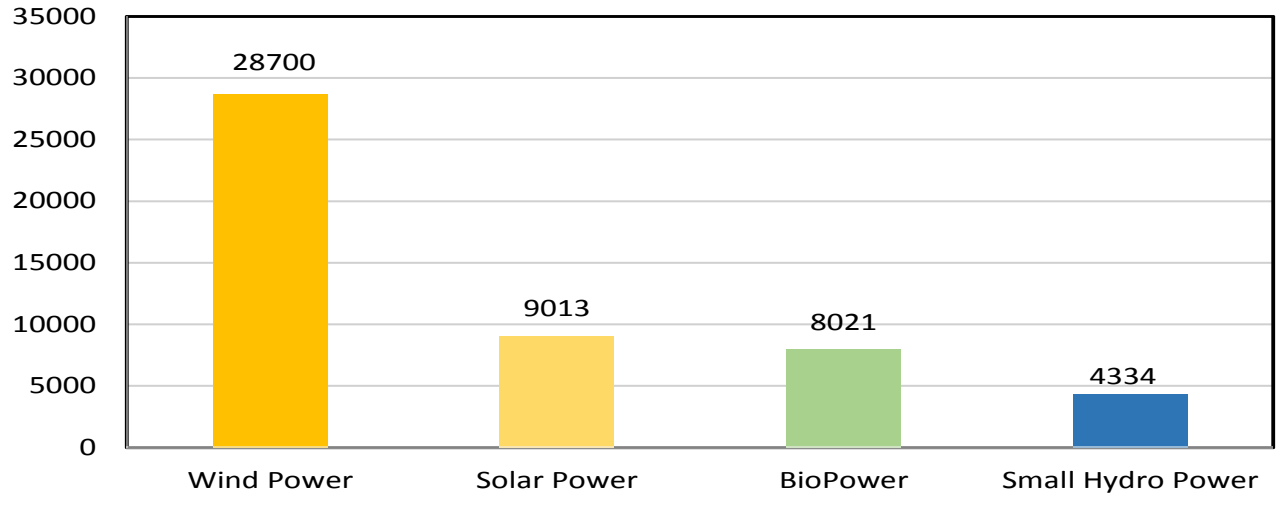
electricity. Renewable energy has been witnessing over 20 per cent growth in the last five years. From the total renewable power installed capacity of 14,400 MW at the beginning of 2009, it has reached a capacity of 50,068 MW at the end of December 2016. Wind energy continues to dominate India's renewable energy industry, accounting for over 57.4% of installed capacity (28,700 MW), followed by solar power (9,013 MW), biopower (8,021 MW) and small hydro power (4,334 MW) as shown in **Graph 1.2.**

1.18 Till 31st December 2016, over 9828 MW capacity projects have been registered under GBI, likely to reach 12000 MW during scheme period i.e. up to March 2017. Funds of Rs.1605 crore have been already disbursed under the scheme.

1.19 India occupies the fourth position in the world with a wind power installed capacity of 28.7 GW. During the year against a target of 2400 MW 1,923 MW wind power projects were commissioned. During the year 2016-17 up to 31st December 2016, 2249.81 MW Solar Power Projects were commissioned.

1.20 The cumulative biomass power projects including through baggasse cogeneration with an power generation capacity of about 7907.34 MW have been successfully commissioned. Off-grid power capacity from biomass gasifier in 8 rice mills and other industries including

Graph 1.2 Sector-wise Installed Capacity of Renewable Energy in India as on 31.12.2016 in MW



** includes Bio Power and waste to power*

flour mill, bakeries for meeting captive demand of electricity and thermal applications have been installed in various states during 2016-17. Small hydro projects with a capacity of 59.92 MW have been commissioned during the year. Capacity addition from solar power projects installations using solar photovoltaics and solar thermal technologies are being commissioned during the year.

National Solar Mission

1.21 26 SPV projects of aggregate 330 MW capacity have been commissioned. Thus, 523 MW solar PV projects and 202.5 MW solar thermal power projects have been commissioned under the bundling scheme. Under the 100 SPV power plants, 78 projects were selected to set up 98 MW capacity projects from 12 States. Against this, 71 projects of total capacity 90.80 MW have been connected to grid.A Payment Security Mechanism involving a revolving fund of Rs.486 crore has been put in place to ensure timely payments to developers in the event of delays/ defaults in payments by the purchasing State Utilities to NVVN.

1.22 Under the 750 MW VGF scheme under Phase II Batch I, large-scale ground-mounted solar PV projects with cumulative capacity of 490 MW have been commissioned and are under commercial operation, thereby bringing the aggregate capacity commissioned and under commercial operation in this scheme to 680 MW across seven states. Under the 2000 MW VGF scheme under Phase II Batch III, Letters of Intent and PPAs have been signed for 2395 MW in five states. Under the 5000 MW VGF scheme under Phase IV Batch II, Letters of Intent and PPAs have been signed for 1020 MW in three states.

1.23 Under the scheme for setting up of 1000 MW of Grid connected Solar PV power projects by CPSUs and Govt. organizations under various Central/State Schemes/Self use/3rd Party sale/Merchant sale with Viability Gap Funding (VGF) under Phase-II of JNNSM, MNRE had allocated 1037.26 MW capacity to 16 CPSUs/Govt. Organizations within the sanctioned funds of Rs.1000 Crore for this scheme.

Shri Piyush Goyal, Minister of State (IC) for Power, Coal and New & Renewable Energy and Mines with the award winners of the CST and Solar Cooker Excellence Awards 2016

1.24 Under the Mission, the Ministry has also set up the following schemes:

- Under the Grid Connected Solar PV Power Projects (3000 MW) by NTPC and other PSUs Tenders for 3000 MW capacity project allotted to Andhra Pradesh (1250 MW- all in solar park), Rajasthan (420 MW in solar park, 230 MW outside solar park), Uttar Pradesh (100 MW outside solar park), Karnataka (600 MW in solar park) and Telangana (400 MW outside solar park) have been issued by NTPC Ltd. Lowest bid for solar power in the country (without any VGF) @ Rs. 4.34/unit has been received for solar PV power plants to be set up at BhadlaSolar Park in Rajasthan under this scheme
- Project for Setting up of 15,000 MW of Grid-Connected Solar PV Power Plants through NTPC Limited / NTPC VidyutVyapar Nigam Limited (NVVN) under National Solar Mission is under implementation.

1.25 Under the Grid-Interactive Rooftop PV, 3044 MWp solar rooftop systems have been sanctioned/ approved of and aggregate 506 MWp have been installed in residential, industrial, commercial and institutional sectors. Solar rooftop projects are being implemented by State Nodal Agencies (SNA's), Solar Energy Corporation of India (SECI), Public Sector Undertakings (PSUs) and other Multi Government Agencies (MGAs), Private Developers etc. During the year, solar systems having total capacities of

A 3 HP Solar Water Pump set-up at Kanpur Dehat, Uttar Pradesh

98.50 MWp which includes solar lanterns, solar home lights, solar street lights, solar pumps and power plants were installed in various States.

25 MW Solar Park at Solar Power Plant, Bhadla Phase-I

1.26 During the financial year, 11 no. of CST systems with 5090 sq. m collector/ reflector area were installed and commissioned and 54 no of CST projects with 24930 sq. m collector/ reflector area are under installation for process heating, air conditioning and steam cooking requirements in industrial, institutional and commercial establishment.

Renewable Energy for Rural Applications

1.27 More than 35,000 biogas plants of the approved models were installed across the country with financial support of the Ministry, taking the cumulative installation to over 49.40 lakh biogas plants in all States and Union Territories of the country. The target of 1.00 lakh during the year is likely to be achieved in full.

1.28 Under the National Biomass Cookstoves Initiative, several pilot projects have been taken up during the year for deployment of improved biomass cookstoves for demonstration among domestic and large sized community cooking in Anganwadis, Mid-day meal schemes in schools, Tribal Hostels etc. Projects taken up under Unnat Chulha Abhiyan are now eligible for Carbon Credits under the CDM mechanism with Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE), an autonomous institute of MNRE, located at Jalandhar, Punjab has been designated as Coordinating and Managing Entity (CME). At present 53 models of improved cookstoves have been approved by the Ministry, as per the Test Reports issued by the Test Centres.

Renewable Energy for Urban, Industrial and Commercial Applications

1.29 During the year 2016-17, the physical achievement under the programme is 12MWeq. and cumulative achievement in the sector is 277.5MWeq. As part of the new initiatives the Government has amended the National Tariff Policy to make Distribution Licencees to 100% procure power produced from WTE plants.

1.30 A cumulative capacity of 651.91 MW has so far been commissioned mainly in the states of Tamil Nadu, Uttar Pradesh, Haryana, Karnataka, Andhra Pradesh, Uttarakhand, Punjab and Rajasthan.

1.31 CEA have notified norms for determination of Generic Tariff for MSW, RDF and Biogas based WTE projects along with Generic Tariff for FY 2015-16. As a part of the new initiative for supporting Bio-CNG production, 3 projects of cumulative production of 10,767 kg/day of Bio-CNG, were commissioned during the financial year 2016-17, in Punjab, Rajasthan and Maharashtra.

1.32 Under Development of Solar Cities Programme the Ministry assists Municipal Corporations and Urban Local Bodies in preparation of a Master Plan for increasing energy efficiency and renewable energy supply in the city. Sanction has been accorded during the year for developing three cities as Solar City. Under the programme 60 cities have been sanctioned of which master plan of 49 cities has been finalized.

Research and Development

1.33 The Research and Development efforts of the Ministry are directed towards technology development and demonstration, leading to commercialization, apart from strengthening the capacity of R&D/ Academic Institutions and Industry for taking up advanced research for technology development. The ultimate goal is to reduce the cost and improve efficiency in the near future. The prominent projects taken up include advanced research and demonstration of higher efficiency solar cells, solar thermal power generation, hydrogen energy storage and fuel cells development, development and deployment of improved biomass cook stoves, etc. Research & development activities have been taken up with national laboratories, universities, scientific & educational institutions & industry for improvements in the renewable energy systems and products. The focus is on improved efficiency, cost reduction and technology transfer and demonstration for their commercialization. A National Laboratory Policy for Renewable Energy Sector is under finalization.

1.34 MNRE is also partner to IMPacting Research Innovation and Technology (IMPRINT), a flagship national initiative of the Government, under which MNRE has agreed to support five projects in the area of biofuel, hydrogen and fuel cells, storage for SPV and Solar Thermal Systems with specific deliverables. The MNRE share of Rs.3.69 crore for these projects will be provided under the RD&D Programme.

1.35 The Technical Regulation for SPV Systems/Components under BIS Act for quality control has been approved and is under consideration of Ministry of Law for vetting.

1.36 Continued emphasis was laid on research and development in various areas of solar energy technologies and application. The focus was on indigenization of technology, product development and resource assessment. At present, 24 number of R&D projects are under implementation in area of solar photovoltaic (SPV) and solar thermal (ST).

Technical and Financial Institutions

1.37 National Institute of Solar Energy (NISE) continued :

(i) Up-gradation of SPV module test facility; (ii) Up-gradation of solar cell test facility; (iii) Expand of battery test facility; (iv) Enlarge SPV water pumping test facility and other labs; (v) Up-gradation of Solar Thermal Labs; (vi) Establishment of IT cell; (vii) Renovation of work shop facility; (viii) Establishment of R&D monitoring cell; (ix) Setting up of 500 kW SPV power plant and (x) Housing of the Secretariat of the International Solar Alliance. NISE also supported capacity building activities under National Solar Mission.

1.38 NISE has also taken up in a big way Skill Development Activities by conducting a number of Training programmes for trainers and other professionals. It has conducted 55 skill development

programmes during the year. Another training programme is the Suryamitra Programme apart from the international training programmes is being conducted regularly.

1.39 The National Institute for Wind Energy (erstwhile Centre for Wind Energy Technology) serves as the technical focal point for wind power development in India. During the year, one new wind monitoring station was commissioned in Tamil Nadu. To understand wind shear profile and collect long term wind profile for assisting wind power forecasting five numbers of 120m tall guyed wind monitoring stations have been installed at Lamba (Gujarat), Akal (Rajasthan), Jagmin (Maharashtra), Jogimatti (Karnataka) and Kayathar (Tamil Nadu).

1.40 The certification unit of NIWE has completed two type certification projects. The unit has also issued letters in connection with grid synchronization for three prototype wind turbine models. During the year, two RLMM lists have been issued. Six new wind turbine models including one new Indian wind turbine manufacturer have been included in the said lists.

1.41 Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE), at Wadala Kalan, District Kapurthala (Punjab) is an autonomous Institution of the Ministry focused on biomass energy research and development. The testing and certification centre for Cookstoves has begun its operation with testing of available cookstove models as per new BIS norms. One natural draft cook stove model has been designed and developed at the Institute with different possible modifications using locally available materials and is in the process for approval. In addition, research projects on: Process development for bioethanol production from agricultural residues and Biogas production and utilization of heat and power generation applications using potential alternative feedstocks continued.

1.42 The Indian Renewable Energy Development Agency Ltd. (IREDA), a non-banking financial institution under the Ministry sanctioned loans to the tune of Rs.7027.19 crore and disbursed Rs.4850.24 crore against the annual target of Rs.10,000 crore and Rs.6,100 crore respectively. The loans were sanctioned for the establishment of about 1751.30 MW of installed capacity of power generation. The cumulative sanctions and disbursements as on 31st December 2016 were of the order of Rs.45,660.08 crore and Rs.26,046.96 crore respectively. As on date, paid up capital of IREDA is Rs.784.60 Crore against the authorized share capital of Rs.6000 crore. IREDA raised resources to the tune of Rs.991.72 crore from 1st April, 2016 to 31st December, 2016 from various external sources i.e. Kreditanstalt fur Wiederaufbau (KfW), Japan Cooperation Agency (JICA),Agence Francaise De Developement (AFD), Asian Development Bank (ADB) and European Investment Bank (EIB).

1.43 IREDA has spent Rs.6.25 crore during the FY 2015-16 on CSR activities which works to 1.94% of average net profit of last 3 years. During the year 2016-17, 12 activities/projects were undertaken by IREDA as part of its CSR activities with a projected expenditure of Rs.587.94 lakh

1.44 Solar Energy Corporation of India, was set up as a Section 25 of Companies Act, 1956, as a not for profit Company, under the administrative control of the Ministry to assist the Ministry functioned as the implementing and executing arm of the NSM for development, promotion and commercialization of solar energy technologies in the country. SECI has been set up with an Authorized Share Capital of Rs.2,000 crore and Rs.304 crore has been released by the Govt. of India as a budgetary support up to 31st December 2016. Under the 750 MW VGF scheme under NSM Phase II Batch I, 680 MW capacity has been commissioned across the country. Under the Solar Parks Scheme, 34 solar parks have been given administrative approval by MNRE. Under the Grid Connected Solar Rooftop Programme, an aggregate capacity of 62.25 MWp capacity has been allocated out of which 60 MWp capacity is completed. Under this scheme for rooftop

solar projects SECI has released one of the world's largest tenders of 500 MW capacity,LoAs for 432.7 MWp have been issued to successful bidders.

1.45 In addition, SECI continued with development and sale of low cost solar lanterns, development of mini/micro grid projects for rural electrification, installation of solar street lights under CSR activity.

Information and Public Awareness

1.46 The Ministry continued its programme of Information and Public Awareness through a multi-agency approach namely, State Nodal Agencies, Directorate of Advertising & Visual Publicity, Doordarshan, All India Radio, National Films Development Corporation etc., using the electronic, print and outdoor media. Two Booklets on 'SPV Off-grid Programme' and 'Working Paper on International Solar Alliance' were printed as well as one Folder on 'Solar Rooftop Systems' designed and printed for creating awareness and publicity. A booklet of MNRE Model MoU, PPA (RESCO Project) is under process for designing & printing.

1.47 Production and broadcasting of Radio Sponsored Programme (RSP) titled "AkshayUrja Aur Hum"of this Ministry, having a duration of 15 minutes, on various technologies, systems and devices of renewable energy is being broadcast on every Tuesday and Friday, through National Film Development Corporation in Hindi and 19 regional languages (Assamese, Bengali, Gujarati, Konkani, Kannada, Kashmiri, Khasi, Malayalam, Manipuri, Tamil, Marathi, Mizo, Nagamese, Nepali, Oriya, Punjabi, Telugu, Urdu and Garo) from 94 Radio Stations (37 Vivid Bharati, 20 FM Rainbow, 4 FM Gold and 33 Primary Channels/Local Stations) of All India Radio is under progress.

1.48 The Ministry is implementing a comprehensive Human Resources Development Programme with components such as support to undertake short-term training programmes on various aspects of renewable energy with focus to skill development including Surya Mitra Programme; fellowships/stipend under National Renewable Energy Fellowship scheme: for M.Sc./M.Tech. students and Research Scholars (under PhD & PDF) and National Solar Science Fellowship Scheme: for eminent scientists working in research institutes with an innovative idea in Renewable sector; Institution of Renewable Energy Chairs by providing endowment fund to Universities/Institutions; Support to higher educational institutions and IREP Training Centers for lab and library upgradation; Participation/support to Power Sector Skill Council, and Electronics Sector Skill Council and Skill Council for Green Jobs; Development of course/ study material; Support to CIIE Initiatives, IIM Ahmedabad for supporting innovation, incubation and entrepreneurship development; and Support to State Nodal Agencies and DISCOMs.

International Cooperation

1.49 During the year 2016-17, the Ministry of New and Renewable Energy took various initiatives for promoting cooperation with other countries in the field of renewable energy. Memoranda of Understanding (MoUs) / Agreements / Letter of Intent (LoI) etc were signed and Bilateral / Multilateral Meetings / Joint Working Group Meetings were convened and participated by MNRE. The Ministry also gets support from various international / multinational funding agencies, like World Bank, United Nations Development Programme (UNDP), Asian Development Bank (ADB), and United Nations Industrial Development Organization (UNIDO) and Global Environment Facility (GEF), who are providing project based assistance for

renewable energy programmes in India. Currently there are 47 Memoranda of Understanding with 36 countries, including new MoUs with France, Mongolia, USA, Mozambique, Belgium, Germany and Indonesia.

Renewable Energy in North Eastern States

1.50 As per the directions of the Government of India, 10% of the annual budget of the Ministry is allocated for the promotion of renewable energy programmes & projects in the North-Eastern States of India including Sikkim. Special emphasis was accorded to the implementation of programmes such as solar photovoltaic power, biogas, small hydro power, village energy security test projects & biomass gasifiers for meeting the lighting, cooking and other electrical needs of the far and remote villages and hamlets in the North-Eastern States including Sikkim.

1.51 During the year 5753 biogas plants have been installed and 3 solar parks (69 MW in Assam, 20 MW in Meghalaya and 60 MW in Nagaland) have been sanctioned. Small wind energy hybrid systems of 383 kW capacity and solar power projects of 11.73 MW were installed in NE States including Sikkim.

Greening of Islands

1.52 The Ministry has formulated a scheme for setting up of 40 MW Distributed Grid-Connected Solar PV Power Projects in Andaman & Nicobar and Lakshadweep Islands with Capital Subsidy from MNRE with the objective to develop Carbon Free Islands by phasing out use of diesel for generation of electricity and to contribute to the National Action Plan on Climate Change. The initiative will also help in reduction in cost of electricity generation in different Islands in Andaman & Nicobar (about 40 MW at 4 -5 locations in Port Blair, 2-3 MW each at Havelock and Neil) including 5 MW floating solar in different Islands of Lakshadweep. The implementation of the scheme has been entrusted to four PSUs namely NTPC, SECI, Neyveli Lignite Corporation Ltd. and Rajasthan Electronics & Instruments Ltd (REIL).

2: INTRODUCTION

A view of proposed new building Atal Akshay Urja Bhawan of MNRE

INTRODUCTION

2.1 In 1982, a separate Department of Non- Conventional Energy Sources (DNES) was created in the Ministry of Energy to look after all the aspects relating to new and renewable energy. The Department was upgraded into a separate Ministry of Non-Conventional Energy Sources (MNES) in 1992 and was re-christened as Ministry of New and Renewable Energy (MNRE), in October 2006.

ALLOCATION OF BUSINESS RULES

2.2 Under the Allocation of Business Rules, the MNRE has been assigned the following specific items:

1. Research and development of bio-gas and programmes relating to bio-gas units.
2. Commission for Additional Sources of Energy (CASE).
3. Solar Energy - including photovoltaic devices and their development, production and applications.
4. All matters relating to small/mini/micro hydel projects of and below 25 MW capacity.
5. Programmes relating to improved chulhas and research and development thereof.
6. Indian Renewable Energy Development Agency.
7. Research and development of other non-conventional/renewable sources of energy and programmes relating thereto.
8. Tidal Energy.
9. Integrated Rural Energy Programme (IREP).
10. Geothermal Energy.
11. (i) national Policy on Bio-fuels;
    (ii) research, development and demonstration on transport, stationary and other applications of bio-fuels;
    (iii) setting up of a National Bio-fuel Development Board and strengthening the existing institutional mechanism; and
    (iv) overall coordination concerning bio-fuel

Structure of the Ministry

2.3 Shri Rajeev Kapoor is the Secretary in Ministry of New and Renewable Energy with effect from 13th December, 2016. The Ministry has one Financial Adviser, two Joint Secretaries, three Economic Advisers and 12 Advisers (Scientist-G). Various programmes are being implemented by the Ministry through State Nodal Agencies (SNAs) and channel partners.

Institutions under the Ministry

2.4 The Solar Energy Centre (SEC), which was functioning as an attached Office of the Ministry, has since been converted into an autonomous institution with the name "National Institute of Solar Energy" (NISE) from 24.09.2013. Located at Gwalpahari in Gurgaon, Haryana, the Institute has been working on various aspects of Research and Development in solar energy and technology development in collaboration with other research institutions, implementing agencies and industry. National Institute of Wind Energy (NIWE), an autonomous institute under the Ministry, is functioning from Chennai, Tamil Nadu. This serves as the technical focal point for wind power development. The Sardar Swaran Singh National Institute of Bio

Energy (SSS-NIBE) has been established at Kapurthala near Jalandhar in Punjab. The Indian Renewable Energy Development Agency Ltd. (IREDA), a Public Sector Undertaking under the Ministry with the objective of financing and developing renewable energy projects, is located in New Delhi. Solar Energy Corporation of India (SECI), New Delhi is a Section 25 Company, not for profit, under the administrative control of the Ministry of New & Renewable Energy. Government of India conveyed its approval for conversion of existing Section 8 Company of the Companies Act, 2013 (erstwhile Section 25 of the Companies Act, 1956) into Section 3 company during the Financial Year 2014-15 so as to enable it to become a self-sustaining and self-generating organization; to work as a commercial organization; and to take a development of all segments of Renewable Energy viz. geo-thermal, off-shore wind, tidal, apart from solar energy.

GRIEVANCE REDRESSAL MECHANISM

2.5 Grievance petitions are received in the Ministry through President's Secretariat, Prime Minister's Office, Department of Administrative Reforms and Public Grievances (DARPG), Vice President's Secretariat, other Ministries/ Departments and from the individuals concerned on MNRE's Window of CPGRAMS portal of DARPG. With a view to deliver expeditious redressal of grievances in a responsible and effective manner, the following measures have been put in place in the MNRE:

i. Sh. B. L Ram, Scientist 'G' has been designated as Liaison Officer for implementation of scheme of reservation for persons of Schedule Caste (SC) and persons with disability. Shri G.L. Meena, Scientist 'G' has been designated as Liaison Officer for implementation of Scheme of reservation of persons of Scheduled Tribe (ST) category.

ii. A Committee has been constituted to enquire into the complaints of sexual harassment, if any, of the women working in this Ministry.

iii. Grievances/petitions/complaints received are forwarded by Public Grievance Cell, MNRE to the Division Head concerned for redressal/ taking necessary action and final disposal, with the request to send a final reply to the petitioner, as per time schedule provided. These petitions are monitored on regular basis to keep track of their disposal by reminders etc. The position regarding final disposal of petitions is also intimated to the authority from which the grievance was received, by post or through CPGRAMS and the individuals concerned.

iv. Time Frame for Redressal of the Grievance/ petition:

Sl. No	Subject	Time Frame
1	Issue of acknowledgement to the petitioner	03 days
2	Forwarding of the grievances / petition to the concerned authority	07 days
3	Issue of interim reply to the petitioner or to send communication seeking additional information from petitioner.	15 days
4	Final disposal of petition/grievance and time limit for informing the position of the outcome.	60 days

Citizens' / Clients' Charter of MNRE

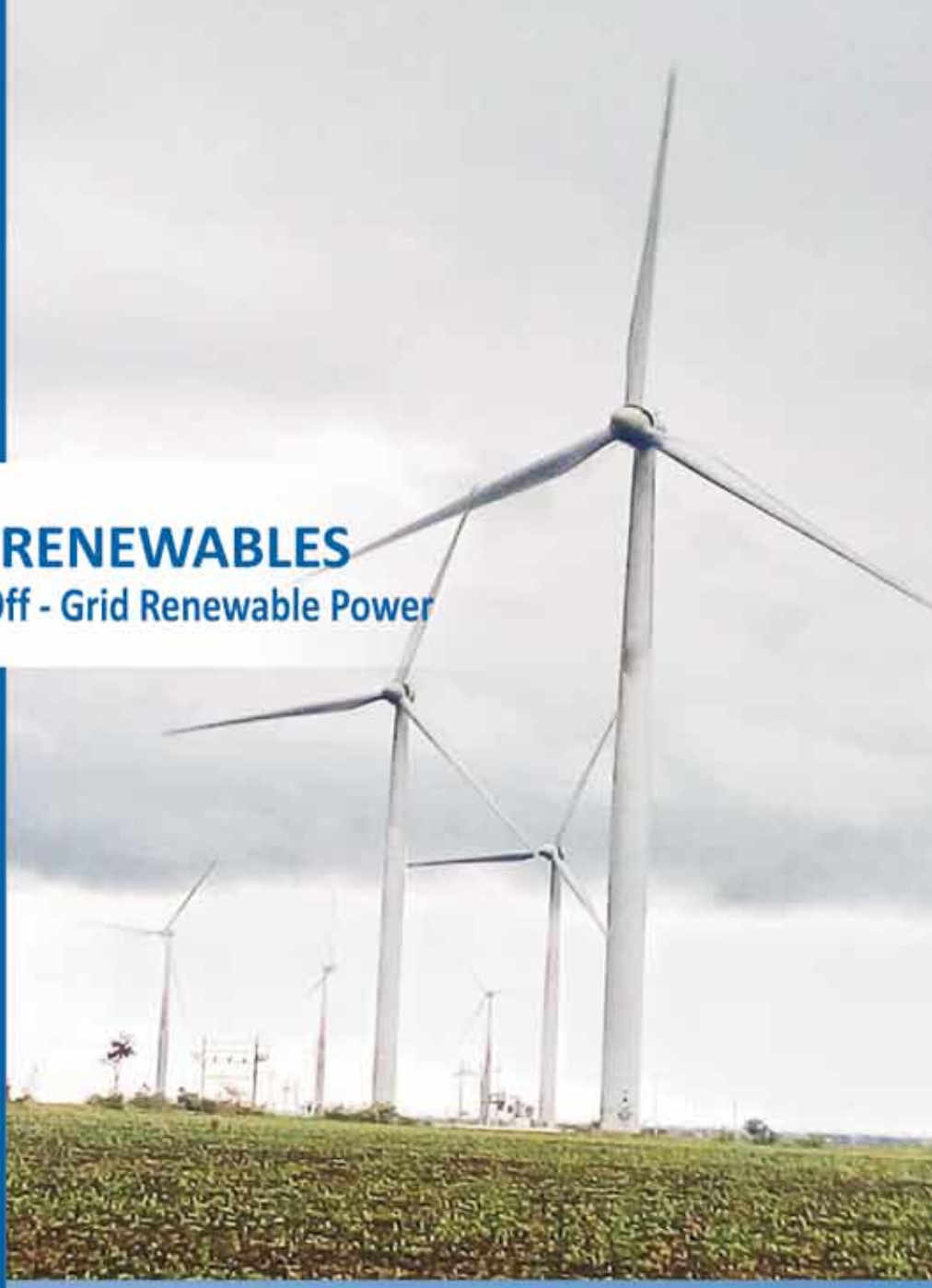
2.6 In order to ensure timely delivery of services to its Clients/ Citizens and redressal of their grievances in a time-bound manner the Ministry has brought out a Citizens'/Clients' Charter (CCC), incorporating its mission, main Services/ Transactions and commitment to its clients and the people of India in general, is available on MNRE's website. The Charter contains the following elements: (i) Vision and Mission Statement; (ii) Details of business transacted by the Ministry; (iii) Details of clients; (iv) Details of services provided to each client group; (v) Details of grievance redress mechanism and how to access it; and (vi) Expectations from the clients.

2.7 It aims at addressing problems of interface between the Ministry and its clients'/ citizens' and also continuously improving the quality of public services for the people at large to make them responsive to their needs and wishes. It also aims at providing a mechanism for redressal of clients'/citizens' grievances.

Click here to go to contents

3: POWER FROM RENEWABLES

- Grid Interactive and Off - Grid Renewable Power



POWER FROM RENEWABLES – GRID INTERACTIVE AND OFF-GRID RENEWABLE POWER

3.1 The focus of this Ministry has been to promote the development and deployment of various technologies for increasing the capacity of grid interactive and off-grid renewable power. Towards this end, the government has been offering a number of fiscal and financial incentives to investors to increase the penetration of renewable power in the energy and electricity mix of the country. India's renewable energy installed capacity has grown from 3.9 GW in 2003-14 to about 50 GW in December 2016. Wind energy has been the predominant contributor to this growth. It accounts for 28.70 GW or 57.4 per cent of the installed capacity followed by Solar power 9.01 GW, small hydro power 4.33 GW and biomass power 7.85 GW.

GRID INTERACTIVE RENEWABLE POWER

WIND ENERGY PROGRAMME

3.2 Wind energy has emerged as most successful renewable energy option in India and is the fastest growing renewable energy technology for generating grid connected power amongst various renewable energy options. The Ministry's wind power programme covers wind resources assessment, facilitation of implementation of demonstration and private sector projects through various fiscal and promotional policies. A total capacity of 28700.44 MW has been established up to December, 2016 in the country. India is the fourth largest wind power producer in the world, after China, USA and Germany.

Wind Resource Assessment and Potential

3.3 The Wind Resource Assessment (WRA) Programme is an ongoing activity and is being coordinated by the National Institute of Wind Energy (NIWE), Chennai in association with State Nodal Agencies. WRA has so far been covered in 29 states and 3 Union Territories involving establishment of about 809 dedicated wind monitoring stations. Out of the total stations established so far, 252 stations have shown potential for commercial wind power installations and 30 stations are presently in operation as on 31.12.2016.

3.4 Ministry has sanctioned another project entitled "Offshore wind resource assessment at Dhanuskodi, Rameshwaram, Ramanathapuram District in Tamil Nadu" to NIWE, Chennai with an objective to examine the feasibility for setting up of offshore wind farm project. The project has two parts i.e. Wind measurements at Dhanushkodi with 100 m anemometry and to collect satellite radar wind data from ERS satellite above the sea surface between Kanyakumari and Rameshwaram in Tamil Nadu covering about 400 sq.km and converts it to 10 m height wind speed data to assess offshore wind farm development. A 100 m level wind monitoring station has also been installed and commissioned at Dhanuskodi during 2013-14 and data is currently being collected remotely through a modem.

3.5 As per the Indian Wind Atlas, the on-shore wind power potential has been estimated as 49,130 MW at 50 m height. On a conservative consideration, a fraction of 2% land availability for all states except Himalayan states, Northeastern states and Andaman & Nicobar Islands has been assumed for potential estimation. In Himalayan states, North-Eastern states and

Table – 3.1: Wind Power Potential in India			
		Indicative Installable Potential (MW)	
S.No	**States / UTs**	**@50m**	**@ 80 m**
1	Andaman & Nicobar	2	365
2	Andhra Pradesh	5394	14497
3	Arunachal Pradesh*	201	236
4	Assam*	53	112
5	Bihar	-	144
6	Chhattisgarh*	23	314
7	Daman & Diu	-	4
8	Gujarat	10609	35071
9	Haryana	-	93
10	Himachal Pradesh *	20	64
11	Jharkhand	-	91
12	Jammu & Kashmir *	5311	5685
13	Karnataka	8591	13593
14	Kerala	790	837
15	Lakshadweep	16	16
16	Madhya Pradesh	920	2931
17	Maharashtra	5439	5961
18	Manipur*	7	56
19	Meghalaya *	44	82
20	Nagaland *	3	16
21	Odisha	910	1384
22	Puducherry	-	120
23	Rajasthan	5005	5050
24	Sikkim *	98	98
25	Tamil Nadu	5374	14152
26	Uttarakhand *	161	534
27	Uttar Pradesh *	137	1260
28	West Bengal*	22	22
	Total	**49130**	**102788**

** Wind Potential has yet to be validated with measurements*

Andaman & Nicobar Islands, it is assumed as 0.5%. However, the potential would change as per the actual land availability in each state. The wind potential has also been extrapolated at 80 m height and has been found to be 1,02,788 MW. However, this needs to be validated with field measurements. State-wise installable potential is given at **Table-3.1.**

3.6 Recently, NIWE had chosen advanced modelling techniques and revisited the earlier studies as per the guidance and directives of MNRE, Govt. of India, with realistic and practical assumptions and estimated the wind power potential at 100m height as 302 GW.

119.7 MW wind farm in Ellutla, Andhra Pradesh

The present potential assessment has been carried out at a very high (10 times finer than 5km) spatial resolution of 500m, using the advanced meso-micro coupled numerical wind flow model, and with the corroboration of almost 1300 actual measurements spread all over India, which can be stated as first of its kind. The State-wise installable potential is given at **Table-3.2**.

Table – 3.2: Wind Power Potential in India @ 100m above ground level

State	Rank I	Rank II	Rank III	Total
Andaman & Nicobar	4	3	1	8
Andhra Pradesh	22525	20538	1165	44229
Chhattisgarh	3	57	16	77
Goa	0	0	1	1
Gujarat	52288	32038	106	84431
Karnataka	15202	39803	852	55857
Kerala	333	1103	264	1700
Lakshadweep	3	3	1	8
Madhya Pradesh	2216	8259	9	10484
Maharashtra	31155	13747	492	45394
Odisha	1666	1267	160	3093
Puducherry	69	79	4	153
Rajasthan	15415	3343	13	18770
Tamil Nadu	11251	22153	395	33800
Telangana	887	3348	9	4244
West Bengal	0	2	0	2
Total in MW	**153020**	**145743**	**3489**	**302251**
Total in GW	**153**	**146**	**3**	**302**

Figure 3.1 : Wind Power Potential at 100m above ground level

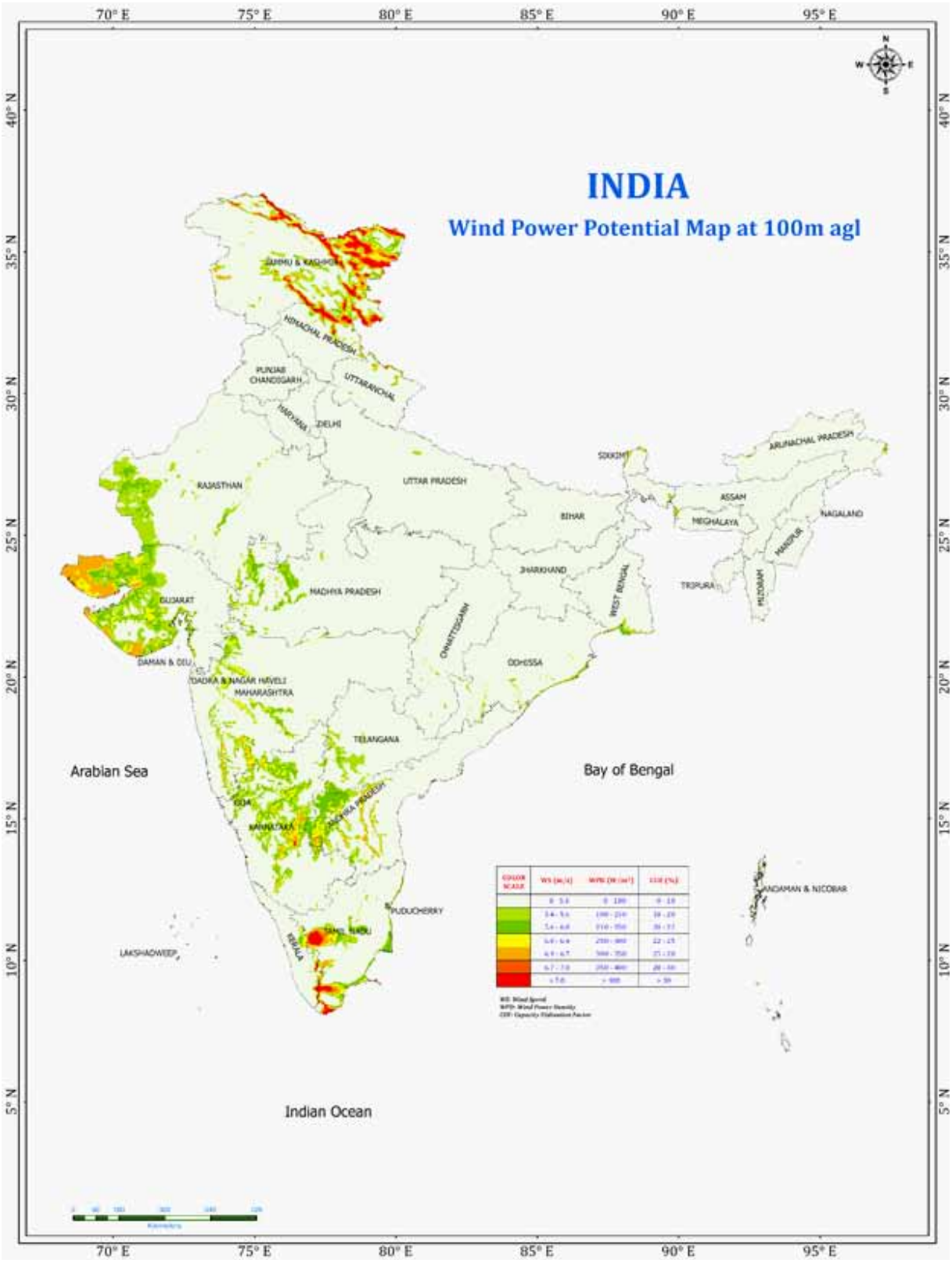
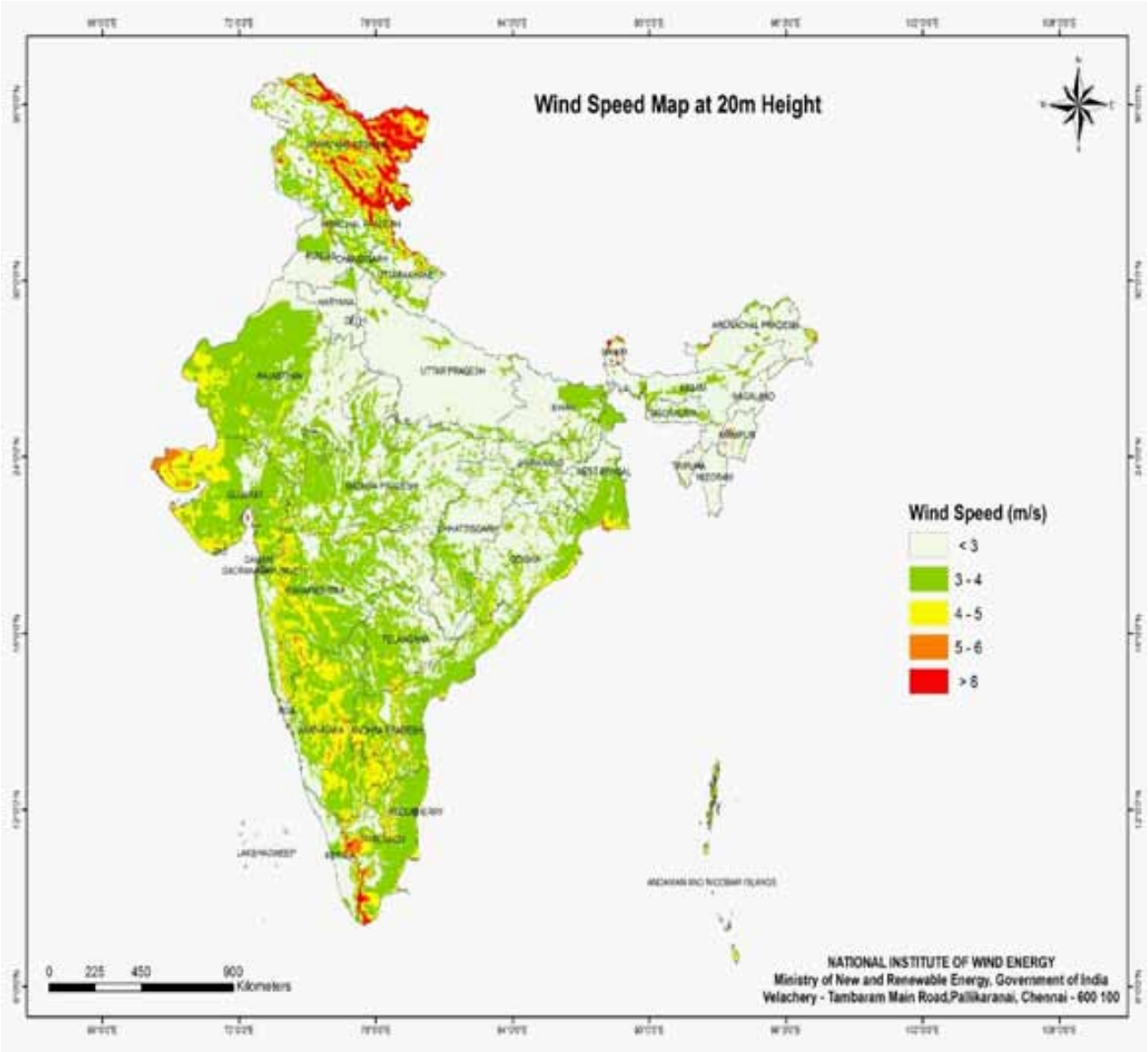


Figure 3.2: Wind Speed Map of India at 20 m above ground level



3.7 In order to facilitate the Small Wind Energy and Hybrid System (SWES) sector in identifying potential locations/ areas for the development of SWES projects, NIWE prepared GIS based wind speed map of India based on meso-micro coupled modelling methodology. After successful preparation of Wind Speed Map of the country at 20 m level, NIWE had publicized the Wind Speed Map of India at 20 meter above ground level on online Geographic Information System (GIS) platform on 1st July, 2016.

Research & Development (Wind Energy)

3.8 The Ministry is supporting R & D proposals from R & D institutions, Academic institutions & companies in the thrust areas of small wind energy & hybrid systems through a separate budget head from 2014-15. Currently there are 13 ongoing R & D projects through this programme.

90.3 MW hybrid tower wind farm in Madhya Pradesh

3.9 The Ministry had invited Call for R&D proposals of Small Wind Energy Hybrid Systems from Research entities i.e. CSIR laboratories in public as well as private sector, academic/ research institutions in identified thrust areas during 2016-17. An R&D evaluation committee was constituted under the chairmanship of Director General, NIWE to scrutinize and evaluate the 55 R&D proposals received by the Ministry. Subsequently, 9 R&D project proposals were recommended during 2016-17 by R&D Sectoral Project Appraisal Committee (RDSPAC) of the Ministry for consideration of financial support.

Development of Offshore Wind Energy

3.10 With a focus to exploit the vast coastline of 7,600 km for development of offshore wind energy in the Indian Exclusive Economic Zone (EEZ), GoI has notified National Offshore wind energy policy in October 2015.

3.11 Initial studies indicate offshore wind energy potential in the coasts of Gujarat and Tamil Nadu, which requires validation by actual measurements. Actions have been initiated to carry out the Geophysical, Geotechnical, Oceanographic & offshore wind resource data collection. In principle clearance from MoD has also been obtained. Fabrication work of the support platform for installation & commission of LiDAR off the coast of Gujarat has been completed. The LiDAR is expected to be commissioned by January 2017 & data acquisition will be started.

Deployment

3.12 Against the target of 4000 MW for the year 2016-17, a wind power capacity of 1923.00 MW has been added up to December, 2016. With this the cumulative wind power installed capacity in the country has reached to 28700.44, which is mainly located in 7-8 wind resource rich states. The State-wise installed capacity as on 31.12.2016 is given at **Table-3.3.**

Technology Development and Manufacturing Base

3.13 Wind turbines are being manufactured by 21 manufacturers in the country with 55 models up to a capacity of 3.00 MW single turbine, mainly through joint ventures or under licensed production agreements. A few foreign companies have also set up their subsidiaries in India, while some companies are now manufacturing wind turbines without any foreign

Table 3.3 State-wise Wind Power Installed Capacity (MW) (upto 31.12.2016)		
S. No.	**State**	**Wind Power Installed Capacity(MW)**
1.	Andhra Pradesh	2092.50
2.	Gujarat	4441.57
3.	Karnataka	3154.20
4.	Kerala	43.50
5.	Madhya Pradesh	2288.60
6.	Maharashtra	4666.03
7.	Rajasthan	4216.72
8.	Tamil Nadu	7694.33
9.	Telangana	98.70
10.	Others	4.30
	Total	**28700.44**

collaboration. The current annual production capacity of domestic wind turbine industry is around 10,000 MW. The indigenization of wind turbine manufacturing has reached up-to 70% and cost of Indian wind turbines among lowest in the world. The technology is continuously upgraded, keeping in view global developments in this area.

Promotional Policies

3.14 A package of incentives which includes fiscal concessions such as, concession in custom duty for specific critical components, excise duty exemption, special additional duty exemption, income tax exemption for 10 years on profits for power generation, etc. is being

50.4 MW hybrid tower wind farm in Rajasthan

Table 3.4 showing wind tariff in different windy states	
State	**Tariff per kWh (Rs.)**
Andhra Pradesh	4.84
Gujarat	4.19
Karnataka	4.50
Madhya Pradesh	4.78
Maharashtra	3.82-5.56
Rajasthan	5.76 & 6.04
Tamil Nadu	4.16

provided for promotion of wind power in the country. The Accelerated Depreciation was restored in July 2014 and the GBI scheme continued for the 12th Plan period with increased ceiling of Rs.1.00 crore/MW. Till December 2016 around 10,000 MW capacity projects have been registered under GBI, and it is likely to reach 12000 MW during scheme period i.e. up to March 2017. An amount of Rs.1605 crore has been already disbursed under the Scheme.

Tariff in states

3.15 Wind potential States are providing promotional tariff for wind power projects in their respective States. Details are given at **Table 3.4**:

3.16 The State Electricity Regulatory Commissions (SERCs) in Andhra Pradesh, Haryana, Punjab, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Gujarat, Kerala, Odisha and West Bengal have announced preferential tariff for purchase of power from wind power projects. State-wise policy for wind power projects in major windy States is given in **Table-3.5**. Many States have also announced renewable energy purchase obligations, which catalyze the growth in the wind power generation.

Policy initiatives

a. Amended Tariff Policy

3.17 The Amended Tariff Policy notified on 28 January 2016 provides for notification of long-term Renewable Purchase Obligations (RPO) trajectory by Ministry of Power (MoP). The MoP has issued RPO trajectory up to 2019 notifying uniform RPO across the country as under:

Year	Solar	Non-Solar	Total
2016-17	2.75%	8.75%	11.50%
2017-18	4.75%	9.50%	14.25%
2018-19	6.75%	10.25%	17.00%

3.18 Wind power potential is concentrated in 7-8 windy states and to facilitate the interstate transmission of wind power suitable provisions have been made in the Tariff Policy, waiving

92 MW Lahori Project in Madhya Pradesh

the interstate transmission charges and losses for interstate sale of wind and solar power. MoP has already issued order in this regard.

b. Repowering Policy

3.19 The Ministry in August 2016 released Policy for Repowering of Wind Power Projects with the objective of promoting optimum utilization of wind energy resources by creating facilitative framework for repowering.

3.20 Higher wind capacities and power generation is now possible from wind potential sites occupied by old, de-rated and small capacity wind turbines by using more efficient new technology wind turbines of much higher capacities.

3.21 Under this policy initially old projects which have installed wind turbine generators of capacity 1 MW and below would be eligible for repowering. Indian Renewable Energy Development Agency will provide an additional interest rate rebate of 0.25% for repowering projects apart from all fiscal and financial benefits available to the new wind projects.

3.22 The State governments will support repowering by augmenting transmission infrastructure, facilitating acquiring additional footprint required for higher capacity turbines, purchase of additional wind power at prevailing rate and relaxing micro-siting criteria. The project developers will also be exempted from any penalties on non-production of electricity during the repowering period.

c. Draft Wind-Solar Hybrid Policy

3.23 Wind and Solar Power being infirm in nature impose certain challenges on grid security and stability. Studies have revealed that wind and solar are almost complementary to each other and hybridizing of two technologies would help in minimizing the variability apart from optimally utilizing the infrastructure, including land and transmission system.

3.24 Accordingly with the objective to provide a framework for promotion of large grid connected wind-solar PV system for optimal and efficient utilization of transmission infrastructure and land, reducing the variability in renewable power generation and thus achieving better grid stability Ministry issued draft wind-Solar Hybrid Policy.

3.25 The goal of the policy is to reach wind-solar hybrid capacity of 10 GW by 2022 and it policy aims to encourage new technologies, methods and way-outs involving combined operation of wind and solar PV plants. The Policy is under process of approval.

Table 3.5 State-Wise Policy Introduced by The State Governments /SERC's Regulations for Wind Power Projects

	Andhra Pradesh*	Karnataka*	Madhya Pradesh*	Maharashtra*	Rajasthan*	Tamil Nadu*	Gujarat*
Wheeling and Transmission	Zero	5 % of energy	Allowed 2% of energy + transmission charges as per ERC	Normal Open Access Charges	Normal Open Access Charges	40% of normal charges, losses as per actuals	Normal OA Transmission Charges and transmission losses for > 66 kV Normal OA Transmission Charges and 10.0% as transmission and wheeling losses for < 66 kV
Banking	Allowed @ 2% of energy input (Drawal of banked unit restricted from January to June)	Allowed @ 2% of energy input	Allowed	Yearly	Monthly settlement	Allowed @ determined annually	Monthly settlement
Buy-back (Rs./ Unit)	4.84	4.50	4.78	#	Rs.5.76 /unit for Jaisalmer, Barmer and Jodhpur etc. and Rs. 6.04 / unit for other district	4.16	4.19
Open Access transaction	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
RPO	4.75% (non-solar) 0.25% (Solar)	Utilities- 7.5% to 11%, Captive & Open Access -5% (Non-Solar) + 0.25% (solar)	2016-17 - 6.50% (Non-Solar) + 1.25% (Solar)	2016-17- 10.00% (Non-solar) +1.00% Solar	2016-17 – 11.40%^	9.00% (Non Solar) + 2.5% (Solar)	2016-17 – 10.00%$

*Policy announced by State Electricity Regulatory Commission in the respective State.
The Tariff is as follows

Particular	Net Levellised Tariff (FY 2016-17)
Wind Zone – 1	**5.56**
Wind Zone – 2	**4.89**
Wind Zone – 3	**4.08**
Wind Zone – 4	**3.82**

$ - Bifurcation of RPO				
Financial Year	Obligation expressed as % of energy consumption			
	Total	Wind	Solar	Other
2016-17	10.00	7.75	1.75%	0.50%

$ - Bifurcation of RPO				
Financial Year	Obligation expressed as % of energy consumption			
	Total	Wind	Solar	Other
2016-17	11.40	7.80	2.50%	1.10%

d. Wind Bidding Scheme

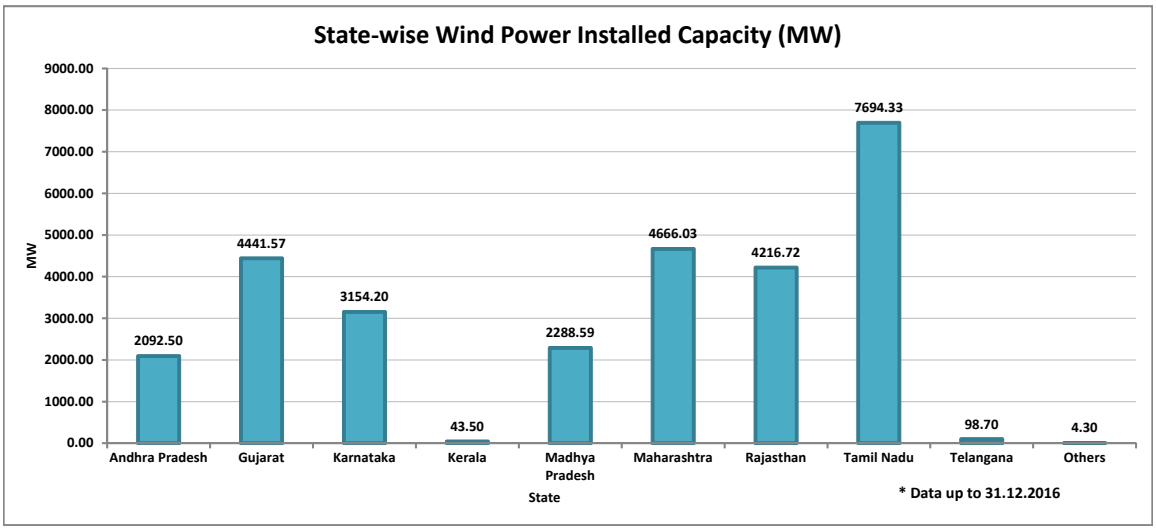
3.26 To enable Discoms of the non-windy States to fulfil their non-solar RPO obligation, through purchase of wind power at a tariff determined by transparent bidding process, a Scheme has been sanctioned. Under the Scheme, 1000 MW wind power projects are envisaged to be set-up in windy States.

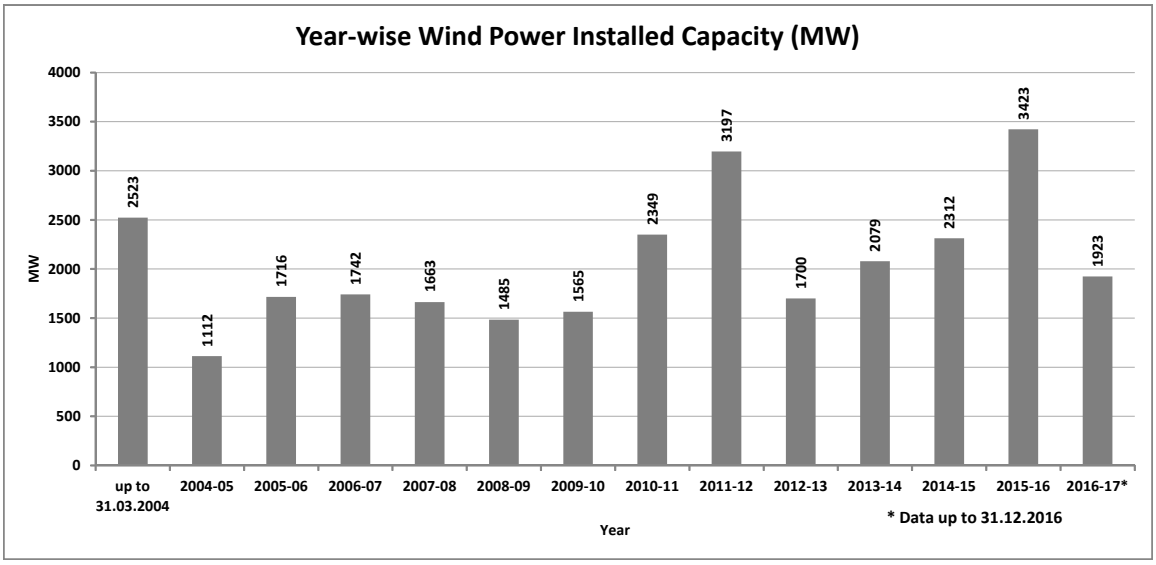
3.27 The Scheme is being implemented by SECI. Wind Power developers (WPD) will be selected through open and transparent competitive bidding to provide wind power at tariff discovered through e-reverse auction. Trading Company selected by SECI will sign PPA with WPD at bidder tariff and back-to-back Power Sale Agreement (PSA) with Buying Entities at a pooled price of the total bids selected. The duration of PPA and PSA will be 25 years from Commercial Operation Date (COD) of the project.

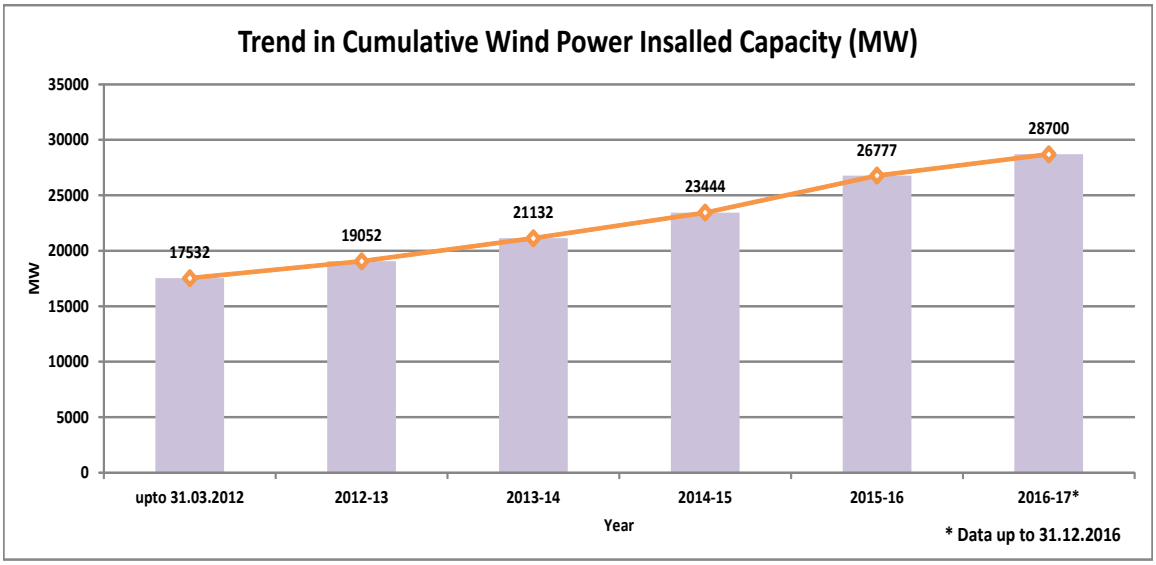
e. New Guidelines for Development of Onshore Wind Power Projects

3.28 To ensure healthy and orderly growth of wind power sector in the country, Ministry issued Guidelines for wind power projects in July 1995, which were revised in June 1996. Clarifications and modification in the Guidelines were issued by the Ministry from time to time. However, with advancement in the wind turbine technology and requirement to comply with various standards and regulations issued by CEA and other regulatory bodies and to address issues related to micro-siting, decommissioning, health and safety, it is felt to issue comprehensive guidelines for development of wind power projects in the country.

3.29 Accordingly, Ministry issued new Guidelines incorporating requirement of site feasibility, type and quality certified wind turbines, micro-siting criteria, compliance of grid regulations, real time monitoring, online registry and performance reporting, health and safety provisions, decommissioning plan, etc.


State-wise Wind Power Installed Capacity (MW)
MW
9000.00
8000.00
7000.00
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
2092.50
4441.57
3154.20
43.50
2288.59
4666.03
4216.72
7694.33
98.70
4.30
Andhra Pradesh
Gujarat
Karnataka
Kerala
Madhya Pradesh
Maharashtra
Rajasthan
Tamil Nadu
Telangana
Others
State
* Data up to 31.12.2016


Year-wise Wind Power Installed Capacity (MW)
MW
4000
3500
3000
2500
2000
1500
1000
500
0
2523
1112
1716
1742
1663
1485
1565
2349
3197
1700
2079
2312
3423
1923
up to 31.03.2004
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17*
Year
* Data up to 31.12.2016


Trend in Cumulative Wind Power Insalled Capacity (MW)
MW
35000
30000
25000
20000
15000
10000
5000
0
17532
19052
21132
23444
26777
28700
upto 31.03.2012
2012-13
2013-14
2014-15
2015-16
2016-17*
Year
* Data up to 31.12.2016

BIOMASS POWER AND BAGASSE CO-GENERATION PROGRAMME

3.30. Biomass Power and Bagasse Co-generation Programme is being promoted by the Ministry during the year. The Programme aims at efficient utilization of biomass such as agro residue in the form of stalks, stems and straw; agro-industrial residues such as shells, husks, de-oiled cakes and wood from dedicated energy plantations for power generation. The potential for power generation from agricultural and agro-industrial residues is estimated at about 18,000 MW. With progressive higher steam temperature and pressure and efficient project configuration in new sugar mills and modernization of existing ones, the potential of surplus power generation through bagasse cogeneration in sugar mills is estimated at 7,000 MW. The potential for bagasse cogeneration lies mainly in sugar producing States, like Maharashtra and Uttar Pradesh. Thus, the total estimated biomass power potential is about 25,000 MW.

3.31 Over 530 biomass power and cogeneration projects aggregating to about 7907.4 MW capacity have been installed in the country upto December 2016 for feeding power to the grid.

3.32 The technologies used under the programme are combustion and cogeneration. The cycle used is the conventional Rankine cycle with biomass being burnt in a high pressure boiler to generate steam and operates a turbine. The net power cycle efficiencies that can be achieved are about 23-25 %. The exhaust of the steam turbine can either be fully condensed or used partly or fully as process heat in sugar mills. The latter mode is called cogeneration.

A 14.8 MW Cogeneration project at Saswad Mali Sugar factory Ltd, Malinagar, Dist. Solapur, Maharashtra

3.33 Sugar industry has been traditionally practicing incidental cogeneration by using bagasse as a fuel for meeting the steam and power requirements of sugar processing and sugar mill complex. With the advancement in the boiler and turbine technologies for generation and utilization of steam at high temperature and pressure, sugar industry can produce electricity and steam for their own requirements and surplus electricity for sale to the grid using same quantity of bagasse through optimum cogeneration. For example, if steam temperature/ pressure is raised from 400° C /33 bar to 485° C /66 bar, more than 80 kWh of additional electricity can be produced for each tonne of cane crushed. The sale of surplus power generated through optimum cogeneration is helping a sugar mill to improve its viability, apart from adding to the power generation capacity of the country.

3.34 The Programme has the following components:

- Biomass based power generation in grid connected mode
- Bagasse based cogeneration in sugar mills for export of surplus power to grid

3.35 The programme has the following objectives:

I. To promote efficient and economic use of surplus biomass for power generation.

II. To maximize surplus power generation from sugar mills using improved technologies.

III. To promote technologies of co-generation and biomass combustion for supplementing conventional power.

IV. To promote BOOT model projects for surplus power generation in cooperative sector sugar mills.

3.36 Eligibility Criteria for Admissible Projects with Respect to:

a. Types of Biomass Resources

- For biomass power projects:- Biomass such as agro-based Industrial Residues, wood produced in Energy Plantations or recovered from wild bushes / weeds, wood waste produced in industrial operations; Crop / Agro industrial Residues.
- For bagasse cogeneration projects: Bagasse during crushing season

b. Financing Institutions

3.37 All registered financial Institutions Development / Investment Corporations; all nationalized banks, private banks, Central & State Cooperative Banks, State/Public Sector Leasing and Financing Corporations.

c. Promoters

3.38 Promoters include individual / independent registered companies, Joint Sector / public sector companies / state agencies and private and public sector investors having technical and managerial capabilities for implementing Biomass Power / Bagasse cogeneration projects on BOOT / BOLT or IPP basis or State Govt. undertaking or Sate Govt. supported Joint Venture Company/SPV Company.

3.39 Grid connected Biomass Power and Bagasse Cogeneration Projects with the following capacity / parameters will only be eligible under the scheme;

Biomass Power (combustion)	• Minimum 60 bar steam pressure • Maximum of upto 15% use of fossil fuel of total energy consumption in K. cals or as per DPR, whichever is less. • For only new boilers and turbines(capacity limited to in accordance with the estimated potential in a state)
Bagasse Co-generation by Private/ cooperative / Public Sector Sugar Mill	• Minimum 40 bar steam pressure • Maximum of upto 15% use of fossil fuel of total energy consumption in K. cals. or as per DPR, whichever is less.
Bagasse Cogeneration through BOOT/BOLT model by IPP's / State Govt. undertaking / State Govt. Joint Venture Company	• Minimum 60 bar steam pressure • Maximum of upto 15% use of fossil fuel of total energy consumption in K. cal or as per DPR, whichever is less, during crushing season • Minimum export of power – 5 MW.
Bagasse Cogeneration in existing Cooperative Sugar Mill employing boiler modification	• Minimum 40 bar steam pressure • PPA as per SERC • Maximum of upto 15% use of fossil fuel of total energy consumption in K. cals. or as per DPR, whichever is less, during crushing season. • Minimum export of power – 3 MW.

Central Financial Assistance (CFA)

3.40 The Central Financial Assistance for private sector projects viz IPP Grid interactive biomass combustion power projects and bagasse co-generation in private / Joint sector sugar mills, IPP based BOOT/BOLT model projects in cooperative / Public sector sugar mills will be released after successful commissioning, and commencement of commercial generation and testing of the project (Back ended Central Financial Assistance), except in the case of bagasse co-generation projects in cooperative/public sector sugar mills implemented by State Government undertaking / State Government Joint Venture Company/SPV through BOOT/BOLT model and cogeneration projects by cooperative / public sector sugar mill themselves, wherein 50% of eligible upfront Central Financial Assistance will be provided and the balance 50% will be released after successful commissioning and performance testing of the project.

3.41 Central Financial Assistance depending upon category and type of grid connected projects would to be provided as per Table A, B, & C. The amount of Central Financial Assistance would be calculated for biomass combustion power projects based on installed capacity and for bagasse cogeneration project in sugar mills based on surplus power exported to grid. The appraisal of the proposals / DPR as carried out by Financial Institutions (FI's) will generally be acceptable to Ministry & will be considered by Ministry for eligible incentives under the programme.

A. CFA for Biomass Power Project and Bagasse Cogeneration Projects by Private/Joint/ Coop./Public Sector Sugar Mills

Project Type	Special Category States (NE Region, Sikkim, J&K, HP &Ut-tarankhand)	Other States
	Capital Subsidy	Capital Subsidy
Biomass Power projects	Rs.25 lakh X C MW) (Maximum Support of Rs 1.5 Crore per project)	Rs.20 lakh X (C MW) (Maximum Support of Rs 1.5 Crore per project)
Bagasse Co-generation by Private sugar mills*	Rs.18 lakh X (C MW) (Maximum Support of Rs 1.5 Crore per Project)	Rs.15 lakh X (C MW) (Maximum Support of Rs 1.5 Crore per Project)
Bagasse Co-generation projects by cooperative/ public sector Sugar Mills* 40 bar & above 60 bar & above 80 bar & above	Rs.40 lakh Rs.50 lakh Rs.60 lakh Per MW of surplus power @ (max. support Rs. 6.0 crore per project)	Rs.40 lakh * Rs.50 lakh * Rs. 60 lakh * Per MW of surplus power @ (maximum support Rs. 6.0 crore per project)

**For new sugar mills, which are yet to start production and existing Pvt. & Co-op. sugar mills employing back pressure route/ seasonal/incidental cogeneration, which exports surplus power to the grid, subsidies shall be one-half of the level mentioned above.*

@ Power generated in a sugar mill (-) power used for captive purpose i.e. net power fed to the grid during season by a sugar mill. Here C is the capacity in MW.

B. CFA for bagasse cogeneration project in cooperative/ public sector sugar mills implemented by IPPs/State Government Undertakings or Special Purpose Vehicle (Urja Ankur Trust) through BOOT/BOLT model

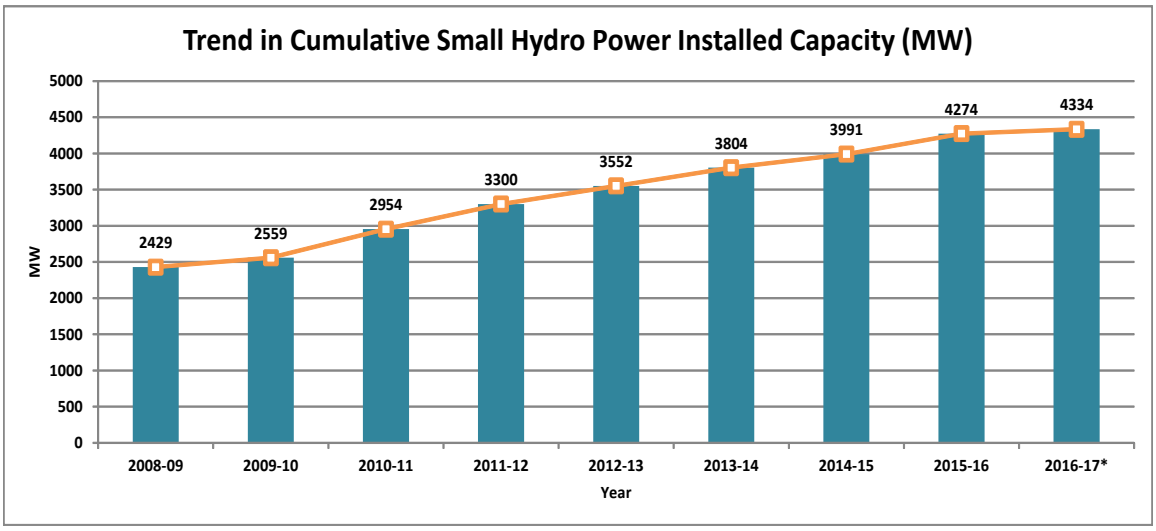
PROJECT TYPE	MINIMUM CONFIGURATION CAPITAL SUBSIDY
Single coop.mill through BOOT BOLT 60 bar & above Model	Rs.40 L/MW of surplus power *
80 bar & above	Rs.50 L/MW of surplus power* (maximum support Rs. 6.0 crore/ Sugar Mill)

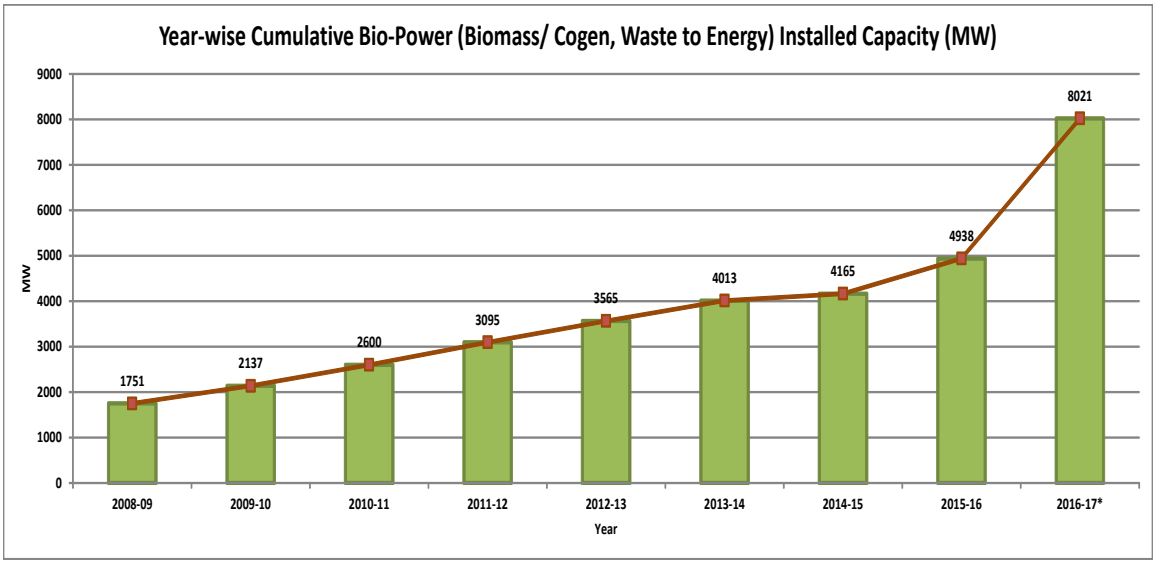
** Power generated in a Sugar Mill (-) power used for captive purpose i.e. Net power fed to the grid during season in a sugar mill*

C. CFA for bagasse co-generation project in existing cooperative sector Sugar Mills employing boiler modifications

Project Type	Minimum Configuration	Capital Subsidy
Existing Cooperative Sugar Mill	40 bar & above 60 bar & above 80 bar & above	Rs.20 Lakh/MW of surplus power* Rs.25 Lakh/MW of surplus power* Rs.30 Lakh/MW of surplus power*

** Power generated in a Sugar Mill (-) power used for captive purpose i.e. Net power fed to the grid during season in a Sugar Mill. CFA will be provided to the Sugar Mills who have not received CFA earlier from MNRE under any of its scheme.*


Trend in Cumulative Small Hydro Power Installed Capacity (MW)
MW
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
2429
2559
2954
3300
3552
3804
3991
4274
4334
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17*
Year


Year-wise Cumulative Bio-Power (Biomass/ Cogen, Waste to Energy) Installed Capacity (MW)
MW
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1751
2137
2600
3095
3565
4013
4165
4938
8021
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17*
Year

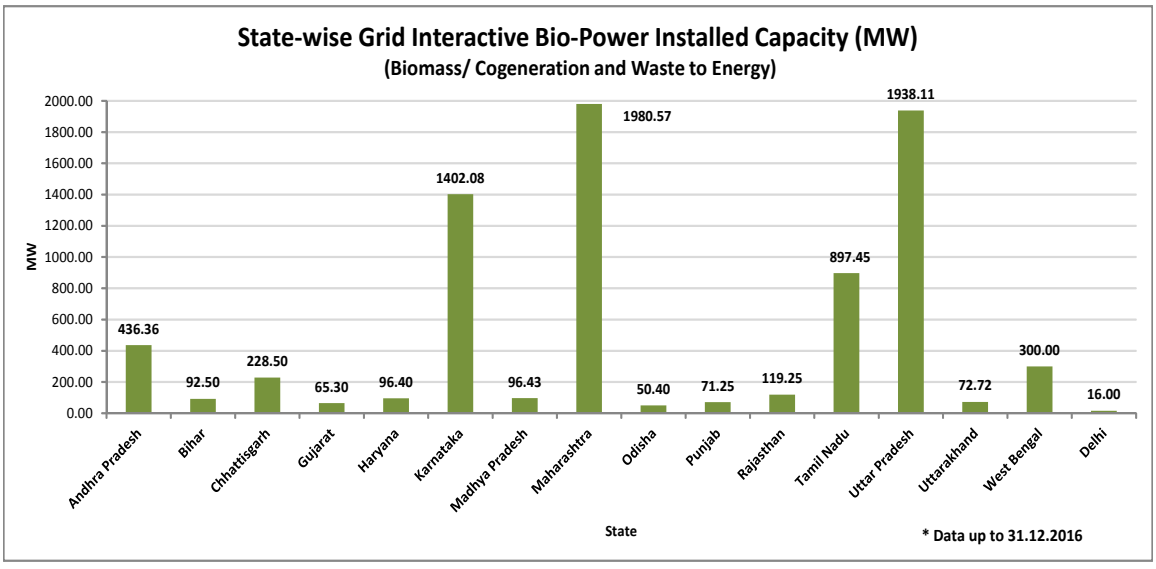

State-wise Grid Interactive Bio-Power Installed Capacity (MW)
(Biomass/ Cogeneration and Waste to Energy)
MW
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
436.36
92.50
228.50
65.30
96.40
1402.08
96.43
1980.57
50.40
71.25
119.25
897.45
1938.11
72.72
300.00
16.00
Andhra Pradesh
Bihar
Chhattisgarh
Gujarat
Haryana
Karnataka
Madhya Pradesh
Maharashtra
Odisha
Punjab
Rajasthan
Tamil Nadu
Uttar Pradesh
Uttarakhand
West Bengal
Delhi
State
* Data up to 31.12.2016

Table 3.6 State wise Cumulative Commissioned Biomass Power and Bagasse Cogeneration Projects Grid Connected		
S. No.	**State**	**Installed Capacity (in MW)**
1.	Andhra Pradesh	378.2
2.	Bihar	92.5
3.	Chhattisgarh	228.5
4.	Gujarat	65.3
5.	Haryana	96.4
6.	Karnataka	1401.08
7.	Madhya Pradesh	92.53
8.	Maharashtra	1967.85
9.	Odisha	50.40
9.	Telangana	158.1
10	Punjab	62
11	Rajasthan	119.25
12	Tamilnadu	889.4
13	Uttarakhand	72.72
14	Uttar Pradesh	1933.11
15	West Bengal	300
	Total	**7907.34**

Achievements

3.42 A cumulative capacity of 7907.4 MW has so far been commissioned all over India. State wise details are given in **Table 3.6.**

SMALL HYDRO PROGRAMME

3.43 Ministry of New and Renewable Energy has been vested with the responsibility of developing Small Hydro Power (SHP) projects up to 25 MW station capacity. Ministry has announced a scheme for implementation of Small Hydro Projects along with various other sub-schemes. Given below is the finer classification among various capacities under Small Hydro with respective application/ uses:-

Type	Use	Capacity (kW)
Water Mills	For local use	Up to 5
Micro	Village electrification	Up to 100
Mini	Village Electrification & Grid	101 to 2000
Small	Grid	2001 to 25000

3.44 The estimated potential for small / mini hydel projects is 19,749 MW from 6474 identified sites. Out of this potential, most of the SHP potential lies in the States of Himachal Pradesh, Uttarakhand, Jammu & Kashmir and Arunachal Pradesh as river based projects i.e. run

off river scheme. In the plain region Maharashtra, Chhattisgarh, Karnataka and Kerala have sizeable potential.SHP projects are environmentally benign, economically viable and consequently private sector invested in such project. Viability of the projects improves with increase in the station capacity. Focused attention is given towards these States through close interaction, monitoring of projects and reviewing policy environment to attract private sector investments. The Ministry has been providing central financial assistance to State Governments and private sector to set up small / mini hydro projects.

3.45 The Ministry provides central financial assistance/ financial support in the form of grants / assistance / subsidy towards the following schemes / activities / sub-schemes.

A) Resource assessment and support for identification of new sites: scheme to support identification of new potential SHP sites, preparation of Plan and Detailed Project Report (DPR) including detailed survey & investigation(DSI) for SHP project sites to the Central / State government department and agencies/ local bodies.

B) Scheme to support for setting up new SHP projects in the private/ co-operative/ joint sector.

C) Scheme to support for setting up new SHP projects in the Government Sector.

D) Scheme to support for renovation and modernisation of existing SHP projects in the government sector.

E) Scheme to support for development / Upgradation of Water Mills (mechanical/ electrical output) and setting up Micro Hydel Projects (up to 100KW capacity).

F) Research & Development and Human Resource Development: Support to R&D projects, strengthening of technical institutions, setting up turbine laboratory, business meets, training programme/ courses, fellowships etc., monitoring of SHP projects, consultancy and/ or any other activity left necessary for the SHP development. The Financial assistance will be considered for these activities on case to case basis.

3.46 Ministry provides Central financial assistance to the following sub scheme of SHP as per details given below:-

(a) Resource Assessment and Support for Identification of new sites:

Areas	Up to 1MW	Above 1 MW & upto 25 MW
All States & UTs	Rs.6,00,000.00	Rs.10,00,000.00

(b) For Financial support to set up New SHP Project up to 25MW capacity in the Private, Co-operative, joint Sector etc.
The quantum of financial support will be independent of the term loan and will be limited to the amount indicated below.

Category	Above 0.1MW-25MW
N E Region, J&K, H.P & Uttarakhand (special Category States)	Rs.1.5 crore/MW limited to Rs.5.00 crore per project.
Other States	Rs.1.0 crore/MW limited to Rs.5.00 crore per project.

(c) Scheme for Financial support to set up New SHP Project up to 25 MW station capacity in the Government/ State Sector.

Category	Above 100 kW & Upto 1000 kW	Above 0.1 MW-25 MW
N E Region, J&K, H.P & Uttarakhand (special Category States)	Rs.75,000 per kW.	Rs.7.5 crore/MW limited to Rs.20.00 crore per project.
Other States	Rs.35,000 per kW.	Rs.3.5 crore/MW limited to Rs.20.00 crore per project.

(d) Scheme to support for Renovation and Modernisation of existing SHP projects in the Government sector.

Areas	Upto 1000 kW	Above 1 MW & upto 25 MW
All States & UTs	Rs.10,000.00 per kW	Rs. 1.00 crore/MW limited to Rs.10.00 crore per project

(e) Scheme to support for development/up gradation of Water Mills (mechanical/ electrical output) and setting up Micro Hydel projects (up to 100 KW capacity).

S. No.	Category of Watermill	Amount of CFA
1.	Mechanical output only	Rs.50,000/- per Watermill
2.	Electrical output (up to 5 kW) or,	
	Both mechanical and electrical output (up to 5 kW)	Rs. 1,50,000/- per Watermill

(f) Micro Hydel Projects up to 100 kW Capacity:

Areas	Amount of CFA
All states	Rs.1,25,000/- per kW

3.47 Small hydro projects are environmentally benign and normally do not encounter the problems usually associated with large hydro projects like deforestation and resettlement/ rehabilitation due to submergence. The projects have potential to meet power requirements of remote and isolated areas. These factors make small hydro as one of the most attractive renewable source of grid quality power generation. 24 States of the country have policies in place policies towards private sector participation to set up SHP projects in their states. The Ministry has taken a series of steps to promote development of SHP in a planned manner and improve reliability & quality of the projects.

3.48 Ministry has introduced special programme to promote new and efficient designs of water mills for mechanical as well as electricity generation and setting up of micro hydel projects upto a capacity of 100 KW for remote village electrification. These projects are taken up with the involvement of local organizations such as the Water Mills Associations, State Government Department/ State Nodal Agencies/ Tea Garden, Cooperative Societies, local bodies/registered NGOs, village energy cooperatives, and individual entrepreneurs.

3.49 The total installed capacity of small hydro projects, at the end of 11th Plan, was 3395 MW. This was achieved by adding an aggregate capacity of 1419 MW during 2007-2012. On an average 12th Plan target for small / mini hydro is 250 MW per year. Year wise target and achievements for the 2012-13, 2013-14, 2014-15, 2015-16 & 2016-17 is given in Table below:

Period	Physical		Financial	
	Target (MW)	Achievement (MW)	Allocation (Rs. in crore)	Achievement (Rs. in crore)
2012-13	300.00	236.94	159.00	158.93
2013-14	250.00	171.40	123.18	122.82
2014-15	250.00	251.60	108.00	107.99
2015-16	250.00	218.60	105.05	104.99
2016-17(as on 30.11.2016)	150.00	50.90	125.00	101.68
	Total	**929.44**	**620.23**	**596.41**

3.50 The current year i.e. 2016-17 target is 150 MW. During the year, SHP projects aggregating to a capacity of 50.90 MW (up to 30.11.2016) have been commissioned both in private and State Sector.

3.51 In cumulative terms, 1075 small hydropower projects aggregating to 4324.86 MW have been set up in various parts of the country. In addition, 232 projects of about 793.73 MW are in various stages of implementation. **Table 3.7** provides state-wise details of projects completed and under execution.

3.52 Private developers are also identifying sites in States and are termed as self-identified sites. There is change in potential at some of the sites after detailed investigation by the private developers. It is now estimated that there is a potential of about 20,000 MW of Small Hydro in the Country. A list of over 6474 sites has been prepared with an estimated potential of about 19,749MW. AHEC has helped the Ministry in compiling this information.

3.53 The Hon'ble Prime Minister had announced a package of Rs.550.00 crore to electrify/ illuminate border villages of Arunachal Pradesh. Accordingly, a plan was made to electrify

A Small Hydro Project installed at Vellathooval, Kerala

A Power House at 15 MW Small Hydro Project at Barapole

Table 3.7- State-wise details of Small Hydro Projects completed and under execution.							
STATE WISE NUMBERS AND AGGREGATE CAPACITY OF SHP PROJECTS(UPTO 25 MW)							
POTENTIAL, INSTALLED & UNDER IMPLEMENTATION (as on 31.12.2016)							
Sl. No.	State	Potential		Projects Installed		Projects under Implementation	
		Nos.	Total Capacity (MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)
1	Andhra Pradesh & Telengana	387	978.4	72	241.98	5	17.7
2	Arunachal Pradesh	677	1341.38	152	104.605	17	54.05
3	Assam	119	238.69	6	34.11	5	33
4	Bihar	93	223.05	29	70.7	10	8.3
5	Chhattisgarh	200	1107.15	10	76	1	24
6	Goa	6	6.5	1	0.05	0	0
7	Gujarat	292	201.97	6	16.6	13	92.31
8	Haryana	33	110.05	9	73.5	1	0.1
9	Himachal Pradesh	531	2397.91	180	798.81	27	211
10	J&K	245	1430.67	40	158.03	25	45.15
11	Jharkhand	103	208.95	6	4.05	0	0
12	Karnataka	834	4141.12	166	1220.73	3	13.4
13	Kerala	245	704.1	31	205.02	9	74.015
14	Madhya Pradesh	299	820.44	11	86.16	0	0
15	Maharashtra	274	794.33	64	346.175	16	54.15
16	Manipur	114	109.13	8	5.45	0	0
17	Meghalaya	97	230.05	4	31.03	2	25.5
18	Mizoram	72	168.9	19	41.47	4	8.7
19	Nagaland	99	196.98	12	30.67	8	3.75
20	Orissa	222	295.47	10	64.625	3	18.5
21	Punjab	259	441.38	54	170.9	12	30
22	Rajasthan	66	57.17	10	23.85	0	0
23	Sikkim	88	266.64	17	52.11	2	15
24	Tamil Nadu	197	659.51	21	123.05	0	0
25	Tripura	13	46.86	3	16.01	0	0
26	Uttar Pradesh	251	460.75	9	25.1	1	1.5
27	Uttarakhand	448	1707.87	101	209.32	5	19.6
28	West Bengal	203	396.11	24	98.5	0	0
29	A&N Islands	7	7.91	1	5.25	0	0
Total		**6474**	**19749.44**	**1076**	**4333.855**	**169**	**749.725**

/ illuminate 1053 un-electrified villages of all border districts of Arunachal Pradesh. The project is now in the final stages of implementation. Out of 1053 villages, 976 villages have been illuminated / electrified. These include, 523 villages, where all households have been provided with solar home lighting systems.

3.54 The Ministry is also implementing a project titled 'Ladakh Renewable Energy Initiative' w.e.f. June 1st, 2010 to minimize dependence on diesel / kerosene in the Ladakh region and meet power requirement through renewable energy sources locally available. The approach is to meet power requirements through small / micro hydel and solar photovoltaic power projects /systems and use solar thermal systems for water heating / space heating /cooking requirements. The project was supposed to be implemented in a time bound mode of three and a half years with a total cost of Rs.473.00 crore. The project duration has been extended up to 31st December 2017. The project envisages setting up of 30 small/mini hydel projects with an aggregate capacity of 23.8 MW at a total cost of Rs.267 crore. Success Story is given in the **Box 3.1**.

Box 3.1 Water Mill Project of MNRE, GOI

The installation of Improved water Mill is to renovate the existing old Gaharatas (Chakki) used to grind flour and also to generate electricity by using motors that will use for individual households as well as cluster of villages for Electrification as well as to use end machines like butter churner, spinning Machines, small carpentry Machines and the most is the electrification of the Households as most of the remote villages are still not connected with grid and without electricity and it will gives a significant impact on the general standard of living of the village communities. The main benefit of electrification is lighting, which results in a longer working day as well as a better quality of life. In addition to lighting, electrification enables the use of machines for saving time and effort in domestic activities as well as generating income.

Installation of Improved Water Mill):There is lot of demand from the public for installation of new and improvement of the existing old water Mills with Mechanical or Electrical. KREDA had proposed to install 100 Nos of improved water Mills in different villages of Kargil with maximum contribution from the beneficiary. The ministry i.e. MNRE, GOI has sanctioned 30 nos. of Mills 20 Mechanical and 10 Electrical.

So far four Water Mills have been installed & commissioned out of 30 Water Mills. 26 more shall be installed (Both Electrical & Mechanical).

Inauguration of Water Mill by Hon'ble Executive Councilor LAHDC Kargil along with Deputy Commissioner/CEO LAHDC Kargil (June 2016)

3.55	The Hon'ble Prime Minister had announced a package named as "Development/ Reconstruction package for Jammu and Kashmir" of Rs.2350.00 crore for Renewable Energy which includes Rs.2000.00 crore for Small Hydro. This may cover Preparation of DPRs and implementations/ installations of SHP projects. Duration of project is 2014-15 to 2020.

3.56 During the year 2016-17, the Ministry had interaction with the State Governments, SHP developers and manufacturers of SHP equipment. A meeting under the chairmanship of Hon'ble Minister was held on 06.04.2016. Ministry has to achieve a target up to 5 GW by the year 2022 through SHP in the total target of 175.00 GW from Renewable Energy Sources. To achieve the target in full during the remaining period of 12th Plan, the Ministry interacted with SHP developers (State Nodal Departments/Agencies). A consultative meeting held on 31st August, 2015, wherein the State Governments opted to achieve the following targets voluntarily. State wise details are given below:-

Target setup during the meeting:-

S.No.	Name of State	Target allocated (MW)
1	Arunachal Pradesh	500
2	Himachal Pradesh	750
3	Jammu & Kashmir	500
4	Karnataka	250
5	Maharashtra	200
6	Odisha	100
7	Punjab	100
8	Uttarakhand	500
	Total	2900

3.57 Water mill programme of the Ministry involve local organizations such as the Water Mills Associations; Cooperative Societies; Registered NGOs, local bodies, State Nodal Agencies and individual entrepreneurs. The Ministry has sanctioned support for water mills and micro hydel projects (up to 100 KW) in states.

Development of Efficient Cross Flow Turbine for Hilly Region

3.58 In order to exploit the micro hydro potential more efficiently and effectively, there is a need to develop an efficient cost effective cross flow turbine design. Efficiency of cross Development of laboratory for sediment monitoring and impact analysis studies in Hydro power plant

3.59 Main objective of setting up of sediment laboratory is development of material(s) which will be more resistant to abrasions due to sediments, especially for hilly regions where the problems associated with silt is more pronounced. The laboratory will carry out the studies in various river basins and outcome of study/ research will be a step ahead in field of erosion problems in hydropower plants especially in Himalayan region.

SOLAR ENERGY

3.60 Grid connected Solar Power generation, Tail end Grid connected Solar Power and Solar Thermal Power programmes have been covered in detail in **Chapter 4 on National Solar Mission.**

OFF GRID RENEWABLE POWER

BIOMASS GASIFIER PROGRAMME

3.61 Biomass gasification is thermo-chemical conversion of biomass into a combustible gas mixture (producer gas) through a partial combustion route with air supply restricted to less than that theoretically required for full combustion. A gasifier system basically comprises of a reactor where the gas is generated, and is followed by a cooling and cleaning train which cools and cleans the gas. The clean combustible gas is available for power generation in diesel genset or 100% producer gas engines.

3.62 The Ministry is promoting multifaceted biomass gasifier based power plants for producing electricity using locally available biomass resources such as small wood chips, rice husk, arhar stalks, cotton stalks and other agro-residues in rural areas. The main component of the biomass gasifier programmes are:

i. Distributed / Off-grid power for Rural Areas

ii. Captive power generation applications in Rice Mills and other industries.

iii. Tail end grid connected power projects up to 2 MW capacities.

3.63 The focus of the biomass gasifier programme is to meet captive electrical and thermal needs of rice mills and other industries which in turn help in replacing / saving of conventional fuels such as coal, diesel, furnace oil etc. In addition, it provides for unmet demand of electricity for villages for lighting, water pumping and micro-enterprises. Emphasis is also given for setting up of small biomass gasifier based power plants up to 2 MW capacities connected at the tail end of grid as it provides multiple benefits such as reducing T&D losses, ensuring sustainable supply of biomass, access to electricity in villages etc.

3.64 The programme envisages implementation of such projects with involvement of Independent Power Producers (IPPs), Energy Service Companies (ESCOs), industries, Co-operative, Panchayats, SHGs, NGOs, manufactures or entrepreneurs, industries, promoters & developers etc.

3.65 During 2016-17 off-grid power capacity from biomass gasifiers of 3400 kWeq for electrical and thermal applications in industries have been installed in 8 rice mills and other industries including flour mill, bakeries for meeting captive demand of electricity and thermal applications in the states of Haryana, Tamil Nadu and Uttar Pradesh.

Details of Financial Incentives provided under the programme are stated below:		
S No.	**Items**	**Pattern of CFA**
i.	Distributed / off grid power projects in rural areas and grid connected power projects with 100% producer gas engines or biomass based combustion projects.	Rs.15,000 per kW
ii.	Biomass gasifier systems retrofitted with duel fuel mode engines	Rs. 2,500 per kW
iii.	Projects involving installation of 100% gas engines with an existing gasifier.	Rs.10.00 lakh per 100 kW
iv.	a. Thermal applications in rice mills and other industries. b. Captive power needs through dual fuel engines in rice mills and other industries. c. Captive power needs through 100% producer gas engines in rice mills and other industries.	Rs.2.0 lakh / 300 kWth Rs.2.5 lakh / 100 kWe Rs.10,000 per kW
v.	Support towards lighting devices and distribution network for off grid village level projects.	Financial support limited to a maximum of 3 km i.e. Rs.3.00 lakh per project (@ Rs.1.00 lakh per km).
vi.	Special category states and Islands	20% higher CFA

Small Wind Energy and Hybrid Systems (SWES)

3.66 Small Wind Energy systems including water pumping windmills, aero-generators and wind-solar hybrid systems have been found to be useful for harnessing wind and Solar energy in un-electrified areas or areas having intermittent electric supply. These systems can be set up in rural, semi urban/ urban areas having annual average wind speed of about 15 kmph or above, at 20 m height. These systems consist of aero-generator(s) and photovoltaic panels of suitable capacity for mutually supplementing power generation from wind and solar energy to offer a reliable and cost effective electricity supply in decentralized mode. The programme on "Small Wind Energy and Hybrid Systems" to promote these devices and the scheme is being continued for the 12th plan period (2012-17).

3.67 The manufacturers of the small aero-generators are getting their machines empanelled under the NIWE. The testing facilities have been developed at NIWE's test station at Kayathar in Tamil Nadu. Currently, 7 small wind turbine manufacturers with 13 models ranging from 570 W to 10 kW have been empanelled.

3.68 A cumulative total of 1496 water-pumping windmills including 79 nos. installed during 2016-17 and an aggregate capacity of 2972 kW of the aero-generators/ hybrid systems including 280 kW have been installed during 2016-17. The state-wise installations of Water Pumping Mills and Aero-generators / Wind Solar Hybrid Systems are given in **Table-3.8.**

50 kW Wind-Solar Hybrid System at PSN College of Education, Tirunelveli

Table-3.8: Installation of Water Pumping Mills and Aero-generators/ Wind-Solar Hybrid Systems (2016-17)

S.No	State/ UT	Water pumping Mills	Aero-generators & Hybrid Systems (kW)
1	Andaman & Nicobar	2	0
2	Andhra Pradesh	6	103
2	Arunachal Pradesh	0	7
3	Assam	3	6
4	Bihar	46	0
5	Goa	0	194
6	Gujarat	1026	20
7	Haryana	0	10
8	Jammu & Kashmir	0	96
9	Karnataka	28	39
10	Kerala	79	8
11	Madhya Pradesh	0	24
12	Maharashtra	26	1637
13	Manipur	0	140
14	Meghalaya	0	192
15	Mizoram	0	21
16	Nagaland	0	20
17	Odisha	0	13
18	Puducherry	0	5
19	Punjab	0	50
20	Rajasthan	222	14
21	Sikkim	0	16
22	Tamil Nadu	60	257
23	Tripura	0	2
24	Uttarakhand	0	24
25	West Bengal	0	74
	Total	1496	2972

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4 : NATIONAL SOLAR MISSION

NATIONAL SOLAR MISSION

Introduction

4.1 India is endowed with a very vast solar energy potential. Most parts of the country have about 300 sunny days. Average solar radiation incident over the land is in the range of 4-7 kWh per day. The solar energy can be utilized through solar photovoltaic technology which enables direct conversion of sunlight into energy and solar thermal technologies which utilizes heat content of solar energy into useful applications. Over the last three decades several solar energy based systems and devices have been developed and deployed in India which are successfully providing energy solutions for lighting, cooking, water heating, air heating and cooling, and electricity generation. The research and development efforts have also helped in better efficiency, affordability and quality of the products. As a result many solar energy systems and devices are commercially available with affordable cost in the market.

4.2 National Solar Mission (NSM) was launched on 11th January, 2010. The Mission targetted include (i) deployment of 20,000 MW of grid connected solar power by 2022, (ii) 2,000 MW of off-grid solar applications including 20 million solar lights by 2022, (iii) 20 million sq. m. solar thermal collector area, (iv) to create favourable conditions for developing solar manufacturing capability in the country; and (v) support R&D and capacity building activities to achieve grid parity by 2022. The Mission is to be implemented in three phases.

4.3 For the first phase of the Mission, the Cabinet had approved a target to set up 1,100 MW grid connected solar plants including 100 MW capacity as rooftop and other small solar power plants till March 2013. In addition, a target of 200 MW capacity equivalent off-grid solar applications and 7 million square meter solar thermal collector area were also approved. The Cabinet had also approved setting up of large utility scale grid power plants through bundling of solar power with the unallocated thermal power available from NTPC stations and the policy to provide generation based incentive for small grid connected solar power plants.

4.5 The Cabinet in its meeting held on 17/6/2015 had approved revision of cumulative targets under NSM from 20,000 MW by 2021-22 to 1,00,000 MW by 2021-22 for Grid Connected Solar Power Projects. The revised target of 1,00,000 MW is planned to be achieved in 7 years period and broadly consist of 40 GW Grid connected Rooftop projects and 60 GW large and medium size land based solar power projects.

PHASE-I OF NSM (2010-13)

A) Grid Connected Solar Power

4.6 The Phase-I comprises of two sub-components viz., (i) 1,000 MW of large grid solar plants connected to 33 KV and above grid line, and (ii) 100 MW of rooftop and small solar plants, connected to grids below 33 KV.

1000 MW Capacity Grid-Connected Solar Power Projects implemented through NVVN

4.7 This scheme covered large solar power plants of total 1,000 MW capacity connected to grid at 33 kV and above - 500 MW capacity each based on Solar Thermal (ST) and Solar Photovoltaic

(SPV) technologies. It includes three stages: (i) Migration Scheme (ii) NSM Phase-I, Batch-I and (iii) NSM Phase-I, Batch-II

Migration Scheme

4.8 With a view to facilitate quick start-up to NSM and also speedier implementation of the then on-going projects under advanced stage of implementation in different States, this scheme was introduced in Feb 2010 to allow the migration of such projects to NSM. A total of 16 projects of 84 MW capacity (13 nos., 54MW - SPV and 3 nos., 30MW ST) were approved under this scheme for long-term procurement of power by NTPC Vidyut Vyapar Nigam Limited (NVVN) at Central Electricity Regulatory Commission (CERC) notified tariff for 2010-11 viz. Rs.17.91/ unit for SPV and Rs.15.31/unit for ST. 11 nos. SPV projects of 48 MW capacity and one ST project of 2.5 MW capacity have been commissioned under this scheme.

NSM Phase-I, Batch-I & Batch-II

4.9 Under NSM Phase-I, Batch-I and Batch-II, solar power projects were allotted through a process of reverse bidding. Bids for same were invited in two batches: Batch-I of 150 MW SPV and 470 MW ST in Aug 2010 and Batch-II of 350 MW SPV in Aug 2011.

4.10 In Batch-I the eligible project capacities were 5 MW for SPV and upto 100 MW for ST. 30 nos. SPV Projects with an aggregate capacity of 150 MW and 7 nos. of ST Projects with an aggregate capacity of 470 MW were selected. The bid tariffs for SPV projects were in the range of Rs.10.95-12.76/ unit, with average of Rs.12.11/unit and for ST projects in the range of Rs.10.49-12.24/ unit, with weighted average of Rs.11.48/unit. 26 nos. SPV projects of aggregate 140 MW capacity and 3 nos. ST projects of aggregate 200 MW capacity have been commissioned under NSM Phase-I, Batch-I.

4.11 In Batch-II for SPV, the project capacity fixed was 5-20 MW. 28 nos. SPV projects with an aggregate capacity of 350 MW were selected. The tariff for the selected SPV projects was ranging between Rs.7.49-9.44/unit, with weighted average of Rs. 8.77/ unit. 26 nos. SPV projects of aggregate 330 MW capacity have been commissioned under NSM Phase-I, Batch-II.

4.12 A 5 MW SPV project by Delhi Mumbai Industrial Corridor Development Corporation Limited (DMICDC) has also been set up under the MNRE bundling scheme of NSM Phase-I.

Thus, under NSM Phase-I, 523 MW solar PV projects and 202.5 MW solar thermal power projects have been commissioned under the bundling scheme.

4.13 Power generated from the commissioned plants is being purchased by NVVN and being sold to State Utilities/ DISCOMS under a mechanism of bundling with power from unallocated quota of power from coal based stations of NTPC Ltd. on equal capacity basis to effectively reduce the average per unit cost of bundled solar power to the purchasing Utilities. A Payment Security Mechanism involving a revolving fund of Rs. 486 crore has been put in place to ensure timely payments to developers in the event of delays/ defaults in payments by the purchasing State Utilities to NVVN.

100 MW capacity Solar Power Plants

4.14 MNRE announced the Guidelines namely Rooftop PV and Small Solar Power Generation Programme (RPSSGP) for solar power plants connected to distribution network (Below 33 kV)

in June 2010. The aim of the scheme was to encourage the States to declare their Solar Policy for grid connected projects focusing on distribution network and to strengthen the tail-end of the grid. The purpose of the scheme was also to encourage as many States as possible to set up small solar grid connected projects. It also helped States to create a database of performance of solar plants under different climatic and grid conditions. This was considered necessary for large-scale replication in future, particularly for meeting rural needs in the next phase of the Solar Mission.

4.15 The role of the Ministry was limited to providing a fixed Generation Based Incentive (GBI) to the State utilities at a rate equal to the difference of the CERC tariff for 2010-11 (Rs. 17.91 per kWh) and a reference rate of Rs. 5.5 per kWh. The projects were registered with IREDA through a web-based process.

Achievement

4.16 78 projects were selected to set up 98 MW capacity projects from 12 States. Against this, 71 projects of total capacity 90.80 MW have been connected to grid with State-wise details as given in **Table 4.1.**

B) Off-grid Solar Applications including Solar Heating

4.17 The guidelines for implementation of off-grid solar applications were also announced on 16th June 2010. A provision of 30% capital subsidy and/or soft loan @5% was made for general category states. In case of solar photovoltaic applications, a capital subsidy limited to a maximum of 90% of the benchmark cost is available for Government driven projects in the special category states viz. NE, Sikkim, J&K, Himachal Pradesh and Uttarakhand and also the international border districts and islands, keeping in view special needs of the region and overall policy of the Government. IREDA was assigned the task to provide refinance to the interested banks to enable them to offer loans to consumers at 5% annual interest rate. In order to encourage multiple channel partners to access support and reach out to the people, a process

Table 4.1 State Wise Projects Commissioned under RPSSGP Scheme

Sr. No.	State	No. of Projects	Capacity (MW)
1	Andhra Pradesh	10	9.75
2	Chhattisgarh	2	4
3	Haryana	8	7.8
4	Jharkhand	8	16
5	Madhya Pradesh	3	5.25
6	Maharashtra	3	5
7	Odisha	7	7
8	Punjab	5	6
9	Rajasthan	12	12
10	Tamil Nadu	6	6
11	Uttarakhand	3	5
12	Uttar Pradesh	4	7
	Total	71	90.8

Solar plant being Devloped by NTPC in Bhadla Solar Park Phase-II

of accreditation of solar system integrators was introduced by the Ministry. Reputed agencies such as CRISIL, Fitch and ICRA were involved in the process.

4.18 Out of capacity of 200 MW, Ministry fixed a target of sanctioning 32 MW capacity projects in 2010-11 against which 40.6 MW capacity off-grid solar PV projects were sanctioned in 2010-11. Another 77.471 MWp were sanctioned during 2011-12 against a target of 68 MWp for the year. During 2012-13, 134.5 MWp capacity projects were sanctioned. The total capacity sanctioned during Phase-I thus was 252.5 MW. For solar thermal collector area during the first phase, about 7.01 million square meter of collector area has been installed against a target of 7.0 million.

Achievements

Application Segment	Target for Phase I (2010-13)	Achievements till March, 2013
Grid solar power		
(large plants, roof top & distribution grid plants)	1,100 MW	1686.44 MW
Off-grid solar applications	200 MW	252.5 MW
Solar Thermal Collectors (SWHs, solar cooking, solar cooling, Industrial process heat applications, etc.)	7 million sq. meters	7.01 million sq..meters

C) Domestic Manufacture

4.19 One of the objectives of the Mission is to substantially enhance solar manufacturing across the value chain in the country. In line with this objective in the first phase of the Mission, 30% domestic content was made necessary for grid solar thermal projects. This condition was in place for all solar thermal power projects selected in the first phase. For the photovoltaic projects selected during 2010-11, use of domestic crystalline silicon modules was mandatory, but solar cells and modules made with other technologies can be imported. In Batch-II projects, selected in 2011-12 use of crystalline silicon solar cells and modules was allowed only if domestically manufactured. Products with other technologies i.e. thin film and CPE could, however, be imported.

D) Institutional Arrangements

4.20 Solar Energy Corporation of India, a Section-25 Company was incorporated on 20th September 2011 with an authorized Capital of Rs.2,000 crore and its office is at Saket, New Delhi. This Company is functioning under the administrative control of Ministry of New & Renewable Energy and would implement and is facilitating the various activities of National Solar Mission (NSM).

4.21 Solar Energy Research Advisory Council (SERIC) has been set up to advise on research policy with a view to achieve Mission targets.

PHASE-II OF NSM (2013-17)

4.22 The Phase-I of NSM (2010-13) generated a huge interest in the solar sector wherein Gird connected and off-grid projects were commissioned throughout the country. Achievements of Phase-I exceeded the targets set for the period. This momentum needs to be carried forward to the next phase.

Targets of Phase-II

Application Segment	Target for Phase 2 (2013-17)
Grid solar power	
(large plants, roof top & distribution grid plants)	9,000 MW
Off-grid solar applications	800 MW
Solar Thermal Collectors (SWHS, solar cooking, solar cooling, Industrial process heat applications, etc.)	8 million sq. meters

Future Plan

4.23 Vision for 100,000 MW of solar power capacity by 2022 is proposed as below:

			(Capacity in MW)
Category-I	**Proposed Capacity**	**Category-II**	**Proposed Capacity**
Rooftop Solar	40,000	Projects by Unemployed graduates, Village Panchayats, Small Scale Industries (SSI) Units	10,000
		Public Sector Undertakings	10,000
		Large Private Sector	5,000
		SECI	5,000
		Under State Policies	20,000
		Ongoing programmes	10,000*
Total	40,000		60,000*

** 3743 MW commissioned upto 2014-15*

Focus area under Phase-II of NSM

A) Grid connected Projects

4.24 Unlike Phase-I, NSM Phase-II aim for achieving significantly higher scales of targets of 100 GW. Hence, Ministry has contemplated all possible options for implementation of the Mission. Selection of capacity for Phase-II, grid connected projects is being done via different schemes such as Bundling, Viability Gap Funding (VGF). This allocation of target capacity may be altered depending upon the availability of resources.

Achievements

4.25 As on 31.12.2016, a total solar power capacity installed is 9012.69 MW. State-wise details are given in **Table 4.2**. Yearwise cumulative growth in Solar Power Installed capacity is shown in **Graph 4.1**

Action Taken

4.26 The Ministry has formulated a range of schemes for achieving the aspirational target of 100 GW. The details of the schemes are given in succeeding paras.

Scheme for setting up over 300 MW of Grid-Connected Solar PV Power Projects by Defence Establishments under Ministry of Defence and Para Military Forces with Viability Gap Funding under Phase-II/III of NSM.

4.27 The Establishments in the border area and remote locations use diesel as the primary source of energy. In some areas they pay very high tariff. Solar power is clean source of energy and can replace diesel power generation to a large extent. Potential of Solar Energy in cantonment and Military Stations are approximately 5000 MW and in Ordnance Factory Boards (OFB) are 950 MW. Ordnance Factory Board (OFB) and other Defence Establishments agreed to set up solar power projects on the large tracts of land and vacant rooftops which they own. The Cabinet has approved the Scheme in its meeting held on 10th December, 2014. The Ministry has issued Administrative Approval on 07th January, 2015.

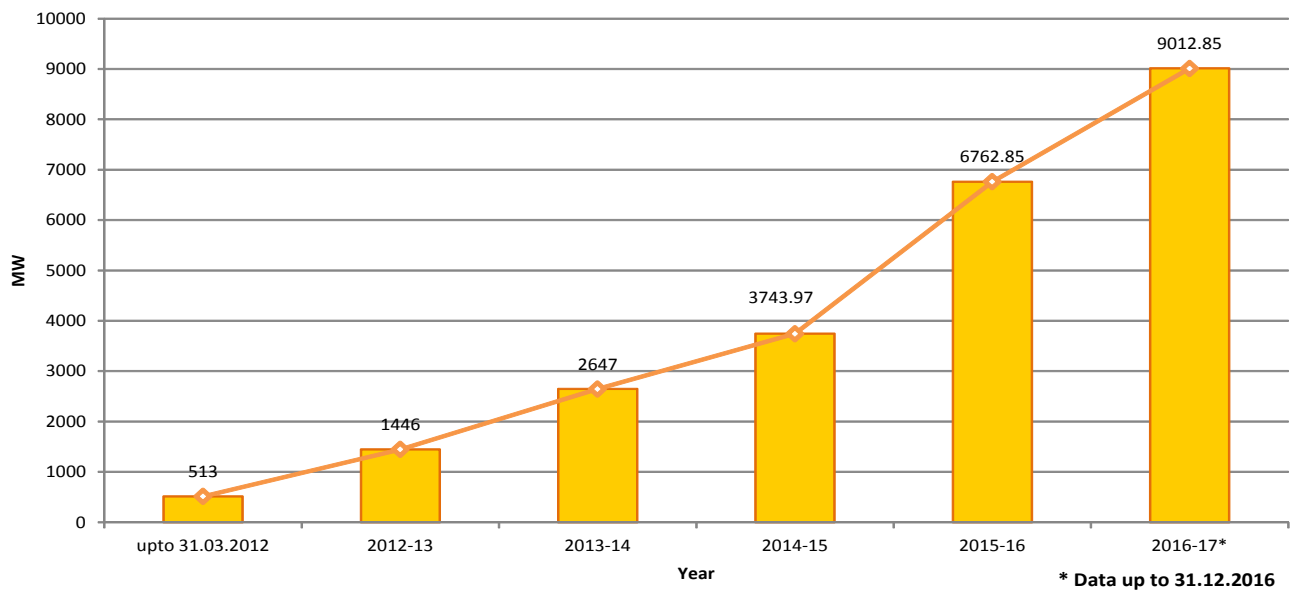
Table 4.2 State-wise estimated Solar Energy Potential vs. installed solar capacity in the Country as on 31.12.2016.

Sr. No.	State/UT	Solar Potential (GWp) #	Installed Capacity (MW) as on 31.12.2016
1	Andhra Pradesh	38	979.65
2	Arunachal Pradesh	9	0.27
3	Assam	14	11.18
4	Bihar	11	95.91
5	Chhattisgarh	18	135.19
6	Goa	1	0.05
7	Gujarat	36	1158.5
8	Haryana	5	53.27
9	Himachal Pradesh	34	0.33
10	Jammu & Kashmir	111	1.00
11	Jharkhand	18	17.51
12	Karnataka	25	327.53
13	Kerala	6	15.86
14	Madhya Pradesh	62	840.35
15	Maharashtra	64	430.46
16	Manipur	11	0.01
17	Meghalaya	6	0.01
18	Mizoram	9	0.10
19	Nagaland	7	0.50
20	Odisha	26	77.64
21	Punjab	3	545.43
22	Rajasthan	142	1317.64
23	Sikkim	5	0.01
24	Tamil Nadu	18	1590.97
25	Telangana	20	973.41
26	Tripura	2	5.02
27	Uttar Pradesh	23	239.26
28	Uttarakhand	17	45.10
29	West Bengal	6	23.07
30	Delhi	2	38.78
31	UTs & Others	1	88.68
TOTAL		750	9012.69

 # Assessed by National Institute of Solar Energy

** includes 100.92 MW from other rooftop systems.*

Graph 4.1



4.28 The broad guidelines of the scheme are as under:

i. A capacity of 300 MW will be set up in various Establishments of Ministry of Defence i.e. Establishments of Army, Navy, Air Force, Ordnance Factory Board, Defence Laboratories and Defence PSUs etc. Para Military Forces would also be covered under this scheme. Minimum size of the project shall be 1 MW.

Government has also given permission for Right to Use the Defence Land by the Developers chosen by Defence Establishments by way of lease and otherwise or for self-use of the same by Defence Establishments themselves for the purpose of setting up of Solar Power Projects and sale of excess power to the Distribution Companies.

ii. The projects under this Scheme will mandatorily use solar cells/modules which are made in India.

iii. The aforesaid Establishments would identify locations for developing solar projects, anywhere in the country including border areas from time to time.

iv. The following two modes may be used for tendering

A) Developer Mode: This is mode under which the project is given to developer, who makes the investment, own the project and supplies power to Defence Establishments.

B) EPC Mode: This is applicable when project is built through EPC contractor and investment is made by the Defence establishment/Para Military Forces.

v. The Defence organisations/Establishments will be free to own the power projects i.e. get a EPC contractor to build the project for them or get a developer who makes the investment and supplies power at a fixed tariff of Rs.5.50 per unit for 25 years (or Rs. 4.75 with AD). EPC has been recommended by MHA, Planning Commission and MoD.

vi. The solar project developers will be provided VGF based on the bid. The bidders will be selected on the basis of bids for minimum VGF requirement for the project with

commitment to supply solar power at Rs. 5.50/KWh for 25 years. However, the upper limits of the VGF are as follows:

Category-I: Rs.2.5 Cr./MW for project capacity upto 5 MW or 30% of the project cost whichever is lower;

Category-II: Rs. 2 Cr./MW for project capacity greater than 5 MW upto 25 MW or 30% of the project cost whichever is lower; and

Category-III: Rs. 1.5 Cr./MW for project capacity greater than 25 MW or 30% of the project cost whichever is lower.

4.29 Domestic Content Requirement (DCR): The entire capacity of 300 MW will be kept for bidding in phases, with DCR. Under DCR, the solar cells and modules used in the solar PV power plants must both be made in India as per specification and testing requirement by MNRE.

4.30 Project Implementation Schedule: Total of 300 W capacities to be added in 5 years period i.e. from 2014-19.

4.31 Achievements: As on date, 356 MW has been allocated under this scheme.

Sl. No.	Name of Organisation	Capacity Sanctioned (MW)	Status
1.	Ordnance Factory Board	07	Construction completed but yet to be commissioned.
2	Bharat Electronics Ltd.	150	*15 MW project awarded to BHEL & construction started. * 20 MW : LOI issued * 23 MW : Tendering to be done by March,2017
3	Bharat Dynamics Limited	25	5 MW: LOI issued
4	Department of Defence	150	Tendering for 15MW to be done by December, 2016
5	Hindustan Aeronautics Ltd., Nasik	15	*39 MW: Tender issued & award by January,2017 *111 MW: Tendering to be done by April,2017
6	Ordnance factory	05	Tendering for 15 MW to be done by December, 2016
7	MIDHANI	04	Tendering for 15MW to be done by December, 2016
	Total	**356**	

Implementation of Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects.

4.32 The scheme for development of Solar Parks and Ultra Mega Solar Power Projects has been conceived on the lines of the "Charanka Solar Park" in Gujarat which is a first-of-its-kind large scale Solar Park in India with contiguous developed land and transmission connectivity.

Solar Modules at the 250 MW Solar Park at Ananthapuramu, Andhra Pradesh

4.33 This scheme envisages supporting the States in setting up solar parks at various locations in the country with a view to create required infrastructure for setting up of Solar Power Projects. The solar parks will provide suitable developed land with all clearances, transmission system, water access, road connectivity, communication network, etc. This scheme will facilitate and speed up installation of grid connected solar power projects for electricity generation on a large scale. All the States and Union Territories are eligible for benefitting under the scheme.

4.34 The salient features of the scheme are as under:

i. It is proposed to set up at least 25 Solar Parks and Ultra Mega Solar Power Projects targeting over 20,000 MW of solar power installed capacity within a span of 5 years starting from 2014-15.

ii. The capacity of the Solar Parks shall be 500 MW and above. However, smaller parks may be considered in Himalayan Region & other hilly States where contiguous land may be difficult to acquire in view of difficult terrain and in States where there is acute shortage of non-agricultural land.

iii. The solar parks will be developed in collaboration with the State Governments and their agencies. The choice of implementing agency for developing and maintaining the park is left to the State Government.

iv. The implementing agency may be sanctioned a grant of upto Rs.25 Lakh/Park for preparing Detailed Project Report (DPR) of the Solar Park.

v. Thereafter, application may be made by the implementing agency to Solar Energy Corporation of India (SECI) for the grant of up to Rs. 20 lakh/MW or 30% of the project cost including Grid-connectivity cost, whichever is lower. The approved grant will be released by SECI as per milestones prescribed in the scheme.

vi. Financial Implications

4.35 A total fund requirement to provide Central Financial Assistance (CFA) is estimated as Rs 4050.00 crore with the following year-wise break up:

Year	Disbursement of funds (Rs. in Crore)
2014-15	500.00
2015-16	550.00
2016-17	600.00
2017-18	1000.00
2018-19	1400.00
	4050.00

4.36 Specific Advantages

i. Solar parks will enable development of solar power in remote areas where land is inexpensive.

ii. As transmission system will be developed for the entire park, developers will not have to set up their own transmission lines. This will not only save money but will also avoid damaging the land scape of the area as only limited transmission lines would be laid.

iii. The developers would be able to set up projects very fast as they will not have to get statutory and other clearances.

iv. India will emerge as a major solar power producing country as nowhere in the world solar parks are being developed on such a large scale.

Achievements

4.37 A total of 34 Solar Parks in 21 States have been approved with a solar power capacity of 20000 MW as on 31.12.2016. State-wise details are given in **Table 4.3.**

(i) Physical Progress: Parks are categorized in 3 categories:

Category	Progress
A: where work has already started	8 solar park with aggregate capacity 7400 MW
B: where work will start in 3 months	20 solar parks with aggregate capacity 10421 MW
C: where work may start after 3 months time	6 solar parks with aggregate capacity 2149 MW

(II) Financial Progress: Central Financial Assistance upto Rs. 25 lakh per DPR is admissible and for Park development, Rs. 20 lakh per MW or 30% of the project cost whichever is lower is admissible. Details of CFA released is as under:

(Rs. in crore)

2014-15	2015-16	2016-17	Total
172.50	365.72	162.80	701.02

Table 4.3 Details of Solar Parks Sanctioned				
Sl. No.	**State**	**Capacity (MW)**	**Name of the Solar Power Parks Developer (SPPD)**	**Land identified at**
1.	Andhra Pradesh	1500	AP Solar Power Corporation Pvt. Ltd., JVC of SECI, APGENCO and NREDCAP	NP Kunta of Anantpuramu & Galiveedu of Kadapa Districts
2.	Andhra Pradesh	1000		Kurnool District
3.	Andhra Pradesh	1000		Galiveedu Madal, Kadapa district
4.	Andhra Pradesh	500		Talaricheruvu Village, Tadipathri Mandal, Anathapuramu district of Andhra Pradesh
5.	Arunachal Pradesh	100	Arunachal Pradesh Energy Development Agency (APEDA)	Tezu township in Lohit district
6.	Assam	69	JVC of APDCL, APGCL	Amguri in Sibsagar district
7.	Chhattisgarh	500	Chhattisgarh Renewable Energy Development Agency	Rajnandgaon, Janjgir Champa districts
8.	Gujarat	700	Gujarat Power Corporation Limited	Radhanesda, Vav, Distt. Banaskantha
9.	Haryana	500	Saur Urja Nigam Haryana Ltd (SUN Haryana)	Bugan in Hissar district, Baralu and Singhani in Bhiwani district and Daukhera in Mahindergarh district
10.	Himachal Pradesh	1000	HP State Electricity Board Ltd.	Spiti Valley of Lahaul & Spiti District
11.	Jammu & Kashmir	100	Jammu and Kashmir Energy Development Agency	Mohagarh and Bdla Brahmana, District- Samba
12.	Karnataka	2000	Karnataka Solar Power Development Corporation Pvt. Ltd.	Pavagada taluk Tumkur dist.
13.	Kerala	200	Renewable Power Corporation of Kerala Limited	Paivalike, Meenja, Kinanoor, Kraindalam and Ambalathara villages of Kasargode district
14.	Madhya Pradesh	750	Rewa Ultra Mega Solar Limited	Gurh, Rewa, MP
15.	Madhya Pradesh	500	Rewa Ultra Mega Solar Limited	Neemuch and Mandsaur
16.	Madhya Pradesh	500	Rewa Ultra Mega Solar Limited	Agar and Shajapur
17.	Madhya Pradesh	500	Rewa Ultra Mega Solar Limited	Chhattarpur
18.	Madhya Pradesh	500	Rewa Ultra Mega Solar Limited	Rajgarh-- Morena
19.	Maharashtra	500	M/s Pragat Akshay Urja Ltd	Sakri, Dhule district of Maharashtra
20.	Maharashtra	500	Maharashtra State Electricity Generating Company Ltd. (MAHAGENCO)	Dondaicha, district Dhule, Maharashtra
21.	Maharashtra	500	M/s K. P. Power Pvt. Ltd	Taluka Patoda, district Beed, Maharashtra
22.	Meghalaya	20	Meghalaya Power Generation Corporation Ltd (MePGCL)	West Jaintia Hills & East Jaintia Hills districts

23.	Nagaland	60	Directorate of New & Renewable Energy, Nagaland	Dimapur, Kohima and New Peren districts
24.	Odisha	1000	Green Energy Development Corporation of Odisha Limited	Balasore, Keonjhar, Deogarh, Boudh, Kalahandi and Angul
25.	Rajasthan	680	Rajasthan Solar Park Development Company Ltd.	Bhadla Phase II, Bhadla, Rajasthan
26.	Rajasthan	1000	Surya Urja Company of Rajasthan Ltd	Bhadla Phase III, Bhadla, Rajasthan
27.	Rajasthan	750	M/s Essel Surya Urja Company of Rajasthan Limited	Villages Ugraas, Nagnechinagar & Dandhu, tehsil Phalodi, dist Jodhpur (450 MW) and villages Lavan & Purohitsar, tehsil Pokaran, dist Jaisalmer (300 MW)
28.	Rajasthan	500	M/s Adani Renewable Energy Park Rajasthan Limited	Bhadla Phase IV, Bhadla, Jodhpur Rajasthan
29.	Rajasthan (421 MW through support of GoI out of 1500 MW)	421	M/s Adani Renewable Energy Park Rajasthan Limited	Fatehgarh & Pokaran, Jaisalmer, Rajasthan
30.	Telangana	500	Telangana New & Renewable Energy Development Corporation Ltd. (TNREDC)	Gattu, Mehboob Nagar Distt.
31.	Uttar Pradesh	600	Lucknow Solar Power Development Corporation Ltd.	Jalaun, Allahabad, Mirzapur and Kanpur Dehat districts
32.	Uttarakhand	50	State Industrial Development Corporation Uttarakhand Limited (SIDCUL)	Industrial Area, Sitarganj (Phase I), Industrial Area, Sitarganj (Phase II) and Industrial Area, Kashipur
33.	West Bengal	500	West Bengal State Electricity Distribution Company Ltd.	East Mednipur, West Mednipur, Bankura
34.	Tamil Nadu	500	To be finalized	Initially proposed in Ramanathapuram district. Site under revision.
	TOTAL 34 solar parks in 21 states	**20000**		

VIABILITY GAP FUNDING (VGF) SCHEME

750 MW VGF Scheme under JNNSM Phase-II, Batch-I

4.38 Solar Energy Corporation of India (SECI) is implementing the first VGF scheme of 750 MW, under JNNSM Phase-II, Batch-I for setting up large scale ground-mounted solar PV projects on pan-India basis. After a transparent selection and award process, project capacity of 680 MW could successfully achieve financial closure. This entire capacity has been commissioned and projects are under commercial operation. State-wise details of commissioned projects are given in **Table 4.4.**

BOX 4.1

250 MW Solar Power Projects established by NTPC at Ananthapuramu Solar Park in Andhra Pradesh

Ministry approved the Ananthapuramu solar park of capacity 1500 MW to be set up in Andhra Pradesh in December, 2014. Andhra Pradesh Solar Power Corporation Private Limited (APSPCL), a Joint Venture Company between Solar Energy Corporation of India (SECI), Andhra Pradesh Power Generation Corporation Ltd (APGENCO) and New and Renewable Energy Development Corporation of Andhra Pradesh Ltd (NREDCAP) was incorporated under the Companies Act, 2013 with the main object of engaging in the business of developing Solar Parks in the State of Andhra Pradesh.

About 11,500 acres of barren and uncultivable land was identified for this Solar Park, out of which about 8000 acres was found to be feasible for establishing solar power projects. The identified land comprised of about 70% government land, 25% assigned land and 5% patta land.

MOU was entered by Govt. of Andhra Pradesh with NTPC in September, 2014 for establishment of 1000 MW solar project in Andhra Pradesh. Around 1250 Acres of land (@ 5 Acres/MW) was handed over to NTPC in April, 2015 for establishing 250 MW solar power project in Phase-I at N.P. Kunta Mandal, Ananthapuramu District. NTPC awarded EPC contract to four agencies in April, 2015. PPA was also signed with APDISCOMS in April, 2015 for supply of solar power @ Rs. 6.16/ kWh. The tariff was later reduced by APERC to Rs. 5.96/ kWh.

The land acquisition was completed in a short span of about 5 months which normally takes more than a couple of years. To expedite and complete the land acquisition in the shortest possible time, Government of Andhra Pradesh (i) transferred the Government Land to APSPCL immediately pending government procedures and finalization of terms and conditions of lease, (ii) constituted Negotiating Committee to negotiate with the farmers and to finalize the compensation through mutual consent for acquiring assigned and patta lands.

33kV/220kV pooling sub-station was established by APTRANSCO on behalf of APSPCL for internal evacuation of solar power from each solar project. The work of 33kV/220kV pooling sub-station commenced in September, 2015 and completed in April, 2016. 220kV/400 kV Grid substation and connected line was established by Power Grid Corporation of India Ltd (PGCIL) for external evacuation. The work for this Grid substation commenced in July, 2015 and was completed in April, 2016.

The solar power projects aggregating 250 MW were commissioned as detailed below:

100 MW:	30.04.2016	50 MW: 30.05.2016
50 MW:	07.06.2016	50 MW: 10.08.2016

The Peak generation so far was 225.7 MW on 30.11.2016 at 11:44 hrs and cumulative generation up to 08.01.2017 was 230.3486 MU. The project is generating power at an average CUF of more than 19%.

Table 4.4 State-wise details of commissioned projects under 750 MW VGF Scheme under NSM Phase-II, Batch-I	
State	**Capacity**
Rajasthan	355 MW
Gujarat	40 MW
Maharashtra	25 MW
Madhya Pradesh	220 MW
Karnataka	10 MW
Tamil Nadu	10 MW
Odisha	20 MW
Total	**680 MW**

2000 MW VGF Scheme of NSM Phase II, Batch III

4.39 The second batch of VGF scheme of 2000 MW capacity (JNNSM Phase II, Batch III) is under implementation by SECI. Tenders are being brought out on state-specific basis, either in solar parks being developed in the states or outside solar parks.

4.40 Under this scheme, developers would be paid tariff of Rs. 4.43 per kWh or the discounted tariff discovered through e-reverse auctioning, for 25 years by entering into a PPA with SECI. Power from these projects would be sold to various discoms/Bulk consumers/state utilities by SECI at Rs.4.50 per kWh (including trading margin of 7 paisa per unit).

4.41 In this scheme, 250 MW capacity has been earmarked for bidding with Domestic Content Requirement (DCR).

4.42 SECI has issued RfS for 2510 MW capacity in 7 states/UTs. LoI has been issued for 2395 MW. PPAs have been signed for 2395 MW. State-wise status as on 31.12.2016 is given in **Table 4.5**:

5000 MW VGF Scheme Batch IV Phase II

4.43 On the lines of the 2000 MW VGF Scheme, another VGF scheme of 5000 MW capacity has been announced. First and second parts are being taken up at present for FY 2015-16 and FY 2016-17 for 2500 MW.

Table 4.5 State-wise status under 2000 MW VGF Scheme of NSM Phase II, Batch III				
S. No.	State	RfS issued	LoI issued	PPA signed
1	Maharashtra	500 MW	500 MW	500 MW
2	Uttar Pradesh	325 MW	325 MW	325 MW
3	Andhra Pradesh	500 MW	500 MW	500 MW
4	Chhattisgarh	100 MW	100 MW	100 MW
5	Karnataka	1000 MW	970 MW	970 MW
6	Puducherry	35 MW	-	-
7	Himachal Pradesh	50 MW	-	-
	Total	2510 MW	2395 MW	2395 MW

20 MW project at Madhya Pradesh

5 MW Project at Rajasthan

4.44 The scheme is proposed to be implemented by SECI in four tranches of 1250 MW each, spread over four years, up to FY 2018-19. This scheme also provides for purchase of solar power by SECI from selected developers at a fixed tariff of Rs. 4.43 per kWh for 25 years and supply to Discoms at Rs. 4.50 per kWh (including trading margin of 7 paise per unit). The projects are being set up either in the solar parks being developed by states or outside the solar parks.

4.45 RfS has already been issued for 2900 MW capacity in 6 states. LoI has been issued for 1020 MW. PPAs have been signed for 1020 MW. State-wise tendering status as on 31.12.2016 is given in **Table 4.6.**

Scheme for setting up of 1000 MW of Grid connected Solar PV power projects by CPSUs and Govt. organizations under various Central/State Schemes/Self use/3rd Party sale/Merchant sale with Viability Gap Funding (VGF) under Phase-II of NSM.

4.46 The Ministry launched the above scheme in January 2015 to set up 1000 MW of Grid Connected Solar PV Power Project by CPSUs and Govt. Organizations with VGF.

4.47 The broad guidelines of the scheme are as under:

(i) The duration of implementation of the Scheme is 2015-18.

(ii) The project is to be owned by GOI Organizations/CPSUs.

(iii) The Project can be set up on land/rooftops.

(iv) The power so generated can be for self-use/third party sale/merchant sale or sale to Discoms on applicable tariff.

Table 4.6 State-wise tendering status under 5000 MW VGF Scheme Batch IV Phase II

S. No.	State	RfS issued	LoI issued	PPA signed
1	Gujarat	400 MW	250 MW	250 MW
2	Odisha	300 MW	270 MW	270 MW
3	Andhra Pradesh	750 MW	-	-
4	Maharashtra	500 MW	500 MW	500 MW
5	Karnataka	200 MW	-	-
6	Rajasthan	750 MW	-	-
	Total	**2900 MW**	**1020 MW**	**1020 MW**

(v) GOI will provide VGF as under:

a) Rs.1 Cr. /MW, if Cells and Modules for the project are manufactured indigenously.

b) Rs.50 Lakh /MW, if Modules for the project are manufactured indigenously.

(vi) VGF will be released in two tranches as follows:

a) 50% on LoI and start of installation work at plant; and

b) balance 50% on successful commissioning of the full capacity of the project (CoD).

4.48 Under the above Scheme, MNRE had allocated 1037.26 MW capacity to following 16 CPSUs/ Govt. Organizations within the sanctioned funds of Rs.1000 Crore for this scheme as shown in **Table 4.7**.

4.49 Status of award of projects in 3 categories:-

Category	Status of work	Capacity (MW)	Name of CPSUs and capacity (MW)
A	(i)Work completed	261.50	NTPC Ltd. (250) (Ananthpur- Andhra Pradesh) **(Box Item 4.1)** and Bharat Heavy Electrical Ltd. (6.50), RINL (5 MW)
	(ii) Work started	434.50	NTPC Ltd. (409.5), BHEL (10 MW), Paradip Port Trust (10 MW); DNH Power Distribution Co. (3 MW), and Scooters India Ltd (1 MW), Sambhar Salts Ltd. (1 MW),
B	Work is likely to be started in next 3 months	305.76	Coal India (200 MW), NHPC (50 MW) , THDC India Ltd. (50 MW); GAIL (India) (5.76 MW)
C	Work is not likely to be started in next 3 months	35.50	NTPC (20.5 MW) NEEPCO (5 MW), PEC Ltd. (1 MW); Central Armed Police Forces Institute of Medical Sciences (CAPFIMS), (1 MW), Cement Corporation of India (6 MW) ; and NIFTEM (2 MW)
	Total	1037.26	

Physical Performance

4.50 Out of the total sanctioned capacity of 1037.26 MW, solar projects of 261.50 MW capacity have already been commissioned so far. The expected date of commissioning in the case of following 7 CPSUs/Govt. organizations who have already started the work is given below:-

No.	Name of CPSU	Capacity (MW)	Expected date of commissioning
1	NTPC Ltd.	250.00 409.50	250 MW – Already commissioned 409.50 MW - Commissioning in 31/03/2017
2	Bharat Heavy Electrical Ltd	6.50 10.00	Already commissioned Commissioning in 31/03/2017
3	Rashtriya Ispat Nigam Ltd.	5.00	Commissioned on 20/12/2016
4	Paradip Port Trust	10.00	June 2017
5	DNH Power Distribution Corp.	3.00	March 2017
6	Scooters India Ltd.	1.00	10 Jan.2017
7.	Sambhar Salts Ltd.	1.00	April 2017
	Total	696.00	

7.5 MW SPV Power Project at Vishakhapatnam Port Trust

Table 4.7 Capacity, VGF allocated and released under CPSU scheme of NSM

No.	Name of PSU/Govt. organisations	Capacity sanctioned (MW)	VGF Amount (in crore Rs.)		Location of the project
			required	released	
1	NTPC	680.00	680.00	422.50	(1) Anantapuramu (A.P.) (250 MW), (2) Mandsaur (MP) (229.5 MW) (3) Bhadla Rajasthan (180 MW) (4) Karnataka (20.5 MW)
2	BHEL	16.50	16.50	3.25	Trichy (TN) Ramachandrapuram,(Hyd.) Telangana) Bhopal (MP)
3	Rashtriya Ispat Nigam Ltd.	5.00	5.00	2.50	Visakhapatnam (A.P.)
4	Coal India Ltd.	200.00	200.00	0.00	MP
5	NHPC Ltd.	50.00	25.00	0.00	Tamil Nadu
6	NEEPCO	5.00	5.00	0.00	Assam
7	GAIL (India) Ltd	5.76	5.76	0.00	5.76 MW at Pata (UP) & balance in MP
Under Ministries/Departments Quota @ 1 MW each					
8	(i) Scooters India Ltd;	1.00	1.00	0.50	Lucknow (UP)
9	(ii) Sambhar Salts Ltd	1.00	1.00	0.00	Sambhar (Rajasthan)

Continued

10	(iii)Dadra Nagar Haveli Power Distribution Corporation Ltd.	3.00	3.00	1.50	Dadra Nagar haveli (UT)
11	(iv) PEC Ltd.	1.00	1.00	0.00	JNU Delhi
12	(v) Central Armed Police Forces Institute of Medical Sciences (CAPFIMS), New Delhi	1.00	1.00	0.00	New Delhi
13	Paradip Port Trust	10.00	10.00	0.00	Paradip Port (Odisha)
14	Cement Corporation of India	6.00	6.00	0.00	Tandur (Telangana)
15	THDC India Ltd.	50.00	25.00	0.00	Kasargod Distt. Kerala
16	NIFTEM	2.00	2.00	0.00	Kundli, Haryana
	Total	**1037.26**	**987.26**	**430.25**	
	SECI's fund handling charge @ 1% of funds disbursed		4.30	3.01	
	Total	**1037.26**	***991.56**	**433.26**	

** Total VGF limit is Rs.1000 Cr.*

Financial performance

4.51 During 2015-16, VGF of Rs.128.75 crore was released to 3 CPSUs as 1st instalment (50 % of the total VGF). VGF of Rs.304.44 crore has been released so far during 2016-17 and Rs.44 crore is also expected to be released till 31.3.2017. Total VGF of Rs.433.19 crore has been released so far under the above Scheme. CPSUs who have started the work in December 2016 or are likely to start work in Jan./Feb.2017 are being pursued for sending the request letter for release of 1st instalment which becomes due on start of work and issue of LoI.

4.52 VGF of Rs.375.00 crore and Rs.148.00 crore is expected to be released during FY 2017-18 and 2018-19 respectively.

15000 MW GRID-CONNECTED SOLAR PV POWER PLANTS THROUGH NTPC LTD.

4.53 The Cabinet has approved the Implementation of Scheme for setting up of 15,000 MW of Grid-connected Solar PV Power projects under National Solar Mission through NTPC Ltd./ NVVN in three tranches as follows :

Tranche-I : 3,000 MW: 2014-15 to 2016-17

Tranche-II : 5,000 MW: 2015-16 to 2017-18

Tranche-III : 7,000 MW: 2016-17 to 2018-19

4.54 In Tranche-I, which is part of Batch-II of Phase-II of National Solar Mission, 3000 MW capacity of solar PV power plants will be based on bundling of solar power (3000 MW) with unallocated thermal power (1500 MW) in the ratio of 2:1 (in MW terms), for which the required 1500 MW unallocated thermal power will be made available by the Ministry of Power.

3000 MW Grid Connected Solar PV Power Projects under NSM Phase-II, Batch-II, Tranche_I – 'State Specific Bundling Scheme'

Mechanism for implementation

4.55 The mechanism of operation of 3,000 MW capacity Solar PV plants under Tranche-I of Batch-II of Phase-II of NSM, is as follows:

a) The eligible plant capacities will be minimum 10 MW and maximum may be fixed for each State lot of projects.

b) The bidding will be State specific and conducted through e-bidding.

c) It will be based on fixed levellised tariffs. The developers will submit bids quoting a fixed levellised tariff for the entire project duration of 25 years.

d) There will be State specific tenders. The selection of bids will be done based on the tariff quoted by the bidders. Selection will be based on lowest quoted levellised tariffs. The tariff bid cannot be higher than the Applicable Tariff on the day bids are received as may be fixed by the State Electricity Regulatory Commission (SERC) for the State where the projects are to be set up/ Central Electricity Regulatory Commission (CERC).

e) The bidders will be free to avail fiscal incentives like Accelerated Depreciation, Concessional Customs and Excise Duties, Tax Holidays, etc. as available for such projects. The same will not have any bearing on comparison of bids for selection.

f) NTPC Ltd. / NVVN will purchase the Solar Power generated from the selected Solar PV plants at the quoted tariffs and Thermal Power at the Tariff as determined by CERC as per Regulations from time to time for power from the respective Thermal Power Plant from which power is allocated. NTPC Ltd. / NVVN will bundle the Solar Power with unallocated Thermal Power from Coal based stations of NTPC Ltd. on 2:1 basis (2 MW of Solar with 1 MW of Thermal), and sell the Bundled Power to willing State Utilities under 25 years Power Sale Agreements (PSAs), at Weighted Average Tariff of the Solar and Thermal components plus Trading Margin of Paisa Seven (7) per kWh. The weighted average tariff will be separately calculated for each State for the solar Power.

g) Excess power whether generated in normal course or through repowering will be purchased at a notional support price of Rs. 3/kWh only. It will be at the option of the developer to offer it (excess power) to NTPC/ NVVN or sell in open market. Further, the developer will be free to sell power to any one for period beyond 25 years of firm PPA offered by NTPC Ltd. / NVVN.

Current Status (as on 31.12.2016):

4.56 Based on the requests received from various States for allocation of solar power under the 3000 MW State Specific Bundling Scheme under NSM Phase-II, Batch-II, the following State-wise allocations have been made:

Sl. No.	State/ UT	Capacity allotted in OPEN category (MW)	Capacity allotted in Domestic Content Requirement (DCR) category (MW)	In Solar Parks	Outside Solar Parks	Total Capacity allotted (MW)
1	Andhra Pradesh	1100	150	1250	0	1250
2	Karnataka	500	100	600	0	600
3	Rajasthan	550	100	420	230	650
4	Telangana	350	50	0	400	400
5	Uttar Pradesh	100	00	0	100	100
	TOTAL	2600	400	2270	730	3000

- Notice Inviting Tender Published for full Tranche-I of 3,000 MW.
- Reverse auction completed: 2750 MW.
- Power Sale Agreement Signed with State Discoms: 2750 MW
- Letter of Intent issued to successful bidders: 2750 MW
- PPAs signed with Solar power developers: 2700 MW.
- Lowest bid for solar power in the country (without any VGF) @ Rs. 4.34/unit has been received for solar PV power plants to be set up at Bhadla Solar Park in Rajasthan under this scheme

GRID-INTERACTIVE ROOFTOP & SMALL SPV POWER PLANTS PROGRAMME

Background

4.57 With an objective of increasing energy security, reducing fossil fuel imports and a cleaner environment, the Government of India (GoI) has set a target of 1,00,000 megawatts (MW) of solar installations by the year 2022, out of which 40,000 MW are targeted for rooftop solar photovoltaic (RTS) systems.

4.58 There is a large potential available for generating solar power using unutilized space on rooftops and wastelands around buildings. Small quantities of power generated by each individual household, industrial building, commercial buildings or any other type of building can be used to partly fulfill the requirement of the building occupants and surplus, if any, can be fed into the grid. If the existing roof space of buildings is utilized, the Grid Connected SPV Rooftop systems on buildings can also replace/ supplement the existing DG gensets installed for minimum load requirement for operation during load shedding

4.59 In a solar rooftop system, the solar panels are installed in the roof of any residential, commercial, institutional and industrial buildings. This can be of two types (i) Solar Rooftop System with storage facility using battery, and (ii) Grid Connected Solar Rooftop System.

4.60 In grid connected rooftop or small SPV system, the DC power generated from SPV panel is converted to AC power using power conditioning unit and is fed to the grid either of 33 kV/11

10MW Grid connected Solar Rooftop Power Plant, Punjab

kV three phase lines or of 440/220 Volt three/single phase line depending on the capacity of the system installed at institution/commercial establishment or residential complex and the regulatory framework specified for respective States.

Scheme Details and Achievement

4.61 The Ministry is implementing a programme on Grid Connected Rooftop and Small Solar Power Plants Programme which is providing subsidy upto 30% of benchmark cost for the general category states and upto 70 % of benchmark cost for special category states, i.e. North Eastern States including Sikkim, Uttarakhand, Himachal Pradesh, Jammu & Kashmir and Lakshadweep, Andaman & Nicobar Islands is available for residential, institutional and social sector. For Government sector incentives upto 25% of the benchmark cost is provided. About 4200 MW is being targeted under this scheme.

4.62 So far, 3044 MWp solar rooftop systems have been sanctioned/ approved of and aggregate 506 MWp have been installed in residential, industrial, commercial and institutional sectors. Solar rooftop projects are being implemented by State Nodal Agencies (SNA's), Solar Energy Corporation of India (SECI), Public Sector Undertakings (PSUs) and other Multi Government Agencies (MGAs), Private Developers etc.

4.63 The major infrastructure sector i.e. Metro Rail Projects, Railways, Airports, Jal Boards, Shipping, Sports Stadia, Oil Companies, Factories etc. are also coming forward for installation of Grid Connected Solar Rooftop Plants.

4.64 Model Power Purchase Agreement (PPA), Memorandum of Understanding and Capex Agreement have been developed duly vetted by Department of Expenditure (Ministry of Finance) and Department of Legal Affairs, Ministry of Law & Justice.

4.65 Solar Energy Corporation of India has tendered 500MWp for Social, Institutional and Residential Sector and 1000 MWp tender for Government Sector including PSUs

4.66 In addition, 1187 Channel Partners/ New Entrepreneurs have been empanelled which are engaged in the promotion/generation of solar power in the country.

4.67 Ministry (MNRE) has been collating data about RTS potential of rooftops and surplus areas of Government building premises of various Ministries/Departments. Based on the data available till now for about 50 Ministries/Departments, about 5900 MW power and annual financial savings of Rs.830 crore can be achieved by these Ministries/Departments.

4.68 The ministry has recently organized a national workshop on 7th June 2016 in New Delhi wherein Commitment Certificate of about 3800 MWp has been received from different Ministries/ Departments. In addition 3 important reference documents were released:

- Compendium of policies and regulations of GOI, State/UTs
- Best Practice Guide on Solar Rooftop
- Working paper on international solar alliance: nurturing possibilities

4.69 Solar Rooftop Calculator has also been developed for financial calculations of grid connected solar rooftop projects on PAN India basis.

4.70 An online platform namely SPIN has been developed for submission of online proposal, project completion reports, empanelment of channel partners/ New Entrepreneurs / Govt. Agencies etc., data management, communications etc. SPIN stands for Solar Photovoltaic installations is an e-governance of initiative of the Ministry. It is an online system designed to monitor almost all activities involved in Solar Rooftop Installations. It contains a useful tool for calculating the rooftop area or estimate for installation of rooftop for a lay man and provision for entering his request for installing the SPV system. For mobile users there is provision for QR Code. For

2 MWp grid connected solar rooftop plant at Kolkata Airport, AAI

198 kWp grid connected solar rooftop plant at Pitambera Polymers Industries Pvt Ltd, Maharashtra

agencies whether it is New Entrepreneur, Channel Partner or Govt agencies or SNAs or any other agencies provision is there for the registration to empanelment and applying for target and disbursement of subsidies. SPIN is also inbuilt with the utilities like email and SMS for communicating to various stake holders. It is a one stop portal for Govt. of India's prestige programme Solar Rooftop Installations. The SPIN is designed and developed by National Informatics Centre (NIC).

a) Mobile App has also been developed for Solar Rooftop Project

b) The technical particulars have been finalised for DG S& D rate contract for Government procurement.

c) State/UT governments on 21st June 2016 were requested to submit their Commitment Certificate for installation of rooftop solar projects in their States/UTs.

4.71 MNRE has developed a panel of expert PSUs for facilitating Ministries/State Governments in bidding process. Ministry/ State Government may also choose to implement RTS projects through their own PSUs/other notified designated agencies in the scheme such as State Nodal Agencies, DISCOMS, ULBs, channel partners for commercial and industrial and their own PSUs. These PSUs are expected to survey potential, submit brief feasibility report, collate RTS projects of various Departments, undertake bidding in model chosen by Department and facilitate signing of agreement between selected developer and the Department. The 3% service/Project Management Consultancy (PMC) charges for such PSUs/designated agencies (except channel partners) will be provided by MNRE.

4.72 In addition, the Ministry is also promoting solar rooftops in the solar cities/smart cities. More than 45 MWp grid connected solar rooftop plants have been installed in these solar cities. In smart city guidelines the minimum 10% energy supply to be met from Solar power.

4.73 Training of Surya Mitras and staff of DISCOM/SNA.

4.74 MNRE is interacting with DISCOMs from all over the country in their review meeting being organized by Ministry of Power every month to seek their cooperation.

4.75 Ministry has also started geo-tagging of the solar rooftop projects.

100 kWp Grid Connected Solar rooftop Power Plant at Municipal Office & Council Hall Building, Vijayawada, Andhra Pradesh

Initiatives by States/UTs

4.76 Electricity Regulatory Commissions of 34 States/UTs namely Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Dadra and Nagar Haveli, Daman and Diu, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram NCT of Delhi, Orissa, Puducherry, Punjab, Rajasthan, Sikkim, Tamil Nadu, Telangana, Tripura, Uttar Pradesh, Uttarakhand and West Bengal have notified regulations for feed-in-tariff.

4.77 So far, 20 States namely Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir ,Jharkhand, Karnataka, Kerala, Madhya Pradesh, Manipur, Punjab, Puducherry, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand and West Bengal have come out with Solar Policy supporting grid connected rooftop systems. Govt. of Haryana, Chhattisgarh and Chandigarh has issued mandatory notification for installation of solar rooftop plants for certain categories of buildings.

4.78 Chief Electrical Inspector (CEI) inspection has been made optional by States of Andhra Pradesh, Haryana and Rajasthan for solar rooftop plants upto certain capacity.

Initiatives for loans and International funding

4.79 Reserve Bank of India has included renewable energy projects under priority sector lending for which bank loans up to a limit of Rs.15 crore to borrowers will be available for renewable energy projects including grid connected solar rooftop and ground mounted systems. For individual households, the loan limit is Rs.10 lakh per borrower.

4.80 Department of Financial Services has advised all Public Sector Banks to provide loans for grid connected rooftop solar systems as home loan/ home improvement loan. So far, ten PSBs

namely Bank of India, Syndicate Bank, State Bank of India, Dena Bank, Central Bank of India, Punjab National Bank, Allahabad Bank, Indian Bank, Indian Overseas Bank and State Bank of Bikaner & Jaipur have given instructions to their branches.

4.81 Department of Expenditure has reduced the Guarantee fee from 1.2% to 0.5% for multilateral loan of USD1370 million including World Bank loan of USD620 million through State Bank of India, Asian Development Bank loan of USD500 million through Punjab National Bank and New Development Bank loan USD250 million through Canara Bank .

4.82 Multilateral grant of USD5 million by ADB, USD1.8 million from USAID and USD28.8 million from World Bank has been approved for solar rooftop programme

4.83 Indian Renewable Energy Development Agency has formulated a scheme of low cost financing with interest rate of 9.9% to 10.75% per annum.

Other Important activities

a) The Central Electricity Authority (CEA) has also notified the "Installation and Operation of Meters" guidelines vide its amendment regulation in 3rd December 2014.

b) Awareness and publicity campaign, country-wide to be launched through electronic and print media.

c) Motivating the major sectors through awards/incentives.

d) Interacting with the banking sector for channelization of subsidy through them and availability of low cost finance for different sectors

PILOT-CUM-DEMONSTRATION PROJECT FOR DEVELOPMENT OF GRID CONNECTED SOLAR PV POWER PLANTS ON CANAL BANKS AND CANAL TOPS.

4.84 With the objective of achieving gainful utilization of the unutilized area on top of Canals and also the vacant Government land along the banks of Canals wherever available, for setting up Solar PV power generation plants for feeding the generated power to Grid, the Government of India, under National Solar Mission (NSM), has approved the implementation of "Pilot-cum-Demonstration Project for Development of Grid Connected Solar PV Power Plants on Canal Banks and Canal Tops".

Administrative Approval issued on 5th December, 2014.

Target

4.85 100 MW Grid Connected Solar PV Power Plants on Canal Banks and Canal Tops (50 MW on Canal Tops and 50 MW on Canal Banks) Implementation Arrangements

4.86 Applicability: All the States and Union Territories having Canal network will be eligible for benefits under the scheme. However, the Scheme may be availed by only those States which have either fulfilled their Solar RPOs or commit to do so within a given time frame.

4.87 Eligibility: State Power Generation Companies/ State Government Utilities/ any other State Government Organization/ PSUs/ GoI PSUs or GoI organisations, provided that they are operating in power sector or own canal systems, i.e. are into irrigation. Proposals from States in Project mode will also be acceptable on completion during 2014-15 or later.

4.88 Implementation agency: The solar PV power plants will be developed by the State Power Generation Companies/ State Government Utilities/ any other State Government Organization/ PSUs/ GoI PSUs or GoI organizations, provided that they are operating in power sector or own canal systems, i.e. are into irrigation.

4.89 Scheme Manager: The Scheme manager on behalf of MNRE would be Solar Energy Corporation of India (SECI) under the MNRE. SECI will handle funds to be made available under the scheme on behalf of GOI, for which they will be provided service charge of 1% of the funds handled/ routed through them.

4.90 Mode of Operation of Scheme: The solar PV power plants will be developed by the State Power Generation Companies/ State Government Utilities/ any other State Government Organization/ PSUs/ GoI PSUs or GoI organizations, provided that they are operating in power sector or own canal systems, i.e. are into irrigation. The Scheme manager on behalf of MNRE would be Solar Energy Corporation of India (SECI) under the MNRE. The Implementing Agency will submit the application / proposal for setting up Grid-connected Solar PV Power Plants on Canal Banks/ Canal Tops to MNRE. MNRE/SECI will analyze/ scrutinize the application/ proposal and if found appropriate, MNRE will sanction the project, including the ones in project mode made during 2014-15. Thereafter, SECI shall release the capital subsidy of upto Rs.3 crore/MW for Canal Top SPV projects and Rs.1.5 crore/MW for Canal Bank SPV Projects.

Central Financial Assistance (CFA)

- Rs.3 crore/MW or 30% of the project cost, whichever is lower, for Canal Top SPV projects and Rs. 1.5 crore/MW or 30% of the project cost, whichever is lower, for Canal Bank SPV projects.
- CFA of upto Rs.225 crore for 100 MW (50 MW on Canal Tops and 50 MW on Canal Banks) to be disbursed over a period of maximum 2 years post sanctioning of the plants as under:

- upto 40% on sanctioning of the projects.
- 60% on successful commissioning of the projects.

- Service charge to SECI @1%: Rs.2.25 crore.

Current Status

4.91 Based on the requests received from various States for allocation of canal-top/ canal-bank solar power projects under the "Pilot-cum-demonstration project for development of grid connected solar PV power plants on canal banks and canal tops", In-Principle approval given for setting up full targeted capacity of 50 MW canal-top and 50 MW canal-bank solar PV power projects, in **Tables 4.8 and 4.9**.

Canal Bank Solar Power project at Teesta Canal Full Stage -II Hydro Electric Power Station of WBSEDCL, Haptiagach, Block - Chopra, Dist. - Uttar Dinajpur, West Bengal.

Table 4.8 State-wise Allocation of 50 MW Canal-Top Solar PV projects				
Sl. No.	**State**	**Implementing Agency in the State**	**Capacity for which in-principle approval has been given (MW)**	**Commissioned As on 31.12.2016**
1	Andhra Pradesh	New and Renewable Energy Development Corporation of Andhra Pradesh (NREDCAP)	1 MW canal-top	yes
2	Gujarat	Sardar Sarovar Narmada Nigam Limited (SSNNL)	10 MW canal-top	--
3	Karnataka	Krishna Bhagya Jala Nigam Limited (KBJNL)	10 MW canal-top	--
4	Kerala	Kerala State Electricity Board Limited (KSEB)	2 MW canal-top	---
5	Punjab	Punjab Energy Development Agency (PEDA)	20 MW canal-top	--
6	Uttarakhand	Uttarakhand Jal Vidyut Nigam Limited	1 MW canal-top	--
7	Uttar Pradesh	Uttar Pradesh Irrigation Department	6 MW canal-top	--
	Total		50 MW canal-top	

Table 4.9 State-wise Allocation of 50 MW Canal-Bank Solar PV Projects				
Sl. No.	**State**	**Implementing Agency in the State**	**Capacity for which in-principle approval has been given (MW)**	**Commissioned As on 31.12.2016**
1	Andhra Pradesh	Andhra Pradesh Power Generation Corporation Limited (APGENCO)	5 MW canal-bank	yes
2	Gujarat	Sardar Sarovar Narmada Nigam Limited (SSNNL)	15 MW canal-bank	--
3	Kerala	Kerala State Electricity Board Limited (KSEB)	1 MW canal-bank	--
4	Uttarakhand	Uttarakhand Jal Vidyut Nigam Limited	19 MW canal-bank	---
5	West Bengal	West Bengal State Electricity Distribution Company Limited (WBSEDCL)	10 MW canal-bank	yes
	Total		50 MW canal-bank	

1 MW canal-top solar PV power project commissioned by NREDCAP on Losari Canal, Gollavanitippa, Bhimavaram Rural (M), West Godavari District, Andhra Pradesh.

4.92 CFA of Rs.69.0 crore already released to SECI for onward disbursal to Project Implementing Agencies of the respective States.

4.93 Further CFA of Rs.159 crore (including service charges of SECI) to be released through SECI in 2016-17, 2017-18 and 2018-19.

OFF GRID SOLAR PHOTOVOLTAICS

4.94 Under the Off-grid and Decentralized Solar Applications for the year 2016-17, the Ministry provides 30% subsidy on the cost of the system ranging from Rs. 21/- per watt peak to Rs.120 /- depending upon the capacity of the modules and configuration of the solar photovoltaic systems /plants in General Category States in the country.

4.95 The Ministry is also providing subsidy of 40% of the capital cost limited to Rs. 160/Wp (LED based) upto 40 Watt peak & Rs. 100/Wp for system above 40 Wp limited to 300 Wp by individuals through NABARD, Regional Rural Banks and other Commercial Banks. For balance of the cost, the banks extend credit facility to the beneficiary at usual commercial rates. 300 Wp to 1 KWp systems are also covered under the scheme but the subsidy is limited to 300 Wp only. The RRBs and other Commercial Banks extended the loan for balance cost of the systems at normal interest rates. Regional Rural Banks and Commercial Banks are extending loans to the consumers and directly disbursing subsidy for solar home lighting systems and small Capacity PV systems under the financing of Off-grid Solar Applications Programme. Banks have extended loans for 1,12,445 solar lighting systems during the last year and the current year as on 30 Nov, 2016.

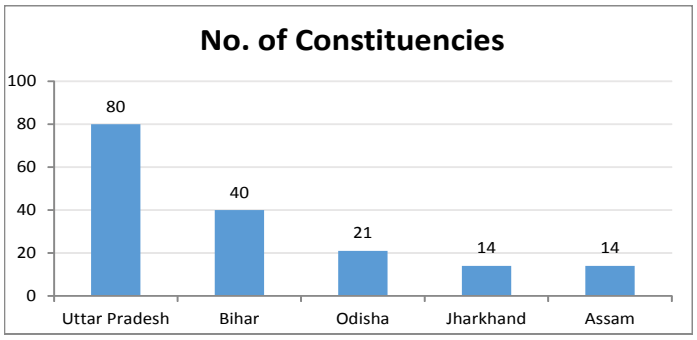
4.96 For installation of stand-alone SPV power plants by Central and State Government Bodies and their establishments in Special Category States and North East States and Islands the Ministry provides 90% subsidy ranging from Rs.72/- to Rs.396/- for off-grid solar PV applications.

4.97 To meet unmet community demand for electricity or in un-electrified rural areas, standalone SPV power plants with battery storage in a micro grid mode/ local distribution network, would be provided in the range of Rs.85 /Wp to Rs.115/Wp of capital subsidy.

4.98 For Solar Water Pumping system, the capital subsidy ranges from Rs.27,630 per Hp to Rs.57,600 per Hp depending upon category and capacity.

4.99 DST has initiated a concept on Micro Solar Dome (MSD) which is based on the Principle of passive as well as active solar device and gives day and night lighting solution. The PV Integrated Micro Solar Dome has been included as a product for off grid solar lighting applications by Ministry of New and Renewable Energy and is eligible for subsidy at par with other solar lighting products. Attempts are being made to integrate Surya Jyoti for subsidy in rural and urban housing schemes, MP Local Area Development Schemes and corporate social responsibility activities of public sector enterprises

ATAL JYOTI YOJNA (AJAY)



4.100 Government of India is committed to providing quality & reliable power supply at reasonable prices through its policies and programmes. The Ministry of New and Renewable Energy (MNRE) has launched Atal Jyoti Yojna which is one such programme. Under this programme, Solar LED Street Lights in rural, semi-urban and urban areas will be installed across states of Uttar Pradesh, Assam, Bihar, Jharkhand and Odisha where the household electrification is less than 50% as per 2011 Census by March 2018.

4.101 The installation of Solar LED Street Lights will ensure ample light in major roads, markets, public conveniences etc. in remote areas and would help the citizens of our country lead a safe and secure life.

Implementing Agency in the Scheme

4.102 Energy Efficiency Services limited (EESL) has been appointed as the Implementing Agency by MNRE. EESL, a Joint Venture of four Public Sector Undertakings (PSUs) of Ministry of Power (MoP), Government of India, was established in 2009 as the implementation arm of MoP and Bureau of Energy Efficiency (BEE), Govt. of India. The objective of EESL is to lead the market transformation initiatives of Government, of India under the National Mission for Enhanced Energy Efficiency (NMEEE) as well as to create and sustain markets for energy efficiency

4.103 A total of 154 MWp capacity solar PV off-grid systems/power plants have been installed till 31st Dec, 2016. Some major Off-grid Solar PV projects sanctioned during 2016-17 are as follows:

- 16 Solar power plants with aggregate capacity of 440 kWp and 400 Solar Street Lights (LED) at various locations in Rangia Sub Division in the state of Assam.

500 kW Solar Power Plant at High Court Bilaspur, Chhattisgarh

A Solar Pump at Dhundi village in Anand district, Gujarat

- 102 x 1.6 kWp Solar power plant each at police stations in the state of Andhra Pradesh.
- 4,900 solar home systems in various districts of Bihar.
- 250 SPV Power plants of with aggregate capacity of 600 kWp at individual households/ schools/offices in the state of Chhattisgarh.
- 4,000 Solar Pumps in the state of Gujarat
- 21,000 solar home systems in various districts in the state of Haryana.
- 10,110 SPV Street Lighting Systems (LED) in scheduled cast concentrated villages in the state of Himachal Pradesh.
- 19,013 solar street lighting systems in various district of Jammu & Kashmir.
- 9 Mini-grid solar power plants with aggregate capacity of 219 kWp at nine villages in Gumla district of Jharkhand
- 5,00,000 Solar Urja Lamps (SoUL) for school going children in various states by Indian Institute of Technology, Bombay

4.104 During the year, the solar systems having total capacities of 76.32 MWp which includes solar lanterns, solar home lights, solar street lights, solar pumps, mini/micro grids and power plants

A 1 kWp Solar PV System at Guntur, Andhra Pradesh

Solar Cold Storage system installed at Jagdalpur, Chhattisgarh

A 3 HP Solar Water Pump at Village Vasudevpur, Distt. Amethi, UP

were installed in various States. Some of the highlights of the completed projects during the financial current year are given below-

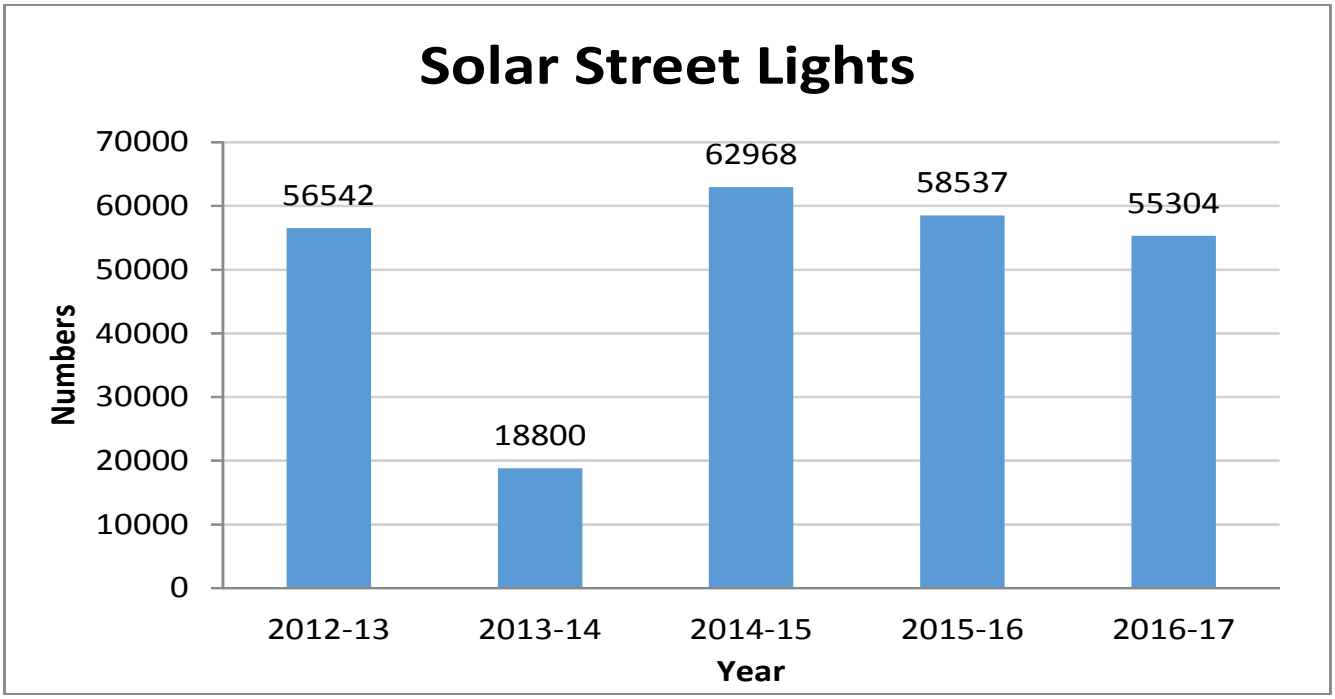
- 2,600 solar street lights have been installed at various villages of Rajasthan.
- Solar power plants having total capacity of 2,467 kWp have been installed at various places including industries in Chhattisgarh.
- 12,100 solar street lights have been installed at villages of Himachal Pradesh.
- 100 SPV Power plants of 1 kWp capacity each at 100 Schools in Barmer district of Rajasthan.
- 3,161 no. of solar pumps in Gujarat at various places. Photo shows an installation of solar pump at Dundi village in Anand district, Gujarat.

4.105 MNRE is also strengthening standards to manage the quality of Off Grid systems and prepared detailed specification for major Off Grid applications such as solar lantern, homelight, street light, inverter, modules, solar pumps etc. MNRE has also accredited 12 labs for testing of various Off Grid applications following MNRE technical specifications.

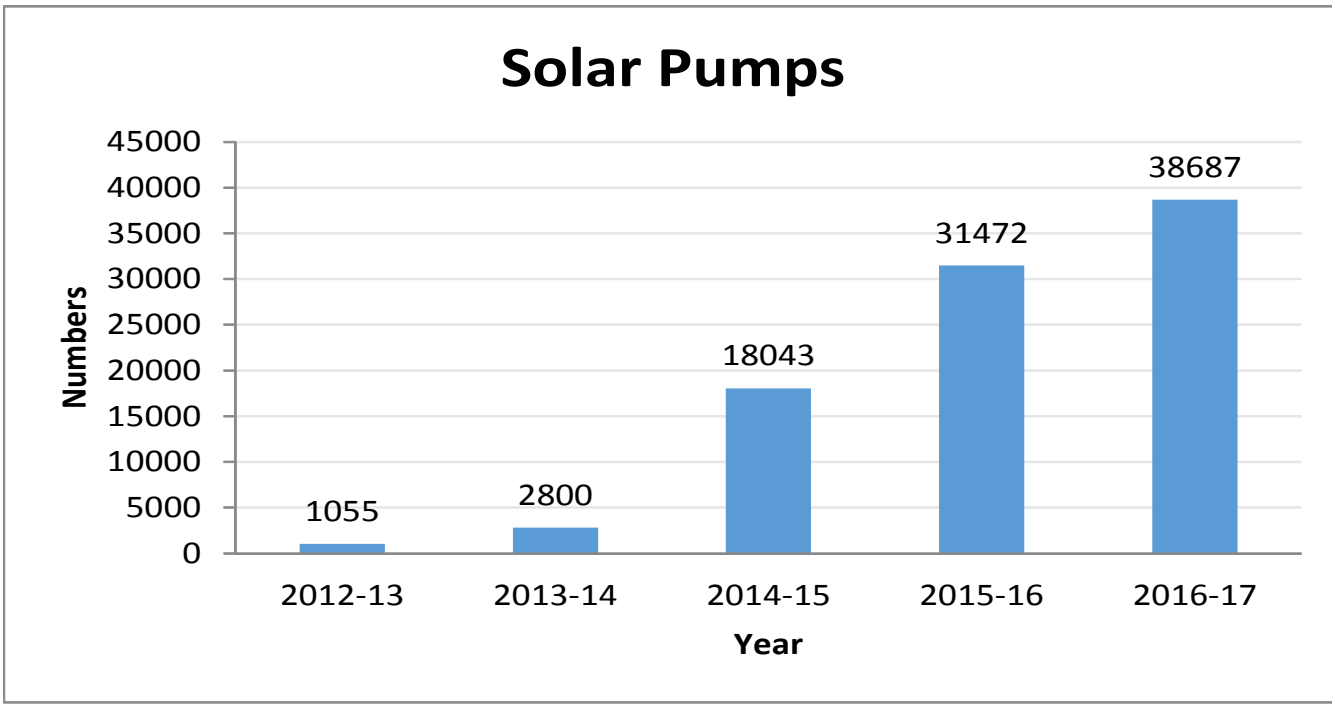
50 KW Rooftop SPVPP Installed at Collectorate Building, Korba, Chhattisgarh

Solar Home Lighting system installed at Distt. Sukma, Jagdalpur, Chhattisgarh

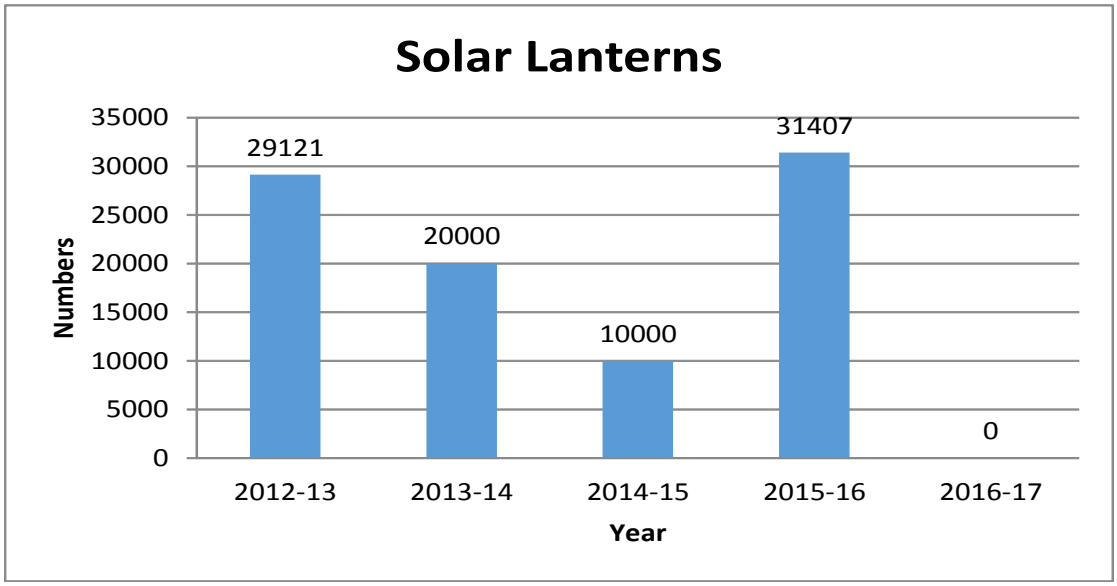
Solar Street Lights installation during last five years including current year (31.12.2016)



Solar Pumps installation during last five years including current year (31.12.2016)



Solar lanterns installation during last 5 years including current year (31.12.2016)



Solar Home Lighting Systems installation during last 5 years including current year (31.12.2016)

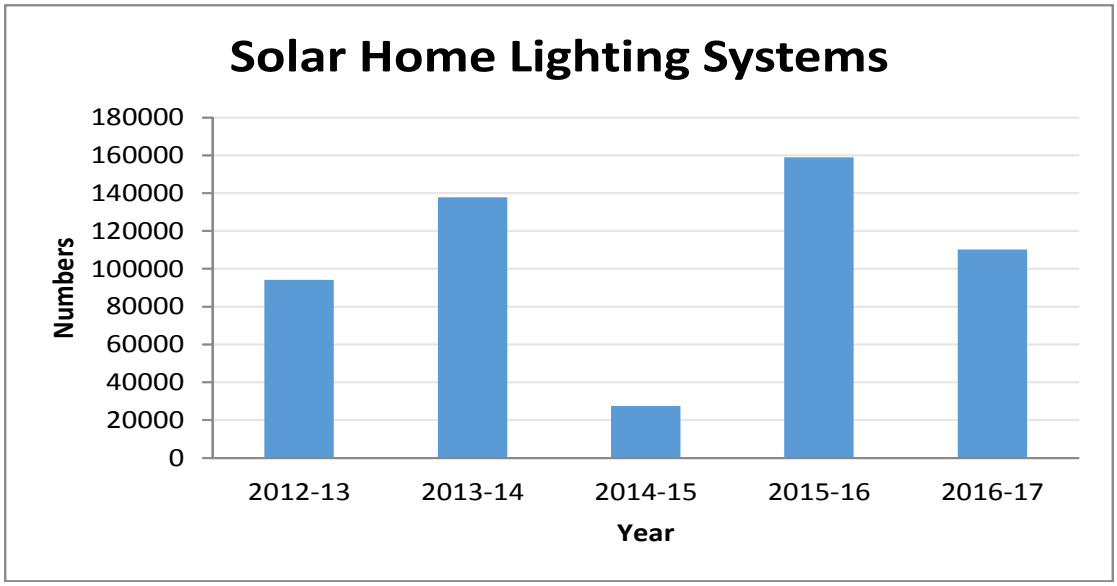


Table 4.10: Cumulative Systems installed up to 31.12.2016	
SPV Systems	**Cumulative up to 31.12.2016**
Solar lanterns Nos	996841
Solar home lights Nos	1396036
Solar street lights Nos	442936
Solar pump Nos	100521
Power plants MWp	172

Table 4.11: State wise Cumulative Installation of SPV Systems as on 31-12-2016						
S. No.	State/UT	Solar Photovoltaic Systems				
		Lanterns Nos.	Home Lights Nos.	Street Lights Nos.	Pumps Nos.	Stand Alone power plants (KWp)
1.	Andhra Pradesh	51360	22972	7812	8952	3785.595
2.	Arunachal Pradesh	14433	18945	1671	22	600.1
3.	Assam	1121	6926	318	45	1605
4.	Bihar	50117	12303	955	2882	3968.6
5.	Chhattisgarh	3311	7754	2042	5388	27867.72
6.	Delhi	4807	0	301	90	1269
7.	Goa	1093	393	707	15	32.72
8.	Gujarat	31603	9253	2004	7620	13576.6
9.	Haryana	93853	56727	22018	543	2321.25
10.	Himachal Pradesh	33909	22592	58508	6	1390.5
11.	Jammu & Kashmir	51224	65319	5806	39	7719.85
12.	Jharkhand	23374	9450	620	2901	3539.9
13.	Karnataka	7334	49644	2694	3200	4676.41
14.	Kerala	54367	40412	1735	810	13894.39
15.	Madhya Pradesh	9444	4016	9378	3813	3654
16.	Maharashtra	68683	3497	10420	1503	3857.7
17.	Manipur	4787	3900	1888	40	1241
18.	Meghalaya	24875	7844	1273	19	884.5
19.	Mizoram	9589	6801	5056	37	1719
20.	Nagaland	6766	1045	6235	3	1506
21.	Odisha	9882	5274	5834	6673	567.515
22.	Punjab	17495	8626	21758	1857	1950
23.	Rajasthan	4716	151964	6852	37306	10850
24.	Sikkim	23300	15059	504	0	850
25.	Tamil Nadu	16818	226946	36802	4763	12752.6
26.	Telangana	0	0	244	424	5368
27.	Tripura	64282	32723	1199	151	612
28.	Uttar Pradesh	62015	235909	185091	8958	10041.46
29.	Uttarakhand	93927	91595	21905	26	1534.03
30.	West Bengal	17662	145332	8726	653	1730
31.	Andaman & Nicobar	6296	468	390	5	167
32.	Chandigarh	1675	275	898	12	730
33.	Lakshadweep	5289	0	1725	0	2190
34.	Puducherry	1637	25	417	21	121
35.	Others	125797	24047	9150	0	23885
36.	NABARD	0	108000	0	1744	0
	Total	**996841**	**1396036**	**442936**	**100521**	**172458**

Table 4.12: State wise SPV Systems installed during 2016-17 as on 31.12.2016						
S. No.	State/UT	Solar Photovoltaic Systems				
		Lanterns Nos.	Home Lights Nos.	Street Lights Nos.	Pumps Nos.	Stand Alone power plants (KWp)
1.	Andhra Pradesh	0	0	0	3174	153
2.	Arunachal Pradesh	0	0	600	4	0
3.	Assam	0	0	0	0	0
4.	Bihar	0	4900	0	1000	2947
5.	Chhattisgarh	0	0	0	3848	4969
6.	Delhi	0	0	0	0	0
7.	Goa	0	0	0	0	0
8.	Gujarat	0	0	0	5218	0
9.	Haryana	0	0	0	0	0
10.	Himachal Pradesh	0	0	34450	0	15
11.	Jammu & Kashmir	0	0	0	0	158
12.	Jharkhand	0	0	0	2901	0
13.	Karnataka	0	0	0	420	0
14.	Kerala	0	0	0	0	10000
15.	Madhya Pradesh	0	0	0	2007	928
16.	Maharashtra	0	0	127	1252	0
17.	Manipur	0	0	960	0	0
18.	Meghalaya	0	0	0	0	0
19.	Mizoram	0	0	3625	0	534
20.	Nagaland	0	0	1764	0	214
21.	Odisha	0	0	0	5516	0
22.	Punjab	0	0	11000	0	0
23.	Rajasthan	0	7400	0	5983	500
24.	Sikkim	0	0	0	0	0
25.	Tamil Nadu	0	97859	0	849	338
26.	Telangana	0	0	244	424	1231
27.	Tripura	0	0	0	0	230
28.	Uttar Pradesh	0	0	2200	3742	240
29.	Uttarakhand	0	0	334	0	0
30.	West Bengal	0	0	0	605	0
31.	Andaman & Nicobar	0	0	0	0	0
32.	Chandigarh	0	0	0	0	0
33.	Lakshadweep	0	0	0	0	0
34.	Puducherry	0	0	0	0	0
35.	Others	0	0	0	0	0
36.	NABARD	0	0	0	1744	0
	TOTAL	**0**	**110159**	**55304**	**38687**	**22457**

BOX 4.2

Mini-Grid

Uttar Pradesh is making efforts to tap resources to improve the availability endowed with vast potential of solar power in the State by promoting the establishment of power projects. In order to provide ensured power supply to rural households in the State for minimum basis facilities e.g. lighting in night, fan, mobile charging, entertainment etc. Government has taken important role in creating and enabling frame work for building sustainable Mini-Grid's. As per policy provisions the Mini-Grid projects shall be installed in un-electrified habitations/hamlets and in contiguous undeveloped and backward rural/urban areas deprived of conventional grid or with relatively less supply of electricity. There are two modes of implementation i.e. with and without State Government Subsidy. This was the first Mini-Grid Policy announced by any Indian State. U.P. Electricity regulatory commission has also outlined the regulatory frame work which is based on and aligned to the Mini-Grid Policy. Policy/Regulations has provision of following Exit Options on Grid arrival in order to secure the investment of Mini-Grid Operators:

a) Continue to supply entire quantum of electricity generated to the consumers.

b) Sell excess/surplus electricity to Distribution Licensee at feed in tariff (FIT)

c) Generate and supply entire electricity generated to the Distribution Licensee at feed in tariff (FIT)

Prior to announcement of the policy the State Government had established Solar Mini-Grid Power Plant capacity 250kW on Pilot Basis in year 2014-15 in village Fakirpur and Chanduahar of district Kannauj on full Government Grant.

Benefits of the Mini-Grid Projects:

- Customized, Reliable and affordable power to villages
- Availability of power during peak hours (5 p.m. to 11 p.m.)
- Kerosene replacement with LEDs, Diesel Elimination at anchor loads
- Carbon Mitigation
- Local employment
- Local entrepreneur development with availability of reliable power
- Upliftment of economic conditions of villages
- Saving of Government Lands as the projects are to be set up on private Lands.

Mini Grid Solar Power Plant Village - Atrauli, District Hardoi, U.P.

BOX 4.3

Million Solar Urja Lamp (SoUL) Program

India has one of the youngest populations in the world, with 350 million children less than 14 years of age making school education essential for future of the country. However, 221 million people residing in India are still without electricity access and many more with poor quality of supply (IEA, 2015). Many young school going students either do not have access to alternate clean light source or suffer from erratic electricity supply, both of which affect their study during evening hours. Alongside 'Right to Education', it is desirable to provide 'Right to Clean Light' and hence there is a need for a countrywide, self-sustainable solar lamp program.

One million SoULs were distributed during 2014-16 in 4 Indian states of Madhya Pradesh, Maharashtra, Rajasthan and Odisha, covering 23 districts, 97 blocks and more than 10,900 villages. There are 54 assembly and distribution centers and 350 SRCs in operation, with training provided to 1,409 local people. While implementing, 7,35,000 lamps were distributed in just 9 months between July 2014 to March 2015, while remaining 2,65,000 lamps in 4.5 months from November 2015 to March 2016. With 77 percent tribal blocks (as defined by Ministry of Tribal Affairs) and 83 percent educationally backward blocks (as defined by Ministry of Human Resource and Development) amongst its intervention blocks, MSP focused on reaching most marginalized population. The impact analysis of the MSP revealed that SoULs have replaced one kerosene wick lamp in beneficiary households, thus contributing to saving kerosene consumed for lighting. Besides its usage for study purpose, it was an aid in various other domestic and livelihood activities.

The objective of the Million Solar Urja Lamp (SoUL) Program developed and executed by IIT Bombay is to provide clean light for study purpose to each and every child in the country, in the fastest possible way and in the most cost-effective manner.

Benefit and Impact of the Project: Being the central coordinating agency, expertise of IIT Bombay in solar technology, operations management and socio-economic impact analysis were integrated in the MSP. Assembly-cum-distribution centers were established at the block level (a unit of intervention), in premises of 9 partnering NGOs.

Locals from intervention blocks were hired and trained to assemble high quality solar study lamps, campaign and distribute lamps to the target beneficiaries (i.e. school students enrolled between classes 5th to 12th), there by encouraging Local employment, entrepreneurial skills, affordable power, upliftment of weaker section of the society and by contribution to the cause of Right to Education.

BOX 4.4

GUJARAT Solar Water Pump Sets for Agriculture purpose

In Gujarat, the power consumption for agriculture pump sets is more than 20 % of the total consumption, which increases year by year, because the DISCOMs are releasing approximately about 1 lakh connections per year.

The issues faced by the DISCOMs with regard to release of agriculture connections are as under.

- The power tariff to agriculture category is subsidized and subsidy burden is increasing due to the increase in conventional power costs.
- There are a large number of agriculture pump sets using diesel, where there is no electricity connection
- Due to large geographical area, huge infrastructure i.e. length of HT line and transformer centre is required to cater power supply to agriculture.
- Huge waiting list of more than 3.70 lakhs applications for Agriculture connections.

In view of above, to reduce burden of subsidy on the State Govt., to save huge expenditure on infrastructure like HT line, transformer etc. & with a view to promote renewable energy, the State Government has implemented Scheme of Solar Water Pump Sets for Agriculture pump sets to be installed at various locations of DISCOMs from FY-2014-15. MNRE is also providing Central Finance Assistance i.e. Rs.32400/- per HP for AC Pump and Rs.40500/- per HP for DC Pump under Solar Water Pumping System.

For the implementation of the Scheme, the State Government had approved budgetary provision of Rs.50 crore, Rs.60 crore & Rs.125.50 crore for FY 2014-15, FY 2015-16 & 2016-17 respectively.

Beneficiaries Criteria for Availing the Benefit of the Scheme.

Registered, FQ paid and FQ under payment for conventional Agriculture connection beneficiaries can switch over their applications for Solar Water Pump sets. Farmers who have not applied for conventional agriculture connection can also register their applications for Solar Water Pump scheme. Scheduled caste farmer/ Tribal farmer is required to pay Rs.1000/- per HP only & All other category farmers have to pay Rs.5000/- per HP only for setting up the solar pump sets as onetime payment.

SOLAR WATER HEATING SYSTEM

4.106 A 100 LPD Solar Water Heating (SWH) System having 2 square meter of collector area, can replace an electric geyser of 2 KW capacity for residential use and may save upto 1,500 units of electricity and up to 1.5 tons of CO2 per year depending upon the location of installation.

4.107 The gross potential for solar water heating systems in India has been estimated to be about 140 million sq. m. of collector area. However, we have achieved about 12 million sq.m collector area. There is a lot of potential for Solar Water Heating Systems in the country.

4.108 The cumulative targets set for installing Solar Collector area under National Solar Mission (NSM), are 15 million square meters up to 2017 and 20 million square meter up to 2022 respectively. Under this, around 12 million square meter collector area has been installed by 31/03/2016 against the total target of 15 million square meters. Residential sector dominates among others and contributed around 85% of the total installations.

Note: The scheme has been discontinued w.e.f. 01.10.2014 onwards because the market of the Solar Water Heating System has reached a level to sustain with own technology and competency due to vigorous Research & Development and nation-wide publicity through print and electronic media.

(i) Only special projects and successful schemes may be continued.

(ii) Subsidy will continue for solar driers and space heating.

(iii) The Channel Partners as well as SNAs will be free to continue to deploy solar water heaters at their end without MNRE subsidy.

4.109 MNRE also has a system of testing and certification of products through accredited labs, making channel partners after rating by credit rating agencies and we are also working on five star rating for solar water heaters. These provisions will be continued so that the customers get quality product and the support available from MNRE for developing the entrepreneurs and companies in this regard is available for further development of the sector.

4.110 Bureau of Indian Standards (BIS) standards have been established for Flat Plate Collectors (FPC) along with appropriate test facilities. BIS has also notified standards for Evacuated Tube Collector (ETC) Solar Water Heating Systems.

4.111 Solar water heaters have become very popular in Karnataka, Maharashtra, Gujarat, Telangana, Kerala, Tamil Nadu and Puducherry etc. Efforts are being made to extend the coverage to other States too. The Ministry is still financially supporting the deployment of Solar Water Heaters in schools/hospitals in backward and/or power deficient and inaccessible areas.

4.112 Extensive publicity and awareness campaigns are taken up through print and electronic media in a large number of cities in various States where potential for installation of solar water heating systems is high. Seminars, workshops and business meets are organized with different stakeholders to focus on accelerating solar water heater deployment in different sectors and potential cities in the country.

Solar Dryer and Space Heating

4.113 The MNRE has also initiated and taken positive steps and measures in the direction of applications of Solar Air Driers and Space Heating. Ministry has been working in close association with various Ministries, Institutions and agencies to develop the application of Solar Air Driers

50 kg Solar Turmeric drier at Mizoram, India

and Space Heating in various horticulture and animal husbandry produces. MNRE in cooperation with Deutsche Gesellschaft fuer Internationale Zusammenarbiet (GIZ), is implementing a project on "Solar Thermal Solution for Space Heating in Ladakh (SolLad)", in Ladakh Region. As part of this project, GIZ has been collaborating with local state agencies and various other stakeholders. On the basis of the experience, Kargil Renewable Energy Development Agency has come up with a proposal to install 1000 Nos of Solar Space Heating systems in the region of Leh and Kargil.

OFF-GRID SOLAR THERMAL PROGRAMME

Concentrating Solar Thermal (CST) Technologies for Community Cooking, Process Heat and Cooling applications

4.114 India is running the largest renewable capacity expansion programme in the world. The government is aiming to increase share of clean energy through massive thrust in renewable.

4.115 Ministry of New and Renewable Energy is implementing a National Programme on Solar Thermal aimed to reduce fossil fuels consumption and providing a clean, non-polluting solution to meet the process heat requirement in industrial, institutional and commercial sectors.

4.116 Industry has significantly improved its energy efficiency in recent decades. But industry's total energy use continues to grow and majority of its energy demand is for the process heating. The major share of the heat, which is needed in commercial and industrial companies for production, processes and heating.Concentrated Solar Technologies (CSTs) track the sun's incoming radiation with mirror fields, which concentrate the energy towards absorbers, which then transfer it thermally to the working medium. The heated fluid or steam may reach high temperatures and may be used for various processes requiring heat. CSTs can produce a range of temperatures, up to 300°C, which can be used in a variety of industrial and commercial heat applications. The industries showing good potential for implementation of solar concentrators are food processing, dairy, paper and pulp, chemicals, textiles, fertilizer, breweries, electroplating, pharmaceutical, rubber, desalination and tobacco sectors. Any industrial/ commercial establishments currently using steam/hot water for process applications can also employ CSTs with a minimum tinkering to the existing setup which can help in reduce conventional fuels which in turn will help in reducing GHG emissions. Some of the emerging concentrated solar technologies are as follows–

a) Scheffler Dish
b) Fresnel Reflector based dish
c) Paraboloid dishes
d) Parabolic troughs
e) Linear Fresnel
f) Non-Imaging Concentrator

Achievement in CST in 2016-17

4.117 During the financial year 2016-17, a number of activities were undertaken by the Ministry and around 14 CST systems with 5200 sq. m collector/ reflector area were completed making a total of 203 systems with 51330 sq.m area installed so far in the country and 63 CST projects with 27970 sq. m collector/ reflector area are under installation for process heating, air conditioning and steam cooking requirements in industrial, institutional and commercial establishment.

National workshop on CST and Solar Cooker Excellence Awards 2016

4.118 A National Workshop on Concentrated Solar Thermal (CST) technologies and Solar Cooker Excellence Awards 2016 was organized by the Ministry of New and Renewable Energy (MNRE) in New Delhi on April 29, 2016. Shri. Piyush Goyal, Minister of State (IC) for Power, Coal and New and Renewable Energy inaugurated the workshop and felicitated 102 awardees at the CST and Solar Cooker Excellence Awards 2016.The Ministry organized the solar thermal excellence awards to recognize and encourage notable achievements in off grid and decentralized solar thermal applications programme.

4.119 The workshop was attended by over 300 CST stakeholders from across the country. In the workshop MNRE highlighted success stories of various CST based systems in the country and also released knowledge documents developed under UNDP-GEF CSH supported project.

BIS Standard for CST Technologies

4.120 To develop BIS Standards for CSTs, a core group of various stakeholders was formed and the first meeting was held on 3rd October, 2016 in Delhi. The draft standards are shared with BIS for approval and publication.

CST & Solar Cooker Excellence Awards 2016

Some success stories of the F.Y 2016-17

4.121 AmulFed Dairy, Gandhinagar a unit of GCMMF Ltd. has installed 615.36 Sq. m. of Parabolic Trough Collector.AmulFed Dairy which is running the world's biggest dairy development program had successfully integrated the use of concentrated solar energy in its daily operations such as CIP (Cleaning in Process), washing, pasteurization and sterilization.

Installation of 615.36 sq. m PTC solar system at AmulFed Dairy, Gandhinagar

4.122 The benefits of CST installation have been encouraging. With the CST system utilized for about 6 - 8 hours every day, 10 months a year, the technology has enabled savings to the tune of Rs 14 Lakhs as fuel cost, equivalent to 50,000 Cubic meters of natural gas per annum.

4.123 Hatsun Agro, Salem, Tamil Nadu has installed 721 sq. m of Non Imaging Concentrating Collectors. A leading diary company has installed 220 no's of CPC panels each of 3.28 m^2 of area totalling 721 m2 CPC collector area in its roof top to provide hot water around 25,000 litre per day at 92-95^0 C for its milk processing mainly to reduce its coal consumption. The unit yields hot water more than 30000 LPD at 92^0 C reducing 700 -750 kg of coal per day and saving of Rs 4000 per day. The installed system is expected to reduce about 6553 tonnes of CO_2 emission in a working life of 15 years.

Installation of 721 sq. m NIC solar system at Hatsun Agro, Salem

4.124 Ultra Marine & Pigment Ltd. (UPL), Ranipet, Tamil Nadu has installed 570 sq. m of Paraboloid Dish (Dual axis) to heat up thermic oil at upto 200° C. UPL are the manufactures of pigments and surfactants used in laundry, cleaning solutions, paints, etc. for which they were previously using kerosene to reduce moisture content from their end products. UPL had installed the CST based system for reducing fuel consumption and carbon footprint. Post commissioning, drying a batch of pigment which earlier required 2-3 days, is now dried in less than 6 hours by hot air generated through CST system to less than 10% moisture content. System is currently drying upto 1400 Kg of pigment every day. The UPL is expected to save upto 140 kg of kerosene oil per day or 4 tonnes per month with Rs 2 Lakhs of savings per month from the CST installation.

Installation of 570 sq. m of Paraboloid Dish at UltraMarine & Pigment Ltd., Tamil Nadu

4.125 Mother Dairy, Patparganj, New Delhi has installed 1520 sq. m of Paraboloid Dish (Dual axis) for generating upto 1 Lakh Ltrs. of hot water per day at upto 85°C for cleaning application. CST system generates hot water at required temperature and stores it in insulated tanks, so as to utilize it anytime as per process requirement. This is one of the largest solar thermal projects for industrial process heating application with total solar field collector area of 1520 m^2. Solar Thermal System since its inception in last two months itself has helped save more than 60,000 kg of CO_2 which has been another huge advantage from this project.

Installation of 1520 sq. m of Paraboloid Dish at Mother Dairy, New Delhi

4.126 Aavin Dairy, Salem, Tamil Nadu has installed 338 sq. m of ARUN Dish for Pasteurization of milk. The Salem Union is procuring around 5.25 lakh litres of milk per day and this procured milk is pasteurized and processed into various products, such as butter, ghee, skimmed milk powder, khoya, flavoured milk, and milk shakes. The heat energy for above processes is supplied in the form of steam and hot water of various qualities. Previously, for pasteurization the steam is generated through boiler using furnace oil as fuel by burning on an average of 6,000 litres of furnace oil per day. The steam generated at a pressure of 3 to 4.5 kg/cm^2 by the two dishes meet the entire steam requirement for pasteurizing 20,000 litres of milk per hour. The savings in the usage of fossil fuel (furnace oil) is about 14,845 kg. On an average, the Salem dairy has pasteurized 60,000 to 70,000 litres of milk per day through the above two ARUN 160 dishes.

Installation of 338 sq. m of ARUN Dish at Aavin Dairy, Salem

UNDP-GEF CSH Project

4.127 MNRE is implementing a Project on 'Market Development of Concentrating Solar Technologies (CSTs) for Process Heat Applications' with the financial support from GEF being received through UNDP. The project started in April 2012 and is expected to be completed by March 2017. Basic objective of the project is to accelerate activities of Ministry's programme on CSTs by removing barriers & develop its market through awareness generation, capacity building & other required measures.

4.128 Under the project, a large number of initiatives have been taken during last four years which has accelerated the use of CSTs in the country. During the year 2016-17, Monthly e-newsletter 'Insolthermtimes', Quarterly magazine on CSTs 'SUNFOCUS' and Toll free helpline number 18002334477 were continued which helped in making people aware of CSTs.

4.129 An assignment on developing four video films on CSTs for different applications was awarded. The films are expected to be ready by February, 2017. Another assignment on giving advertisements on CST in Magazines & Newspapers was awarded which helped in creating good awareness among interested beneficiaries.

4.130 At the Training cum awareness centre on CSTs established with Brahma Kumaris at Mount Abu, seven awareness workshops and four training programmes were organized during the year. A total of 285 officials from various establishments and entrepreneurs/ technicians of manufacturers participated in these programmes. Apart from these three Business meets/ Workshops were organized with potential beneficiaries of CSTs at Thiruvanthapuram, Leh, and Bhilwara and Coimbatore.

4.131 A meeting with manufacturers and few consultants was also organized to discuss issues and plans related to large scale generation of proposals apart from developing guidelines for introducing Renewable Heating Obligation (RHO) for industrial establishments. The meeting helped in assigning an assignment to STFI for preparing draft National Policy on CSTs. To facilitate beneficiaries for getting loans from banks, a meeting was also convened with four designated banks (Syndicate bank, United Bank of India, SBoP and SBBJ) and manufacturers/ developers.

4.132 Under the UNDP GEF project, 2 Test set ups have been developed for CSTs at National Institute of Solar Energy (NISE) NISE and University of Pune (UoP). As on date 12 Nos. of CST technologies have been tested at these centres (both mobile and immobile).

4.133 During the year 2016 , 60 Nos. of new proposals with 21,000 sq. m. of CST area were also sanctioned with additional support from UNDP apart from MNRE subsidy especially for the purpose of on-line performance monitoring, after installation O & M of systems and making the systems economically viable in view of reduced prices of crude oil in international market. Six 5-year old projects were also supported for repair and renovation.

UNIDO-GEF-MNRE Project

4.134 The industrial sector in India is currently the second-largest consumer of energy, and therefore accounts for a substantial amount of GHG emissions. The industrial sector uses this energy to meet heat requirements to reach temperature up to 450 °C to produce steam, hot water, hot air and hot oil. CST systems for industrial application offers solution to address the twin challenge to not only reduce emission intensity in the country but also to optimize the solar energy potential of the country.

4.135 The project has been conceived to promote application of CST technologies in the industrial sector. The project would complement MNRE's support programme by helping to remove barriers associated with CST technologies and their application in the industrial sectors. The overall objective of the project is to develop business models for promoting solar energy based heating/ cooling and, where feasible, tri-generation projects through different concentrating solar thermal technologies in industries and commercial sectors with a view to replace fossil fuel and reduce greenhouse gas emissions.

Development of an Innovative Financing Model to promote CSTs

4.136 The project has launched an innovative financial scheme addressing the financial barriers for promotion of CST technologies in the industrial sector of India. Under the scheme, support for

installation of CST in the industrial sector and manufacturing of indigenous CST components has been developed and announced.

4.137 This new interest subvention scheme for CST technologies administrated by the Indian Renewable Energy Development Agency (IREDA) focuses on increasing the deployment of concentrating solar thermal systems for process heat applications in India. "Technology providers or beneficiaries can use a short-term bridge loan at normal interest rates for pre-financing the 30 % capital subsidy that the Ministry of New and Renewable Energy grants for CST technologies. IREDA would also provide long-term loans covering up to 45 % of the benchmark system cost at 5 % lower-than-usual interest rates. The remaining 25 % are required as equity by the beneficiary. The details of the loan scheme and application format are available at IREDA's website (Link: http://www.ireda.in/forms/contentpage.aspx?lid=740).

Awareness campaign (State level workshops) for application of CST technologies

4.138 UNIDO, jointly with MNRE, organized a series of awareness workshops since beginning of the year in association with the respective State Nodal Agencies (SNAs) in 11 states, coupled with visits to CST project sites, and presentations by their owners about their actual experiences with the systems. A total of 11 workshops and 16 site visits were conducted as a part of this campaign with CII as the outreach and logistics partner. The workshops were attended by about 1000 participants and brought together 11 SNAs, 15 Channel Partners/ Manufacturers of CST technologies and 23 existing consumers of CST technologies.

Deployment of the box and dish type solar cookers

4.139 In developing countries, one of the major energy consuming sectors is the cooking sector. In rural areas, cooking is still a mammoth of a task. Even with the advent of technologies in this area, people are still dependent on traditional fuel and methods of cooking which are not only inefficient but also causes toxic indoor air pollution. This is an important programme leading to reduction in drudgery among the rural women and girls engaged in collection of fuel wood and reduction in the rate of deforestation and getting many health benefits.

4.140 The programme is implemented through multiple agencies such as State Nodal Agencies, Channel Partner and other government organizations.

Funding Pattern

4.141 Capital subsidy of 30% of the benchmark cost would be available for general category states and 60% of the benchmark cost for special category states, viz. NE, Sikkim, J&K, Himachal Pradesh and Uttarakhand. In addition, it would also be extended for remote and difficult areas of Lakshadweep, Andaman & Nicobar Islands and districts on India's International borders, with 60% subsidy. The funds would be released on reimbursement basis on completion and verification by SNA or third party. Upto 3 % of CFA would be admissible as service charges to State Nodal Agencies, SECI/NHB/IREDA or other govt. agencies etc.

Achievement

4.142 The solar cooker programme achieved total 1552 no of cookers having total area of 912 sq. m (Approx.) in different states and 3737 No's of Solar Cooker (Punjab, Uttarakhand and Jammu & Kashmir) having total area of 4309 sq. m. (Approx.) have been sanctioned for the sale and distribution during the financial year 2016-17.

BOX 4.5

"Implementation of Solar Thermal Components including Green House" in Leh and Kargil region

The Ladakh Region of Jammu & Kashmir, with its extreme environment, faces enormous energy adversities throughout the year which become even more acute during the winter months. The "Ladakh Renewable Energy Initiative" scheme of the Ministry of New and Renewable Energy (MNRE) has been launched especially to accelerate widespread use of solar thermal systems for heating, cooking, and steam generating applications. The implementing agencies are Kargil Renewable Energy Development Agency (KREDA) in Kargil and Ladakh Renewable Energy Development Agency (LREDA) in Leh District of Jammu and Kashmir.

Installation of Domestic and Commercial SWHS by KREDA in Kargil region

Achievements: Till November 2016 KREDA has installed 6700 no of Solar water heating systems (SWHs) covering an area of 9000 Sq. m collector area for individual households, government institutions and commercial units in Kargil region. There is a growing awareness and demand for SWH system in the region. LREDA has installed 2150 units of Dish Type Solar Cooker, 20,384 sq. m of Solar Water Heater, 750 No's of Commercial Green Houses, 2500 Domestic Green Houses and 5 Units of Solar Steam Cooking System CST based having 320 sq. m area.

Solar Green House: Kargil has natural advantage of having lots of sunshine in the winter months. Based on this KREDA as per MNRE guidelines introduced Green House in the district. This technique is indigenous using locally available materials. The Green House is designed to maximize the solar absorption in the day and to minimize the heat loss in the night.

Installation of Domestic Type Green House in Kargil region

Inside view of Commercial type Green House installed in Kargil region

Solar Steam Cooking System in Leh: MNRE has sanctioned 9 steam cooking systems, each with an aperture area of 64 m2. It was found that five out of these 9 systems having collector area of 320 sq m. were successfully completed and handed over to the beneficiary.

Jamyang School, Leh-Ladakh (Installation) and (Kitchen)

Lamdon School Girls Hostel, Leh-Ladakh (Installation) and (Kitchen)

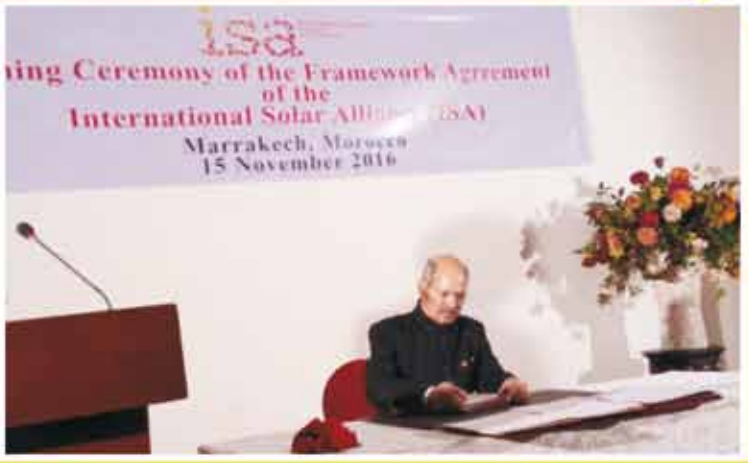
Concessional Custom/ Excise Duty Exemption Certificate Monitoring System (G-2-B) Application

4.143 A web based application is used for online submission of Total Bill of Material (BOM) and issue of Concessional Customs Duty Certificates (CCDC) and Excise Duty Exemption Certificate (EDEC) by this Ministry for availing duty benefits by the Solar Power Project Developers (SPDs) for initial setting up of their solar power plants in India. During the year simplification was made in the process of submission of BOM and issuance of certificates. The new process is as follows:

4.144 SPDs located at any place in the country are required to first register their company through MNRE web portal. System generates Login ID and Password is sent to the SPD through their registered e-mail address. Using this Login ID and Password, SPD submit the total Bill of Material (BOM) online for which the CCDC and EDEC is required for the establishing the project. Upon submission of total BOM by any SPD, a unique (BOM) number is generated by the system which gets printed on all documents pertaining to the SPDs. The Solar Project Developer gets the Application and BOM certify by MNRE empaneled Charted Engineer. Thereafter, Ministry approves proposal after verification of the documents. The Project Developer then prepares CCDC/EDEC certificates for partial withdrawal from the approved BOM. The certificates are scrutinized and issued by the Ministry. A verification code is generated by the system, which is endorsed on each certificate. Custom/ Excise authorities can verify the genuineness of the certificate on-line. After commissioning of the project SPD's submit reconciliation report to MNRE through empaneled Charted Engineer and respective State Nodal Agencies.

4.145 During current Financial Year up to January 2017, Ministry has approved concessions for 752 BOMs of aggregating capacity of 6,200 MW to 587 developers and has issued more than 9000 Excise Exemption certificates and Customs Exemption certificates to various Solar Power Developers.

5: INTERNATIONAL SOLAR ALLIANCE



INTERNATIONAL SOLAR ALLIANCE

5.1 The International Solar Alliance (ISA) was jointly launched by the Prime Minister of India and the President of France on 30 November 2015 at Paris, France on the side-lines of the 21st Conference of Parties to the United Nations Framework Convention on Climate Change. ISA has been envisioned as a specialized platform to contribute towards the common goal of increasing utilization and promotion of solar energy and solar applications in its member countries. The Paris declaration on International Solar Alliance states that the countries share the collective ambition to undertake innovative and concerted efforts for reducing the cost of finance and cost of technology for immediate deployment of competitive solar generation. Financial instruments to mobilise more than 1000 Billion US Dollars of investments needed by 2030 will ultimately pave the way for future solar generation, storage and good technologies for countries' individual needs.

5.2 During the year ISA has made tangible progress. Two Programmes of the ISA "Affordable finance at scale" and "Scaling solar applications for agricultural use", have been launched in a Ministerial side event on ISA on 22 April 2016 on the margins of signing of Paris Agreement on Climate Change in UN Headquarters in New York, USA where Hon'ble Ministers from India and France were present. CMD, IREDA and DG, NISE respectively have been designated as Country Representative for these programmes. Eight countries (Bangladesh, Ethiopia, France, India, Nigeria, Seychelles, Sri Lanka and Uganda) are participating in these Programmes. Initial interactions have been held among the country representatives of these programmes.

The Minister of State for Environment, Forest and Climate Change (Independent Charge), Shri Anil Madhav Dave signing the framework agreement on International Solar Alliance, in Marrakech, Morocco on November 15, 2016.

5.3 On 22 April 2016, the Interim Administrative Cell of International Solar Alliance (ISA Cell) and the United Nations Development Programme (UNDP) issued a Joint Declaration for cooperation to promote ISA's objectives. Follow up meetings have been held with UNDP to further the cooperation activities. On 30 June 2016, the ISA Cell and the World Bank declared their intention to promote solar energy globally. On 15 November 2016, the Climate Parliament and the ISA cell also issued a joint declaration for cooperation in solar energy area.

5.4 In order to make ISA a treaty based inter-governmental organisation, a draft Framework Agreement was first circulated in the 1st ISC meeting on 1 December 2015. A revised draft Framework Agreement, developed with inputs from the prospective member countries of ISA was presented in the 4th ISC meeting on 5 October 2016. Signing and thereafter ratification, acceptance or approval by 15 countries will make ISA an Agreement based inter-governmental organization.

5.5 Main provisions of the Framework Agreement are as under:

i. The Preamble invokes the Paris Declaration on ISA;

ii. ISA membership is open only to the countries between tropics (fully or partially situated);

iii. Partner Country status to be granted to other countries beyond the tropics (by the decision of ISA Assembly) with no voting rights;

iv. ISA will have two tiers - Assembly and Secretariat;

Minister for New and Renewable Energy Mr. Piyush Goyal and French Environment Minister Ms. Segolene Royal at ISA Ministerial Event in United Nations, 22nd April 2016, NY

v. Entry into force of Framework Agreement with ratification, acceptance or approval by 15 countries;

vi. The ISA source for revenue will be non-mandatory and voluntary contributions of its Members; voluntary contributions from Partner countries, bilateral and multilateral organizations, UN & its agencies; earnings on corpus fund; and other possible sources in accordance with the financial rules to be adopted by the Assembly;

vii. UN will be a strategic partner; and

viii. This Framework Agreement shall be registered pursuant to Article 102 of the Charter of the United Nations.

5.6 The Framework Agreement of the ISA was opened for signature on 15 November 2016 in Marrakech, Morocco on the side-lines of 22nd Conference of Parties to the United Nations Framework Convention on Climate Change. Shri Anil Madhav Dave, Hon'ble Minister for Environment, Forest and Climate Change, Government of India was first to sign the Agreement. So far twenty four countries have signed the Framework Agreement. These are Bangladesh, Brazil, Burkina Faso, Cambodia, Democratic Republic of Congo, Dominican Republic, Ethiopia, Fiji, France, Republic of Guinea, Guinea Bissau, India, Liberia, Madagascar, Mali, Nauru, Niger, Senegal, Seychelles, Sudan, Tanzania, Tuvalu, Vanuatu and Tonga. With Cabinet approval on 28 December 2016, India has become the first country to ratify the ISA treaty.

The representatives of the Signatory countries with the Minister of State for Environment, Forest and Climate Change (Independent Charge), Shri Anil Madhav Dave, after the signing ceremony of the framework agreement on International Solar Alliance, in Marrakech, Morocco on November 15, 2016.

6: RENEWABLE ENERGY FOR RURAL APPLICATIONS

RENEWABLE ENERGY FOR RURAL APPLICATIONS

6.1 The Ministry has been supporting programmes for the deployment of renewable energy systems and devices such as biogas plants, photovoltaic systems, biomass gasifiers, solar cookers and solar thermal systems etc for rural and semi-rural applications. The Ministry has also been implementing remote village electrification programme and village energy security test projects.

6.2 The Ministry has been supporting renewable energy programmes for rural areas of the country by deploying renewable energy systems such as family type biogas plants, solar water heating systems, solar cookers and other solar energy devices. In addition to family type biogas plants, the demonstration of integrated Technology package on Biogas-Fertilizer Plants (BGFP) for generation, purification/ enrichment, bottling and piped distribution of biogas as technology demonstration under RDD&D policy was launched during the year 2009-10 and continued in 2015-16. The objectives of the integrated technology demonstration programme is to demonstrate the biogas fuel applications to meet stationary, motive power, electricity needs including cooking and heating requirements.

NATIONAL BIOGAS AND MANURE MANAGEMENT PROGRAMME (NBMMP)

Introduction

6.3 Biogas is a clean cooking gaseous fuel, produced when biodegradable organic wastes are subject to a process called anaerobic digestion. Biogas is mainly a mixture of methane and carbon dioxide and traces of other gases such as hydrogen sulphide, nitrogen and ammonia. At the end of the process organic enriched bio-manure is produced simultaneously as byproduct from this process. The anaerobic digestion process is a low carbon generating technology for efficient management of organic wastes and sanitation. Biogas, thus produced, can be used for cooking, heating, generating electricity and for motive power & operating vehicles. It has the potential for leveraging livelihood development as well as tackling the issues related with health hazard and environmental issues together with in combating the climate change.

6.4 Under the National Biogas and Manure Management Programme (NBMMP), Family Type Biogas Plants are set up where a minimum quantity of about 25 kg organic biodegradable waste is available with a household particularly in rural and semi-urban areas of the country. The main waste available is cattle dung which can be supplemented by other organic wastes such as food and kitchen wastes, poultry waste, human waste etc. The objective of the National Biogas and Manure Management Programme (NBMMP) scheme are -

i. To provide clean gaseous fuel mainly for cooking, lighting and organic manure to rural and semi-urban households.

ii. To mitigate drudgery of rural women, reduce pressure on forests and accentuate social benefits.

iii. To improve sanitation in villages by linking sanitary toilets with cattle dung based biogas plants.

iv. To provide bio-digested slurry as a source of upgraded organic enriched bio-manure to reduce and /or supplement the use of chemical fertilizers.

v. To meet "lifeline energy" needs for cooking as envisaged in "Integrated Energy Policy" of the National Institution for Transforming India (NITI) Aayog (erstwhile Planning Commission).

vi. To help in mitigation and combating climate change by preventing emission of Green House Gases (GHGs) such as Carbon Dioxide and Methane into the atmosphere.

6.5 Household biogas plants in addition to replacing the need of LPG, helps in reducing the pressure on forests and other conventional fuels like coal and kerosene. Small and marginal farmers benefit from biogas plants providing digested slurry with high quantity and quality of Nitrogen, Phosphorus and Potassium (NPK) for use as organic bio-manure, which helps not only in sustaining soil health but also providing nutrients for obtaining higher crop yields. Manure from biogas plants is an approved organic manure under the Fertilizer Control Order, 1985 of the Ministry of Agriculture and Farmer Welfare. The biogas plants are, thus potential source of helping farmers in adopting both conventional and organic farming. A biogas plant is a small farm infrastructure asset for farmers and household amenity for others.

Implementation

6.6 The National Biogas and Manure Management Programme (NBMMP) was launched with a view to give due emphasis to organic bio-manurial value of the biogas plant digested slurry, by redesigning the National Project on Biogas Development (NPBD) during the year 2002-03. A target for setting up 1 lakh family type biogas plants during the year 2016-17 was allocated to State Nodal Departments/ State Nodal Agencies and Khadi and Village Industries Commission (KVIC) and Biogas Development and Training Centers (BDTCs). These designated State implementing agencies, also involve their trained and registered Turn-Key Workers (TKWs) / Rural Energy Technicians (RETs) in implementation. Eight Biogas Development and Training Centers (BDTCs) were continued for providing training and technical and innovative support to the State implementing Departments/Agencies during the year 2016-17, located at various Universities and Indian Institute of Technologies (IITs) and other Technical Institutions. These BDTCs cater to training needs of their assigned States besides carrying out regular inspections, monitoring and evaluation of the programme. Against the annual physical targets of 1 lakh plants for 2016-17, about 35,557 family type biogas plants are reported to have been set up upto December, 2016. The State/ UT-wise details of the cumulative achievements upto 2015-16 and progress of current year 2016-17 (upto 31.12.2016) are given in **Table 6.1.**

Components of Central Finance Assistance

6.7 The MNRE provides subsidy and other supports as Central Financial Assistance (CFA) which have been effective since 08.05.2014. The details of the subsidy and other support are given in **Table-6.2**. In order to maintain the quality of programme implementation and have adequate sustained level of trained manpower, support is also provided for imparting different types of training courses as per details given below-

(i) **Users' Training Course** - To acquaint existing and potential users about the benefits of biogas plants organic bio-manure and how to use the plant efficiently and operate & maintain for its optimal performance.

(ii) **Staff Training Course** - To give exposer to supervisors/Govt. Officials/Bank Officials and other staff to various aspects of biogas technology and its benefits.

Table -6.1 National Biogas and Manure Management Programme (NBMMP) State-wise estimated potential and cumulative achievements of family type biogas plants till 31st March, 2016 and Targets and Achievements during 2016-17 (As on 31.12.2016)

State/ Union Territories	Estimated potential (Plants in Nos.)	Cumulative physical achievements as on 31-03-2016 (Plants in Nos.)	Targets and achievements during 2016-17 (Plants in nos.)	
			Target	Achievements (upto 31.12.2016)*
1	2	3	4	5
Andhra Pradesh	1065000	542654	10200	4590
Arunachal Pradesh	7500	3475	100	5
Assam	307000	121719	9000	5610
Bihar	733000	129829	0	2
Chhattisgarh	400000	53454	3050	430
Delhi	12900	681	0	0
Goa	8000	4187	100	17
Gujarat	554000	431620	2500	632
Haryana	300000	61543	1000	275
Himachal Pradesh	125000	47538	150	60
Jammu & Kashmir	128000	3156	100	0
Jharkhand	100000	7468	200	21
Karnataka	680000	486007	10000	3000
Kerala	150000	147038	2850	947
Madhya Pradesh	1491000	360298	8000	1863
Maharashtra	897000	886071	14500	8217
Manipur	38000	2128	0	0
Meghalaya	24000	9996	200	0
Mizoram	5000	5300	500	78
Nagaland	6700	7903	300	0
Odisha	605000	268905	4000	703
Punjab	411000	176046	5000	1130
Puducherry	4300	578	0	0
Rajasthan	915000	70707	1000	292
Sikkim	7300	9044	250	0
Tamilnadu	615000	222591	300	51
Telangana	-	18999	12300	5050
Tripura	28000	3533	400	60
Uttar Pradesh	1938000	440056	1100	471
Uttarakhand	83000	19932	1400	946
West Bengal	695000	366780	0	0
A&N Islands	2200	137	0	0
Chandigarh	1400	97	0	0

Dadra & Nagar Haveli	2000	169	0	0
KVIC	-	-	8000	1040
BDTC, PAU, Ludhiana	-	-	1500	69
BDTC, IIT Guwahati	-	-	500	0
BDTC, IIT Delhi	-	-	500	0
BDTC, UAS, Bangalore	-	-	1000	0
TOTAL :	12339300	4909639	100000	35,557

**Figures are being firmed-up.*

Table-6.2 Pattern of Central Financial Assistance under the National Biogas and Manure Management Programme, w.e.f. 08.05.2014 for the remaining period of 12th Five Year Plan:

Sl. No.	Particulars of Central Financial Assistance (CFA) & States / Regions and Categories	Family Type Biogas Plants under NBMMP (1 to 6 cubic metre capacity per day)	
A.	Central Subsidy Rates Applicable (In Rs.)	1 Cubic Metre	2- 6 Cubic Metre
1.	NER States, Sikkim (except plain areas of Assam) and including SC and ST Categories of NE Region States.	15,000	17,000
2.	Plain areas of Assam.	10,000	11,000
3.	Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Niligiri of Tamil Nadu, Sadar Kurseong & Kalimpong Sub-Divisions of Darjeeling, Sunderbans (W.B.) and Andaman & Nicobar Islands.	7,000	11,000
4.	Scheduled castes / Scheduled Tribes of all other States except NE Region States including Sikkim & other Hilly States/regions as given in Sl. No. 3 above.	7,000	11,000
5.	All Others	5,500	9,000
B.	Turn-Key Job Fee including warranty for five years and quality control (in Rs. per plant).	Rs.1500/- per plant for fixed dome Deenbandhu type and floating gasholder KVIC type brick masonry models. Turn Key Job Fee also provided for biogas plants with prefabricated material involving part construction work either for digester or dome. No fee is provided for completely prefabricated / manufactured plants such as Bag type plants with rubberized material or plants made of HDPE / PVC / fabric materials, as and when approved.	
C.	Additional CFA for toilet linked Biogas Plants (in Rs. per plant).	1,200/-	
D.	Administrative Charges – for physical target range of biogas plants (in Rs.)		
1.	100-3,000	1,00,000^	
2.	3,001-7,000	10,50,000^^	
3.	Above 7,001	24,50,000 *	
E.	Training support per course (in Rs.)		

1.	Users Course	3,000
2.	Staff Course	10,000
3.	Construction-cum Maintenance / Refresher Course	45,000
4.	Turn-key Workers & Management Course for TKWs / RETs / SHGs/ Officials of SND / SNA / Banks / FIs & Companies / Entrepreneurs.	75,000
F.	Biogas Development & Training Centres	As per the pattern of CFA and staff strength / positions conveyed vide Ministry's sanction letter No. 19-3/2011-BE (Pt.) dated 16th November, 2011 and dated 2nd March, 2012 and annual outlay allocated year-wise.
G.	Support for Communication & Publicity as per the target range of Biogas Plants (in Rs.)	
1.	Up to 1,000	2,00,000
2.	1,001-10,000	4,00,000
3.	More than 10,000	6,00,000
H.	Support for Repair of Non-functional Plants with the restriction of utilization of upto 5% of the annual outlay of the programme, earmarked for the year for the concerned of SND/SNA/UT.	50% of the applicable central subsidy rate subject to sharing of 50% of the cost of repair by the respective beneficiary. Repair cost estimates for a non-functional biogas plant should not exceed the total subsidy amount applicable as per the size of the biogas plant. The proposal prepared by SNDs/SNAs and KVIC by bunching of such non-functional plants, requires prior approval of the Ministry (MNRE).
Household size Family Type Biogas Plants under NBMMP		
^ Extra Rs. 400 per plant in excess of 100 biogas plants.		
^Extra Rs.350 per plant in excess of 3000 biogas plants.		
** Extra Rs. 300 per plant in excess of 7,000 biogas plants subject to maximum of Rs. 60.00 lakh (Rupees Sixty Lakh).*		

Biogas generation and use in kitchen by the beneficiary Smt. Chintha Vijaya Laxmi, W/o- Shri Chintha Laxmi Kantha Reddy, Vill. – Puttapasham, Mandal – Gonegandla, Dist. – Karnool (AP)

2m3 Deenbandhu ferro-cement Biogas Plant under construction at village – Guntappa, Mandal – Guduru, Dist. – Karnool (AP)

MNRE-GIZ one-day workshop of practitioners on "How to improve and scale up best practices" for Small and Community Biogas Plants on 26.10.2016 at MNRE, New Delhi

(iii) **Construction-cum-Maintenance Course (CMC)/Refresher Course** - In order to create a cadre of trained Biogas Masons, Technicians and to make them skilled in the Construction, Construction supervision and Maintenance of commissioned Biogas plants by the implementing agencies.

(iv) **Turn-Key Workers Training (TKWT)** - To create and maintain the availability of trained biogas Turn-Key Workers/ Rural Biogas Entrepreneurs in rural and semi-urban areas for setting up of biogas plants on Turn-Key basis and providing post-installation free warranty and services for five years, under the overall supervision of concerned State Nodal Agency/State Nodal Department and KVIC and BDTC(s).

A 3m3 biogas plant installed for beneficiary Smt. Shailaja, W/o- Shri Anand, vill.- Nandigundi, Tal.- Doddabalapur, Dist. – Bangalore Rural

Progress and Achievements

6.8 During the 12th Plan period, about 3.94 lakh Biogas plants have been set up upto 31.12.2016. The estimated average biogas production capacity of these biogas plants is 7.87 lakh cubic meter per day. These biogas plants are helping directly to an estimated annual replacement saving of about 87.5 lakh numbers of LPG cylinders equivalent. Besides that also producing about 35.95 lakh tonnes of organic enriched bio-manure per year. The organic bio-manure being produced is equivalent to about 38,000 tonnes of Urea per annum.

Alternatively the saving by biogas plants installed during the last four years and during current year 2016-17 (up to 31.12.2016) can replace the use of about 1780 lakh liters of kerosene annually. The installed plants are contributing in saving of about 9.96 lakh tonnes fuelwood per annum, and thereby, helping in preventing emission of about 19,65,000 tonnes of carbon dioxide annually, into the atmosphere.

6.9 Upto December, 2016 with the cumulative total installation of about 49.4 lakh family type biogas plants about 41.1 % of the total estimated potential based on cattle dung waste only has been harnessed. The cumulative achievements under the scheme since inception till March, 2016 and target and achievements during the year 2016-17 under the NBMM Programme are given in **Table 6.1.**

6.10 The households beneficiaries particularly women and children are also getting benefits in terms of reducing drudgery and saving in their valuable time, otherwise spent in collecting fuel wood from long distances/ forests. The independent evaluation study of the National Biogas and Manure Management Programme implemented during 11th Five year plan period brought out that about 92% of the beneficiaries expressed their opinions that there was reduction in daily saving of time by 3 hours for a woman, who will go for collecting fire-wood meeting the cooking fuel requirements.

Monitoring of Programme

6.11 State Nodal Departments/ State Nodal Agencies and KVIC are involved in implementation, maintaining database in hard and soft copies, and performance evaluation/ inspections of the biogas plants are to be done by them on regular basis. The programme implementing State Nodal Departments/ State Nodal Agencies and KVIC etc. are required to upload mandatorily the beneficiary-wise and year-wise lists of biogas plants commissioned during a year, on their official websites.

6.12 In order to ensure that un-commissioned / in-complete plants are not reported for claiming CFA, it is mandatory that all the biogas plants set up during the each quarter are physically verified and a certificate to that effect recorded by the Officers concerned for post verification purpose.

Field Inspections by Biogas Development and Training Centers (BDTCs)

6.13 Biogas Development and Training Centers (BDTCs) being supported under the National Biogas and Manure Management Programme (NBMMP) conduct field inspections of biogas plants in a year selected on random basis in the States of their jurisdictions. The reports prepared by BDTCs based on the physical inspections of biogas plants are useful for the State Nodal Agencies / State Nodal Departments and also for the MNRE to plan further implementation strategies. During the year 8 Biogas Development and Training Centres are working across the country.

Approved Models of Biogas plants and appliances under the NBMMP

6.14 The capacity of a family size biogas plant may vary from 1 cubic metre to 10 cubic metre per day. However, the central financial support, is restricted upto 6 m3 capacity. Biogas plant of more than 6 m3 capacity is not covered for Central Financial Assistance under the National Biogas and Manure Management Programme during the year. The MRNE approved models

of Biogas plants (family size category) are based on the basic design principals of the following type -

A. Floating drum design Biogas Plants

B. Fixed dome Biogas Plants

C. Prefabricated/partly pre-fabricated model of Biogas Plants in fixed dome or floating gasholder design.

D. Bag type Flexi design model of Biogas Plants

E. Solid-state fixed dome model Biogas Plants

6.15 The Solid-state fixed dome design biogas plant has been approved by MNRE during the year under regular implementation of the NBMMP.

Pre-fabricated models of biogas plants

6.16 Earlier during 2014-15, the Ministry under the innovative approach approved prefabricated biogas plants by specifying broad design specifications for HDPE/PVC/FRP/RCC material based KVIC floating design type Family Type Biogas Plants, so that the biogas plants could also reach to the remote and difficult locations/regions of the country where transportation of construction material brick, cement, sand etc. for construction of biogas plants is a difficult task and the LPG supply is also constrained by the same reasons. Further efforts were made to have standardization of such biogas plants through BIS.

Other activities /workshops / seminars

6.17 The on-going NBMM Programme was reviewed and deliberated in depth during the year in Bio-energy Advisory Committee of the MNRE and workshops. A one-day workshop of practitioners on "How to improve and scale up best practices" for small /household and village-community size biogas plants was organized on 26th October, 2016 in MNRE.

UNNAT CHULHA ABHIYAN PROGRAMME (UCAP)

6.18 The MNRE is implementing the Unnat Chulha Abhiyan (UCA) Programme for the promotion of improved biomass cookstoves in the country. The objective of the programme is to replace existing traditional inefficient Chulhas by the efficient improved biomass cookstoves, and hence to address the health concerns and also save biomass resource. The programme was continued for the year 2016-17. The target groups selected under the programme were domestic cookstoves and community cookstoves used for mid-day meal preparation in schools, anganwadis, trival hostels, restaurants etc. The UCA programme is being implemented through State Nodal/ Implementing Agencies which are engaged in implementation of renewable energy projects, State Departments of Education, State Rural Livelihood Missions, through District Coordinators of Mid-Day Meal Scheme, District Level Officer of Anganwadis, District Coordinators/Officers of Tribal/SC/Backward Class Hostels, similar departmental agencies where cook-stoves could be employed.

6.19 During the year 2016-17 few states implementing agencies as Chhattisgarh State Renewable Energy Development Agency (CREDA), Gujarat Energy Development Agency (GEDA), Jammu & Kashmir Energy Development Agency (JAKEDA), Jharkhand Renewable Energy Development Agency (JREDA), Kargil Renewable Energy Development Agency (KREDA), Odisha Renewable Energy Development Agency (OREDA), Uttarakhand Renewable Energy

Demonstration of Unnat Chulah in Sanwar Village in Udaipur, Rajasthan

Development Agency (UREDA), under North East states Assam Energy Development Agency (AEDA), Mizoram Renewable Energy Development Agency (ZEDA) & Tirpura Renewable Energy Development Agency (TREDA) put their efforts for implementation of UCA programme. Both Natural Draft and Forced Draft cookstoves for domestic and community cooking applications have been disseminated.

6.20 MNRE continued to support four Biomass Cookstove Test Centres setup for performance testing of improved biomass cookstove to maintain the quality. These test facilities carried out testing as per Bureau of Indian Standards (BIS) specifications IS-13152. These test centres have been setup in Indian Institute of Technology (IIT), Delhi, Institute of Minerals and Materials Technology (IMMT), CSIR-Lab, Bhubaneswar, Odisha, College of Technology & Engineering, Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur, Rajasthan and Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE), Kapurthala, Punjab. These Test Centres are equipped with advanced testing equipment's at par with international standards. The performance testing involves determination of thermal efficiency, Carbon Monoxide (CO) and Particulate Matter (PM) emissions and material specifications of improved biomass cookstoves.

6.21 All four Biomass Cookstove Test Centres carried out performance testing of different models of Improved Cookstoves as per the standard performance parameters given by BIS-13152 for cookstoves. MPUAT Udaipur tested 12 cookstoves, IIT Delhi tested seven improved cookstoves, CSIR-IMMT Bhubaneswar tested six improved cookstoves and SSS-NIBE Kapurthala tested three improved cookstoves at their testing centres in this year. The progress of MNRE supported test centres was reviewed in the meeting held on 27th May, 2016.

6.22 There are total of 53 biomass cookstoves approved by MNRE out of which 25 are natural draft domestic cookstoves, 13 are forced draft domestic cookstoves, two are natural draft community cookstoves and 13 are forced draft community cookstoves and total 31 manufacturers are incorporated in the list of approved cookstoves models in the MNRE website (www.mnre.gov.in)

6.23 The Biomass Cookstove Test Centres in collaboration with the MNRE organized various conference and other events to create awareness on improved cookstoves from time to time. In 2016-17 Test Centres also organized events to demonstrated functioning of improved cookstoves at village level. MPUAT Udaipur demonstrated Unnat Chulha models and generated awareness at Farmer's fair at MPUAT adopted Smart Village i.e. Challi, P S Gogunda Dist. Udaipur on 25th December, 2016.

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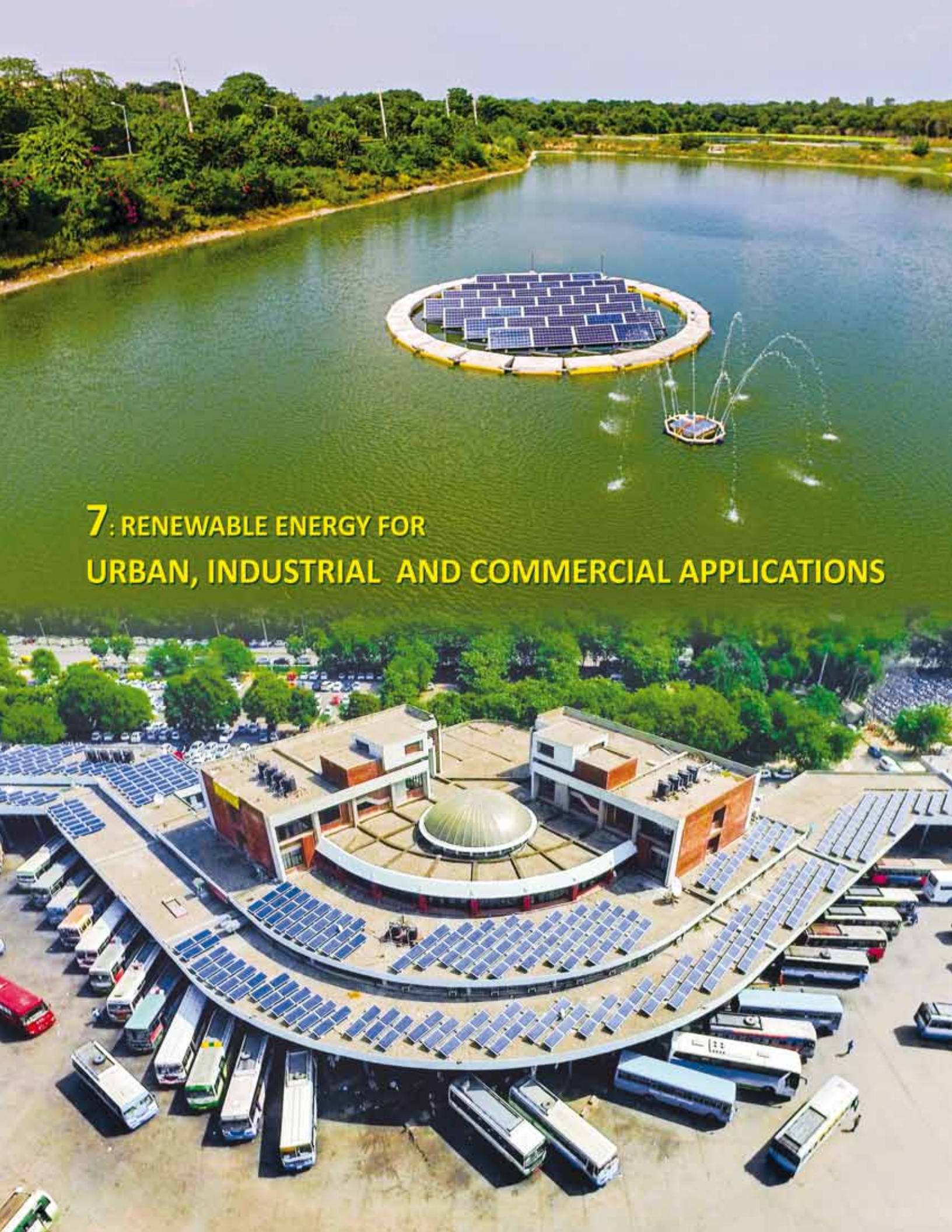

7: RENEWABLE ENERGY FOR URBAN, INDUSTRIAL AND COMMERCIAL APPLICATIONS

RENEWABLE ENERGY FOR URBAN, INDUSTRIAL AND COMMERCIAL APPLICATIONS

7.1 The Ministry has been promoting the use of technologies for energy recovery from municipal, industrial and commercial wastes and solar energy, for meeting certain niche energy demands of urban, industrial and commercial sectors in the country. The programmes being implemented during the year include: i) Energy Efficient Solar /Green Building Programme; ii) Energy Recovery from Urban, Industrial and Agricultural Wastes; and iii) Bio-energy and Cogeneration in Industry.

ENERGY EFFICIENT SOLAR/GREEN BUILDINGS PROGRAMME

7.2 Buildings are major consumers of energy in their construction, operation and maintenance. Globally, about 40% of energy consumption is estimated to be in building sector. At present India is experiencing heavy construction activities in all spheres, thereby the energy demand is increasing rapidly. This is also due to rapidly growing urbanization and the increasing affordability of the people.

7.3 A green building minimizes the demand on fossil fuel based energy, maximizes the recycle, reuse, renewable energy and energy efficient devices & appliances. The need to reduce energy consumption and increase use of renewable energy in buildings has been an important concern of this Ministry. Consequently, energy conscious architecture has been promoted which includes the use of solar passive design concept, use of eco-friendly and less energy intensive building materials, integration of renewable energy and energy efficiency, water conservation, waste recycling etc. This was the origin of the green building concept.

Achievements and Progress

7.4 The Ministry has been implementing a Scheme on "Energy Efficient Solar/Green Buildings" since, February, 2009 which aims to promote the widespread construction of energy efficient solar/ green buildings in the country through a combination of financial and promotional incentives mainly for capacity building, awareness, seminar and workshops and other promotional activities etc. Under the "Energy Efficient Solar/Green Buildings "programme following initiatives have been taken up to promote green building construction in the country.

Dhanas lake SPV Power Plant at Chandigarh under Model Solar Cities Programme

- A GRIHA rating system has been developed in collaboration with The Energy and Resources Institute (TERI) and an independent registered society 'GRIHA Council' is independently providing GRIHA Ratings. So far 850 buildings with aggregate 32 million sq.m built-up-areas have been covered for acquiring GRIHA rating.

SPV Power Plant at ISBT Sector-43, Chandigarh under Model Solar Cities Programme

- 97 building projects of Govt. with 3.05 million sq. m built-up area have been sanctioned for the exemption from the registration cum rating fees for acquiring GRIHA rating. 7 buildings have been awarded GRIHA Ratings.
- About 225 capacity building programme including trainings, seminar, conferences, workshops for Evaluators and Trainers on GRIHA Ratings and awareness programmes on Green Buildings/GRIHA Ratings/Green Architecture were organized across the country by various technical institutions.
- Over 1000 GRIHA evaluators and trainers were developed under the programme.

7.5 Under the programme Rs.0.25 crore has been released towards reimbursement of different capacity building programmes so far in the FY 2016-17.

DEVELOPMENT OF SOLAR CITIES PROGRAMME

7.6 The "Development of Solar Cities" programme aims at minimum 10% reduction in projected demand of conventional energy at the end of five years, which can be achieved through a combination of energy efficiency measures while enhancing supply from renewable energy sources. The Ministry assists Municipal Corporations and Urban Local Bodies in preparation of a master plan for increasing energy efficiency and renewable energy supply in the city, setting-up institutional arrangements for the implementation of the Master Plan and awareness generation and capacity building activities.

7.7 The Ministry has a target to support 60 cities/towns for Development as "Solar/ Green Cities". Financial support up to of Rs.50 lakh for each city is provided for preparation of the Master

Plan alongwith few DPR (up to Rs.10 lakh), oversight of its implementation (up to Rs.10 lakh), setting up and functioning of Solar City Cell in the city (up to Rs.10 lakh) and organizing promotional activities (up to Rs.20 lakh).

7.8 So far under the programme 60 cities have been approved/sanctioned of which master plan of 49 cities has been prepared. The State/City-wise progress is given in **Table 7.1.**

7.9 As per programme, eight cities are being developed as 'Model Solar Cities' for which Bhubaneswar, Chandigarh, Gandhinagar, Mysore and Nagpur have been identified. The financial support upto Rs.9.50 core will be provided to each Model Solar City.

7.10 Fifteen Cities are being developed as 'Pilot Solar Cities' for which 13 cities namely Agartala, Coimbatore, Rajkot, Shimla, Faridabad, Thane, Raipur, Shirdi, Leh, Aizawl, Puducherry, Vijayawada and Amritsar have being identified. The financial support upto Rs.2.50 crore will be provided for each Pilot Solar City.

7.11 Of these 60 solar cities, 33 solar cities were included under the Smart City programme of Ministry of Urban Development.

7.12 34.77 MW SPV Grid Connected Solar Rooftop systems were installed by Solar Energy Corporation of India in the Solar Cities.

7.13 So far, cumulative Rs.102.10 crore has been sanctioned and Rs.24.16 crore has been released under this programme.

Green Campus

7.14 A Green Campus aims to reduce fossil fuel based consumption in next five years by 25% through renewable energy applications and energy efficiency measures. The financial support upto Rs.5.0 lakh is provided for developing a green campus in the educational Institutions, office complexes, residential and commercial complexes etc. The proposals of 20 campuses/ township were sanctioned to develop as Green Campus making a cumulative sanction of 52 green campuses. So far, Rs.2.596 crore has been sanctioned and Rs.0.225 crore has been released for green campuses.

SPV Power Plant at NITTTR Academic Complex (left) and 60 kWp Plant Govt. School Dhanas, Chandigarh (right) under Model Solar Cities Programme

Table 7.1 State/City-wise Progress of Solar City Program				
Sr. No.	**State**	**Approved Solar Cities**	**Status of Master Plans**	**Solar City Cell Created**
1.	Andhra Pradesh	1. Vijayawada* 2. Kakinada 3. Narsapur Town	Prepared Under Preparation Under Preparation	Yes No
2.	Assam	4. Guwahati 5. Jorhat	Prepared Prepared	No Yes
3.	Arunachal Pradesh	6. Itanagar		
4.	Bihar	7. Gaya		
5.	Chandigarh	8. Chandigarh**		
6.	Chhattisgarh	9. Bilaspur		
		10. Raipur*		
7.	Gujarat	11. Rajkot*	Prepared	Yes
		12. Gandhinagar**	Prepared	Yes
		13. Surat	Prepared	Yes
8.	Goa	14. Panji City		
9.	Haryana	15. Gurugram		
		16. Faridabad*		
10.	Himachal Pradesh	17. Shimla*		
		18. Hamirpur		
11.	Karnataka	19. Mysore**		
		20. Hubli-Dharwad		
12.	Kerala	21.Thiruvananthapuram*		
		22. Kochi		
13.	Maharashtra	23. Nagpur**	Prepared	Yes
		24. Thane*	Prepared	Yes
		25. Kalyan-Dombivali	Prepared	Yes
		26. Aurangabad	Prepared	No
		27. Nanded	Prepared	No
		28. Shirdi*	Prepared	Yes
		29. Pune	Under Preparation	Yes
14.	Madhya Pradesh	30. Indore	Prepared	No
		31. Gwalior	Prepared	Yes
		32. Bhopal	Prepared	No
		33. Rewa	Prepared	Yes
		34. Jabalpur	Under Preparation	Yes
15.	Manipur	35. Imphal	Prepared	Yes
16.	Mizoram	36. Aizawl*	Prepared	Yes
17.	Nagaland	37. Kohima	Prepared	Yes

		38. Dimapur	Prepared	No
18.	Delhi	39. New Delhi (NDMC area)	Prepared	No
19.	Odisha	40. Bhubaneswar**	Prepared	No
20.	Punjab	41. Amritsar*	Prepared	No
		42. Ludhiana	Prepared	Yes
		43. SAS Nagar (Mohali)	Under Preparation	No
21.	Rajasthan	44. Ajmer	Under Preparation	No
		45. Jaipur	Under Preparation	No
		46. Jodhpur	Prepared	Yes
22.	Tamil Nadu	47. Coimbatore*	Prepared	Yes
23.	Telangana	48. Mahbubnagar	Under Preparation	No
24.	Tripura	49. Agartala*	Prepared	Yes
25.	Uttarakhand	50. Dehradun	Prepared	Yes
		51.Haridwar & Rishikesh	Prepared	Yes
		52. Chamoli – Gopeshwar	Prepared	Yes
26.	Uttar Pradesh	53. Agra*	Prepared	Yes
		54. Moradabad	Prepared	Yes
		55. Allahabad	Prepared (Finalized)	
27.	West Bengal	56. Howrah	Under Preparation	Yes
		57. Madhyamgram	Prepared	Yes
		58. New Town Kolkata	Prepared	
28.	Jammu & Kashmir	59. Leh*	Under Preparation	No
29.	Puducherry	60. Puducherry*	Prepared	Yes

(**Model Solar Cities, * Pilot Solar Cities)

ENERGY FROM URBAN, INDUSTRIAL AND AGRICULTURAL WASTES/RESIDUES

Programme on Energy from Urban, Industrial & Agricultural Wastes/ Residues during 12th Plan Period

7.15 During the year 2016-17, the Ministry has continued the implementation of the Programme on Energy from Urban, Industrial and Agricultural Waste/Residues aimed at energy generation from different wastes, such as municipal solid wastes, vegetable and other market wastes, slaughterhouse waste, agricultural residues and industrial wastes & effluents.

Objectives of the Scheme

(i) To promote setting up of projects for recovery of energy from urban, industrial and agricultural wastes; and

(ii) To create conducive conditions and environment, with fiscal and financial regime, to develop, demonstrate and disseminate utilization of wastes and residues for recovery of energy.

Subsidy/Grant/Incentive provided under the Scheme

7.16 Central Financial Assistance (CFA) for projects of different categories is given in the form of capital subsidy to the promoters and in the form of Grants-in-Aid for other activities, as given below:

Wastes/Processes/Technologies	Central Financial Assistance
1. Power generation from Municipal Solid Waste	Rs.2.00 crore/MW (Max. Rs.10.00 crore/Project)
2. Power generation or production of bio-CNG from biogas at Sewage Treatment Plant or through biomethanation of Urban and Agricultural Waste/ Residues including cattle dung	Rs.2.00 crore/MW or bio-CNG from 12000 m^3 biogas/day (Max. Rs.5.00 crore/project)
3. Biogas generation from Urban, Industrial and Agricultural Wastes/Residues	Rs.0.50 crore/MW eq.(12000 m^3 biogas/day with maximum of Rs.5.00 crore/project)
4. Power Generation from Biogas (Engine/gas turbine route) and production of bio-CNG for filling into gas cyclinders	Rs.1.00 crore/MW or bio-CNG from 12000 m^3 biogas (Max. Rs.5.00 crore/project)
5. Power Generation from Biogas, solid Industrial, Agricultural Waste/residues excluding bagasse through Boiler + Steam turbine Configuration	Rs.0.20 crore/MW (Max. Rs.1.00 crore / project)

7.17 Other Incentives and Support Measures available to promote/develop the sector are – i) Provide Concessional Customs Duty and Excise Duty Exemption for initial setting up of grid connected projects for power generation or production of Bio-CNG from wastes; ii) Preferential Tariff announced by the CERC /SERC; iii) Energy Buyback, Wheeling & Banking; iv) Incentives to State Nodal Agencies - Service Charge @ 1% of the Subsidy restricted to Rs.5.00 lakh per project; and v) Financial Assistance for Promotional Activities - for Organizing Capacity Building Programmes, Awareness Creation, Business Meets, Seminars / Workshops, Publication of Newsletters, Resource Assessment, Technology Validation and Performance Monitoring and Evaluation subject to a maximum of Rs.3.00 lakh per activity.

7.18 During the year 2016-17, the physical achievement under the programme is about 12 MWeq. and cumulative achievement in the sector as on December 2016 is 277.50 MWeq.

New Initiatives taken by the GOI

Tariff Policy – Power from WTE plants

7.19 In compliance with Section (3) of the Electricity Act, 2003, Ministry of Power (MoP) notified on 12th February, 2005, the Tariff Policy in continuation of the National Electricity Policy (NEP). It was amended and the came into effect from 28th January 2016.

7.20 According to the amended Tariff Policy, Distribution Licensee(s) shall compulsorily procure 100% power produced from all the Waste-to-Energy plants in the State, in the ratio of their procurement of power from all sources including their own, at the tariff determined by the Appropriate Commission under Section 62 of the Act.

i) Generic Tariff for WTE Projects for FY 2016-17

7.21 The Central Electricity Regulatory Commission (CERC) vide notification dated 07th October 2015 and 31st March 2015 have notified norms for determination of Generic Tariff for MSW, RDF and Biogas based WTE projects along with Generic Tariff for FY 2016-17.

Technology	Variable Cost (Rs./ kWh)	Levelised Fixed Cost (Rs./kWh)	Applicable Tariff (Rs./kWh)	Benefit of Accelerated Depreciation (if availed) (Rs./kWh)	Net Levelised Tariff (Rs./ kWh)
MSW	0.00	7.04	7.04	0.54	6.50
RDF based MSW	3.56	4.34	7.90	0.31	7.59
Biogas	3.57	4.29	7.86	0.26	7.60

ii) Ministry of Road Transport and Highways Notification

7.22 Ministry of Road Transport and Highways, vide Notification dated 16th June 2015, has amended the Central Motor Vehicles Rules, 1989 and included the provisions for usage of biogas, in the form of bio-CNG, in motor vehicles as mentioned below:-

a) Provided that bio-compressed natural gas (bio-CNG) shall be permitted for motor vehicles as an alternate composition of the compressed natural gas (CNG);

b) Provided further that the mass emission standards applicable to compressed natural gas (CNG) vehicles under these rules shall be applicable to respective vehicles when they use bio-compressed natural gas (bio-GNG);

c) Provided also that the bio-compressed natural gas (bio-CNG) composition meets the fuel specification for bio-compressed natural gas (bio-CNG) as per IS 16087 and meets the requirement of Siloxanes max 0.1 ppm (calculated as Si).

iii) Indian Standard on Biogas (Bio-methane)

7.23 This standard (IS 16087-2013) prescribes the requirement and the methods of sampling and test for the biogas (Bio-methane) applications in stationary engines, automotive and thermal applications and supply through piped network. Requirements for biogas (Bio-methane) for automotive application and piped network as per standard is as under:-

S.No.	Characteristic	Requirements	Method of Test Ref. to
i)	CH_4 Percent, Min	90	IS 15130 (Part 3)
ii)	Moisture, mg/m^3 Max	16	IS 15641 (Part 2)
iii)	H.S. mg/m^3 Max	30.3	ISO 6326-3
iv)	$CO_2+N_2+O_2$ Percent, Max (v/v)	10	IS 15130 (Part 3)
iv)	CO_2 percent, Max (v/v) (when intended for filling in cylinders)	4	IS 15130 (Part 3)
v)	O_2 percent, Max (v/v)	0.5	IS 15130 (Part 3)

Progress during the year 2016-17

7.24 During the year 2016-17 following 21 projects were commissioned /sanctioned

Commissioned Projects

i) A grid connected power plant of capacity 7.5 MW based on poultry waste was set up by M/s. Redan Infrastructure Pvt. Ltd., Chittoor, Andhra Pradesh.

ii) 3 projects for generation of biogas for power generation/thermal application from industrial effluents/urban waste were set up in Andhra Pradesh, Telangana and Kerala.

ii) As a part of the new initiative for supporting Bio-CNG production, 3 projects of cumulative production of 10,767 kg/day of Bio-CNG, were commissioned during the financial year 2016-17, in Punjab, Rajasthan and Maharashtra. A brief on these projects is as under:-

- A plant for production of 1000 kg/day of Bio-CNG from 2500 m3/day of biogas generated from cattle manure was set up by M/s. NRB Bio-Energy in Hanumangarh, Rajasthan;
- A plant for production of 1847 kg/day from 5000 m3/day biogas from urban waste was set up by M/s Arc Bio Fuel Pvt. Ltd, Barnala, Punjab;
- A plant for production of 7920 kg/day of Bio-CNG from 19,200 m3/day from Distillery Spent Wash was set up by M/s Green Elephant India Pvt. Ltd. at Kissanveer Sahkari Sugar Mill Satara on BOOT basis. Sanctioned Projects

7.25 In addition to above, 14 projects of cumulative capacity of 15.50 MW were sanctioned for production of Biogas/Bio-CNG/Power in different states and are expected to be commissioned by June 2017.

Energy from Urban, Industrial and Agricultural Wastes/Residues including Biomass Co-generation (Non-Bagasse) in Industry

7.26 The industrial sector consumes approximately 35% of total electricity generated in the country. In the absence of good quality, reliable power from the grid, they are increasingly generating their own power, largely through diesel generators and are meeting their thermal energy requirements through fossil fuels such as coal, oil or natural gas. Several industries require electrical as well as thermal energy for their operations, which can either be met through different energy sources or through co-generation using only one fuel. The power and steam generated from such co-generation plants can be used for meeting the captive requirements and the surplus power produced can be exported to the grid. Such projects are being set up in a number of industry sectors namely distillery, paper and pulp, solvent extraction, rice mills, textiles, pharmaceutical industries, etc.

Programme on Energy from Urban, Industrial and Agricultural Wastes/Residues including Biomass Co-generation (non-bagasse) in Industry

7.27 The Ministry is implementing a "Programme on Energy from Urban, Industrial and Agricultural Wastes/Residues" including Biomass Co-generation (non-bagasse) in Industries for exploiting the vast potential of biomass power in the form of thermal energy and power for captive use in industry with the following major objectives :

i. To promote setting up of projects for recovery of energy from urban, industrial and agricultural wastes/residues; and

ii. To create conducive conditions and environment, with fiscal and financial regime, to develop, demonstrate and disseminate utilization of wastes and residues for recovery of energy.

7.28 Capital subsidy on re-imbursement basis is being provided after commissioning of the projects @ Rs. 20 lakh per MW for biomass co-generation projects.

1.0 MW biomass co-generation project installed at Vill. Karambedu, Dist. Thiruvallur, T.N

Progress during 2016-17

7.29 A cumulative capacity of 651.91 MW has so far been commissioned mainly in the states of Tamil Nadu, Uttar Pradesh, Haryana, Karnataka, Andhra Pradesh, Uttarakhand , Punjab and Rajasthan. State wise details are given in Table 7.2.

Table 7.2 State wise details of Biomass Cogeneration (Non-Bagasse) projects

S. No.	State	Installed Capacity (in MW)
1.	Andhra Pradesh	98.98
2.	Chattisgarh	2.50
3.	Haryana	77.06
4.	Himachal Pradesh	7.20
5.	Kerala	0.72
6.	Karnataka	15.20
7.	Madhya Pradesh	12.35
8.	Maharashtra	16.40
9.	Meghalaya	13.80
10.	Odisha	8.22
11.	Punjab	123.10
12.	Bihar	8.20
13.	Rajasthan	2
14.	Jharkhand	4.30
15.	Uttar Pradesh	170.41
16.	Uttarakhand	47.50
17.	West Bengal	19.92
18.	Tamil Nadu	24.05
	Total	651.91

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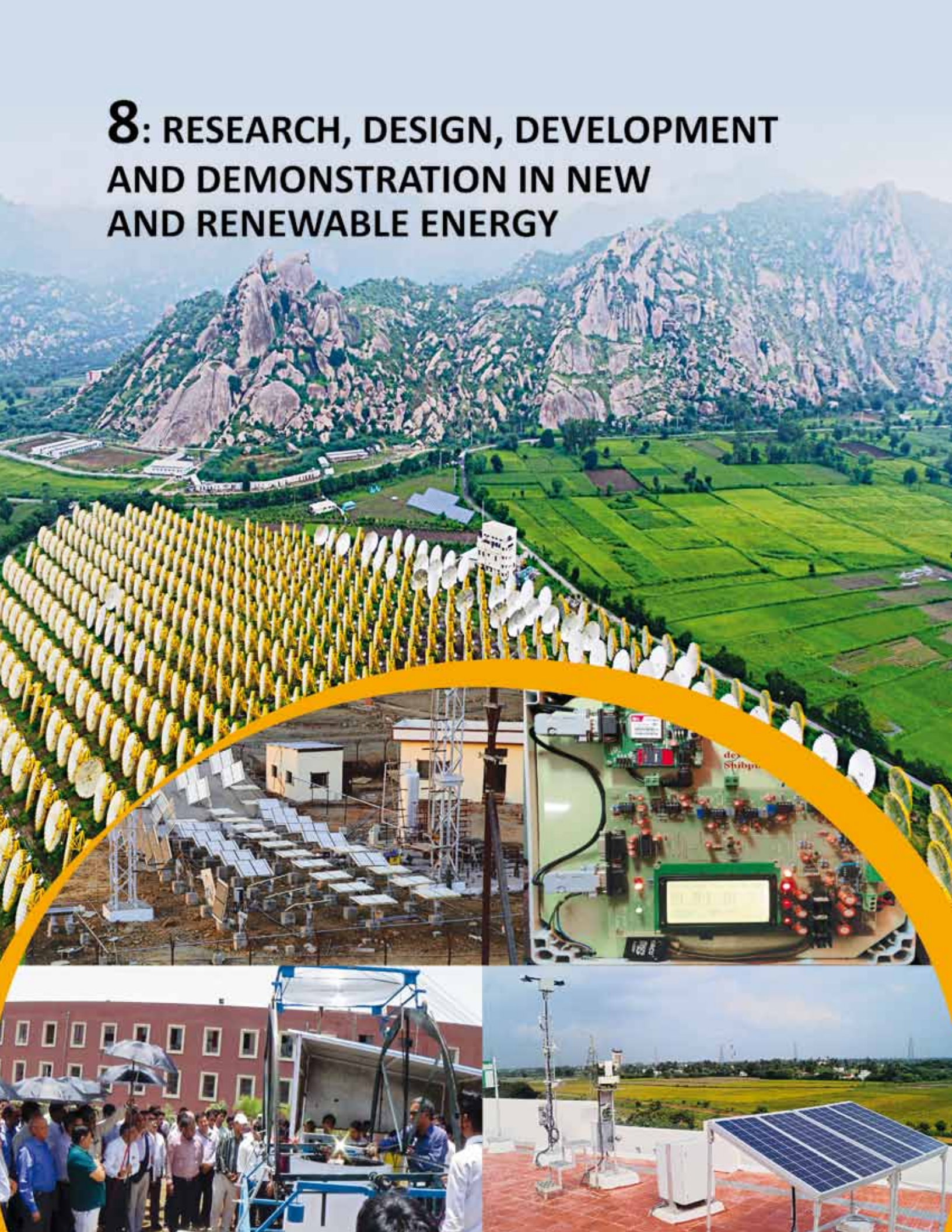
8: RESEARCH, DESIGN, DEVELOPMENT AND DEMONSTRATION IN NEW AND RENEWABLE ENERGY



RESEARCH, DEVELOPMENT AND DEMONSTRATION (RD&D) IN NEW AND RENEWABLE ENERGY

8.1 Research & Development Programme of the Ministry aims at resource assessment, technology development, demonstration and commercialization for promoting the large scale use of new and renewable energy across the country. The Ministry supports Research, Development and Demonstration (RD&D) to develop new and renewable energy technologies, processes, materials, components, sub-systems, products & services, standards and resource assessment so as to indigenously manufacture new and renewable energy devices and systems. The objective of the programme is to make industry competitive and renewable energy generation supply self-sustainable/profitable and thereby contribute to increase share in total energy mix in the country. RD&D Projects are supported to various R&D/academic institutions, industries, NGO's etc. for technology development and demonstration in the field of solar, wind, solar-wind hybrid, biogas, biofuel, hydrogen and fuel cells, geothermal, etc. The RD&D efforts are continued with emphasis on efficiency improvement and cost reduction.

Policy and Guidelines

8.2 A comprehensive policy framework on Research, Development and Demonstration (RD&D) is in place to support RD&D in new and renewable energy sector, including associating and supporting RD&D earned out by industry for market development. It includes R&D perspective of solar energy as envisioned in the National Solar Mission (NSM) for promotion of solar power in the country. The guidelines have special focus on core-support to R&D institutions to strengthen their expertise in the specific area for technology development and demonstration and technology validation in association with industry to facilitate commercialization. Ministry provides upto 100% financial support to Government/non-profit research organizations/ NGOs and 50% to industry.

8.3 The policy framework provides guidelines for project identification, formulation, monitoring, appraisal, approval and financial support. The RD&D projects received from R&D/academic institutions, industries, etc. are evaluated through subject experts. The qualifying projects are appraised by R&D Project Appraisal Committees. The projects recommended by the committees are sanctioned to prospective implementing agencies. A total amount of Rs.446.78 crore has been spent on RD&D in solar, bio-energy, wind, hydrogen and fuel cells during the current Five Year Plan. The policy and guidelines of RD&D are under revision with special focus on efficient evaluation, appraisal, monitoring and review of R&D projects to ensure the outputs and timelines.

Thrust Areas for RD&D

8.4 The MNRE organized a day long "Brainstorming Consultations Meeting on RD&D" on 5th January 2016 under the chairmanship of Secretary, MNRE for reviewing the progress of R&D Programme and for identifying thrust areas for RD&D. The meeting was attended by key subject experts from R&D/academic institutions, industries and representatives of related scientific departments. The progress of R&D projects funded by MNRE was reviewed for achievements and for steps needed to take the progress further for expansion of technology development and demonstration for large scale promotion of new and renewable energy for various applications in the country. The discussion focused on promoting R&D in focused

areas identifying ways and means and encouraging collaboration between R&D/academic institutions and industries in the process of technology development and demonstration keeping in view the cost reduction and efficiency improvement. It was considered that the projects should be periodically monitored by MNRE so that proper and timely action is taken for implementation. Further, the achievements under R&D projects should be validated by standard institutions having testing and evaluation expertise and facilities.

8.5 The various aspects of technology development in solar thermal, solar photovoltaics, energy storage, biogas, biofuel, wind, wind–solar hybrid, small hydro, hydrogen and fuel cells and related power control systems were discussed in detail keeping in view reliable and cost effective energy supply. In solar, the discussion focused on vigorous R&D on materials, technology development for indigenous production and storage systems to improve the reliability of systems/components. "Thrust Areas with Action Plan for RD&D" prepared in the said meeting was adopted for implementation by MNRE. It encompasses the complete strategy for RD&D towards technology development, demonstration, validation and standardization for commercialization. The document is uploaded to MNRE web under the head of RD&D facilitating researchers and scientists to develop projects.

IMPRINT Programme

8.6 MNRE is also partner to IMPacting Research Innovation and Technology (IMPRINT), a flagship national initiative of the Government, launched by the President, Prime Minister and Human Resource Minister on November 5, 2015. IMPRINT aims at addressing and providing solutions to the most relevant engineering challenges faced by the nation by translating knowledge into viable technology (products or processes) in selected domains to enable, empower and embolden the nation for inclusive growth and self-reliance. The IMPRINT Programme, coordinated by MHRD is a multi-disciplinary, multi-partner and multi-goal oriented national programme aimed at technology development covering all engineering disciplines, steered by all IITs and IISc. IIT Kanpur is designated as the National Coordinator of the programme. The IMPRINT framework provides support for projects which ensure prototype/process development for technology development.

8.7 Under this programme, the projects invited by the National Coordinator are reviewed by the Domain Expert Committee (DEC) in consultation with the concerned Ministry/Department. The projects recommended by the DEC are appraised by the Apex Committee under the chairmanship of Secretary, Department of Higher Education, MHRD and comprising Secretaries of the respective Ministries/Departments. The MHRD shares 50% cost of the project. The balance cost has to be shared by the participating Ministry. During the current year, MNRE has agreed to support five projects in the area of biofuel, hydrogen and fuel cells, storage for SPV and Solar Thermal Systems with specific deliverables. The MNRE share of Rs.3.69 crore for these projects will be provided under the RD&D Programme.

National Lab Policy for Testing, Standardization and Certification

8.8 As a follow up to the recommendation of the National Workshop that was organized by MNRE on 10th September 2015, the MNRE has prepared a "National Policy for Renewable Energy Sector for Testing, Standardization and Certification" for quality control of the renewable energy systems/components. The said policy has brought out the clarity about testing and standardization making the testing and standardization mandatory and suggesting the plan for

implementation. It provides a structure for developing a comprehensive plan for establishing, operating and monitoring the testing, standardization and performance certification services including regulatory framework, and promoting better coordination of activities among test labs, programmes and institutions.

8.9 The Lab Policy document is the result of collective efforts of the committee of experts and is based on the review of existing standards, test facilities practices being followed and the need of quality assurance and reliability of renewable energy supply. The Lab Policy will be released in a National Workshop on the subject scheduled to be held in February 2017. It will facilitate quality control and also indigenous technology development.

Scheme on Young Scientist Award on New & Renewable Energy

8.10 The MNRE in 2015 introduced a scheme for "New and Renewable Energy Young Scientist Award" in order to promote excellence in various areas of new and renewable energy. The objective of the scheme is to encourage young scientists to make outstanding achievements in research and development for technology development in new and renewable energy. The nominations received are being consolidated for screening by a screening committee under the chairmanship of an eminent scientist.

Space Technology based Tools for Renewable Energy Resource Assessment

8.11 As follow up to the Cabinet Secretary's directions in July 2015 and subsequent "National Meet for Promoting Space Technology based Tools and Applications in Governance" held on 07.09.2015 at Vigyan Bhawan, New Delhi, MNRE initiated interaction with ISRO for adopting tools and data available with them for resources assessment in solar and wind energy. In this regard, interactive activities between Space Applications Centre (SAC), ISRO Ahmedabad and National Institute of Wind Energy (NIWE), Chennai have been initiated. The activities on validation of satellite based wind and solar data against the ground measured data is being pursued by NIWE. MNRE's institute, namely, SSS-NIBE at Kapurthala, Punjab is being involved in biomass resource assessment.

Institutional Mechanism

8.12 The Ministry is supporting creation of enabling conditions for institutional mechanism for collaboration for faster development and demonstration of technology for commercialization. Centres of Excellences have also been supported for pursuing research in advanced areas for technology development and training for promotion of R&D in the respective areas. The Ministry is actively considering to strengthen its R&D institutions, namely, National Institute of Solar Energy (NISE), Gurgaon, National Institute of Bio-Energy (NIBE), Kapurthala and National Institute of Wind Energy (NIWE), Chennai with their functions for pursuing RD&D for technology development and demonstration, in addition to testing, standardization and certification in solar, bioenergy and wind energy systems, respectively. These institutions have to be transformed to world class R&D institutions in the respective areas.

Technical Regulation for SPV Systems/Components

8.13 The MNRE during the current year initiated interactions with related Departments and Test Labs to explore bringing out Technical Regulation for SPV Systems/Devices/Components in order to ensure quality and reliability of products. Technical Regulation stipulates standards

Technical Regulation Meeting being chaired by Secretary, MNRE

for all goods to maintain the quality and protect human health and safety. This will also prevent poor quality goods from entering into Indian market. In this endeavour, series of meetings with concerned departments and related stakeholders have been organized to discuss the provisions and implications keeping in view the enhanced target of 100 GW solar power deployment set by MNRE by 2022. Accordingly, a draft Technical Regulation was prepared as per relevant BIS Act in consultation with Bureau of Indian Standard (BIS). The draft Technical Regulation approved by BIS was uploaded to MNRE web on 24.08.2016 for comments of public till 26.09.2016. It has a provision for industries/developers to prepare for registration with BIS in one year from the date of notification. Effectively, all products will need to follow Indian Standards.

8.14 In order to finalize the draft Technical Regulation, a meeting was held on 26.09.2016 under the chairmanship of Secretary, MNRE to discuss the draft document including comments received from industries/project developers. The meeting comprised 95 participants including senior officials from Department of Commerce and Industry, BIS, DST, DeitY, DoES, industry representatives, project developers, representatives from test labs, etc., apart from MNRE officers. The draft Technical Regulation was presented in the above meeting and discussed extensively including comments received. The industry including developers appreciated the initiative of MNRE and desired that the standards of all the systems/components to be updated/developed and test facilities need to be set up and strengthen in order to ensure quality and reliable testing results within the given time limits.

8.15 The Technical Regulation for SPV Systems/Components under BIS Act for quality control has been approved by Hon'ble Minister and is under consideration of Ministry of Law for vetting. Thereafter the same will be submitted to Department of Commerce for consideration of notifying to Technical Barriers to Trade (TBT) Committee of WTO and then seeking comments from other countries. The Technical Regulation will not only ensure quality of SPV systems for sustained quality power supply but will also project Indian initiative towards quality control at

global level and encourage domestic manufacture of the systems in the sector. It will, however, require adequate resources for implementation of testing, standardization and certification process as brought out in the lab policy.

Implementation of RD & D Projects

8.16 During the period the Ministry organized meetings of R&D Project Appraisal Committees to review on-going R&D projects and appraise new projects for consideration of funding. A brief description of the R&D activities in solar, biofuel and Hydrogen and Fuel Cell is given below.

Solar R&D

8.17 Efforts were continued to accelerate R&D activities on different aspects of Solar Photovoltaic (SPV) and Solar Thermal (ST) technologies, including multi-disciplinary research, with the objective of improving the efficiency, systems performance and reducing the cost. The details of the ongoing projects, completed and new projects sanctioned during the current year is given below:-

Solar Photovoltaic

Ongoing Projects

- National Centre for Photovoltaic Research and Education (NCPRE) at IIT Bombay. NCPRE was taken up as a project on Centre for Excellence in 2010 for promoting R&D in "Crystalline Si solar cells, education and training". NCPRE is group experts from academia and industries and is actively engaged in research and education in SPV. Crystalline silicon solar cell with 18% efficiency has been developed under NCPRE. In addition, solar inverters of various capacities have also been developed. The projects have facilitated training manpower for R&D and operation and maintenance of SPV projects and also all India SPV module survey. NCPRE faculty and students have resulted 110 Journal papers, 214 conference papers, 22 patents and four reports. 18 industry / NGO are members of NCPRE Industry Affiliate programme. Many industries are ready to take the patented technology of NCPRE.
- In order to take the progress further, the MNRE sanctioned NCPRE Ph-II to IIT Bombay with enhanced targets and with 22% efficiency of Mono crystalline-Si 5 inch x 5 inch IBC Solar Cells, Training of 500 entrepreneurs and handholding of about 15 potential start-up companies for detailed training on technology, 15 % PCE in tandem cells with perovskite-based top cell and Si or CZTSSe cells as the bottom cell; cell area of 4 cm^2 and development of various capacities inverters with 95% efficiency.
- Under a project entitled "Thin silicon solar cells and photovoltaic systems" which was sanctioned to Indian Institute of Engineering Science and Technology (IIEST), Kolkata in May 2011 as Center of Excellence, Single junction a-Si solar cells of area 1cm^2 with initial efficiency of 8.4% has been developed with a degradation of 17% and would reach a stabilized efficiency >7.5% which is the project target. For HIT cells on n-type wafers, efficiency of 14% has been reached. Attempts are being made to improve passivation process, improve ITO/p interface. In case of photovoltaic systems, Super capacitor based Turbo Charger

A 4kVA Grid-Interactive Solar Inverter developed by CEGESS, IIEST, Shibpur, Kolkata

for Mobile Phones for rural applications had been designed and developed and various batteries research is going on. Seven journal papers and 15 conference papers have been published. The second Phase of this Center of Excellence is also under consideration.

- A project "development of improved DS process for mc-Si wafers and their application to Solar Cells" was sanctioned to SSN College of Engineering, Tamilnadu in January 2015. The goal of the project is to grow multi-crystalline silicon ingots with enhanced efficiency equivalent to mono-crystalline wafer using directional solidification process with lower cost and higher yield.
- Design of soft-switching converter with adaptive MPPT Controller and design, development and evaluate a laboratory prototype of an efficient smart control system for domestic roof top PV applications with bidirectional metering provision and increased efficiency of system 90-95% projects was sanctioned in July 2014 to Birla Institution of Technology and Science, Pilani, Rajasthan, Electrical Research and Development Association, ERDA, Gujarat and Jamia Milia Islamia University, New Delhi. The project is on-going.

New Projects

8.18 The following new projects have been sanctioned during the current year;

i. "Development and field testing of Solar powered clean drinking water systems for communities without piped water line and electricity" to Dr. O S Sastry, National Institute of Solar Energy and M/s Saurya Enertech, Gurgaon

ii. Development of Electrode Materials for High Energy Density Lithium ion Batteries and Computational Studies of Solar Absorber layers by Dr. M. Sasidharan, Professor, SRM Research Institute, SRM University, Kattankulathur

iii. From Cell towards Module using low cost Organo-Metal Halide Perovskite Materials by Dr. Shaibal K. Sarkar, Indian Institute of Technology Bombay, Powai, Mumbai

iv. Development of Solar PV and wind hybrid power plant with large scale battery storage at Kaza, Himachal Pradesh by Dr. Y.B.K. Reddy, Sr. Manager (PV), Solar Energy Corporation of India, New Delhi

Solar Thermal

8.19 The following new projects have been sanctioned during the current year:

- Center for Environmental Planning and Technology (CEPT), Ahmedabad in "Area of solar passive architecture and green building technologies": A initiative to Set up Center for Excellence in area of Solar Passive Architecture and Green Building Technologies" at CEPT University – Ahmedabad. CEPT has developed the Generation of database for Building Materials and Laboratory for testing building materials. This is a first kind of Laboratory in Asia for Green building. The project progress is good and achieving the defined deliverables.
- IIT Jodhpur, Rajasthan in "Solar thermal research and education": A project has been sanctioned to develop IIT-Jodhpur as a Center of Excellence in Solar Thermal Research and Education. Design and installation of Solar Air Tower Simulator (SATS) facility is completed. It is being extended for inclusion of solar convective furnace. Developed high temperature solar thermal research laboratory and so far they achieved 360 ^{o}C at a concentration of 420 suns and put target 600 ^{o}C in the next phase
- A project " 30 kW cross liner-CSP system Test Unit " sanctioned to Rajiv Gandhi Proudyogiki Vishwavidyalaya, University Institute of Technology, (RGVP) Bhopal in 2014.
- Design, Construction and Demonstration of zero energy building for Solar Decathlon Europe 2014 project sanctioned to Department of Energy Science and Engineering, IIT Bombay in 2014-15. The IIT Bombay has participated and reassembled the building in IIT

A 1 KW capacity prototype solar thermal storage for Concentrated Solar Plant developed by RKDF University, Bhopal

campus and performance evaluation is going on.

- Dr. V K Sethi, Ram Krishna Dharmarth Foundation University, Bhopal High is implementing a R&D project with USA collaboration (Rensselaer Polytechnic Institute, Troy, New York) entitled Energy Density Thermal Energy Storage for Concentrated Solar Plant. Design and construction of a prototype 1 KW capacity solar thermal storage has been installed and performance evaluation is going on.

SRRA Station at Gangtok, Sikkim

- Development of a monitoring system for the energy reception elements in Solar Thermal Plants by The Energy & Resources Institute (TERI), with co-funding under joint Indo-Spain R&D programme. The broad objective is to develop a reliable, low cost tool that gives a precise and direct evaluation of the energy collection efficiency of each solar collector element including identification of the cause of the error.

New Projects

8.20 The Ministry during the current year sanctioned the following R&D projects :-

i. "Studies on utilization of Solar Energy in Tasar Post Cocoon Technology Operations" by Dr. ZMS Khan, Central Tasar Research & Training Institute, Ranchi

ii. Design Development and Proto building a Solar Energy Driven desiccant & Ejector based Environmental friendly Air Conditioning System by Prof. Anitha A Nene, Department of Mechanical Engineering, MAEERS's Maharastra Institute of Technology, Kothurd, Pune

iii. Development of high efficiency receiver for supercritical CO_2 integrated with static focus parabolic dish by IISc Bangalore was sanctioned by Ministry with to develop a medium scale volumetric s-CO_2 received and establishing design methodology for scale up to industrial scale. It is first of a kind technology and research for supercritical CO_2 cycle

Completed projects

8.21 The following are the completed projects:

- Development and demonstration of 1 MW capacity solar thermal power R&D project with 16-hour thermal storage at Mount Abu, with co-funding from German Ministry and Indian industry. The project is first of its kind to provide thermal storage of 16 hours and will be based on fully indigenously developed solar dish technology. The project has been commissioned and showed some good initial results. This project provides enormous opportunity in terms of product development and energy storage.
- Innovative project "Experimental grid tied solar PV power generation on a water body" sanctioned to IGNOU Community College in 2014. Developed lab Scale model, testing

equipment, protocol and the standards. Similar floating solar power plants is now being proposed by Kerala Govt. in line with this R&D project's achievements and a new scheme is under process.

SRRA Stations

8.22 In order to strengthen the solar resource assessment and to meet the requirement of availability of Solar Radiation data, In Phase- I program, 51 SRRA stations and in Phase- II, 60 SRRA stations and four Advanced Measurement Stations are installed at selected locations spread all over the country. This exercise has been coordinated by National Institute of Wind Energy (NIWE), Chennai an autonomous institution of the Ministry. A central server facility for data collection from all these stations has been set up at NIWE. The data so collected will be useful in developing a solar atlas for the country. In addition, all the solar power projects selected under the Mission have also set up radiation monitoring equipment at their project sites. NIWE has launched a Solar Atlas of India for firming of solar potential of the Country.

BIOGAS

8.23 Ministry of New and Renewable Energy promotes research and innovation in the field of Biogas Technology under RDD & D policy of this Ministry.

8.24 During the year a total of 10 proposals have been received which were processed for the consideration of Research, Design, Development and Demonstration Sectoral Project Appraisal Committee (RDSPAC). Out of the 5 projects considered in the meeting of RDSPAC on Biogas R&D projects held on 14.07.2016 recommended the following two projects with certain changes –

i. "Methanation: A route for CO_2 mitigation and Bio-methane production" received from Indian Institute of Technology, Hyderabad.

ii. "Development and demonstration of application of biogas for milk chilling unit and partial replacement of LPG for cooking at UPES, Dehradun" received from University of Petroleum and Energy Studies, (UPES), Dehradun.

8.25 The PIs of the above two projects have submitted the revised R&D project proposals as recommended by the RDSPAC.

Biomethanation plant at SPRERI, Gujarat

Crusher and feed preparation tank with submersible pump at SPRERI, Gujarat

Projects completed during the year

8.26 Two R&D projects were completed during the year 2016-17. The brief detail of the completed R&D projects are as under -

Biogas purification and bottling unit at IIT Delhi

i. "Integrated Research and Development of Biogas off-gird Power solution for aquatic feed by high rate biomethanation using effective mixing technology" at Sardar Patel Renewable Energy Research Institute (SPRERI), Vallabh Vidya Nagar, Gujarat. Completion report of the above R&D project has been received and the same was sent to experts for their comments. The comments of experts will be placed before the Research, Design, Development and Demonstration Sectoral Project Appraisal Committee (RDSPAC) on biogas for recommendations and finally acceptance of the completion of the project. The final report of progress revealed that the Biomethanation R&D biogas plant based on water hyacinth employing bubble gun mixing technology has been installed and the results of economic analysis shows that there is desirable energy gain which has been successfully demonstrated.

Experimental Set-up for Biogas and Methane Testing at IIT, Guwahati Laboratory

ii. Under the another R&D project titled as "Design and Development of Mobile Unit for Biogas Enrichment" sanctioned to Indian Institute of Technology Delhi, Hauz Khas, New Delhi, a mobile unit for biogas purification and bottling plant mounted on a four wheeled tractor trolley which is towed by a tractor has been developed. The technology employed for the mobile biogas purification system is water scrubbing type that can process 20 Nm^3/h of biogas to upgrade it to natural gas quality fuel. The developed mobile unit has been tested at laboratory in IIT Delhi. The project has been completed and the completion report is being written.

On-going R&D projects

8.27 The progress of the ongoing R&D projects during the year was reviewed by the RDSPAC in its meeting held on 14.07.2016. A project progress review committee was also constituted to have on the spot evaluation of the progress of on-going R&D projects. The status of ongoing projects is summarized as under -

i. Under the R&D project titled "Development & Performance evaluation of a 3 KW biogas based power generation system utilizing Lignocellular Biomass' going on at IIT-Guwahati. The optimization of a 5 HP gasoline/SI engine parameters to run it with Biogas has been completed. Laboratory experiments for optimization of a 5 HP diesel engine parameters have been optimized and the performance testing of the commercial biogas gen-set is in progress. As per the part chart 70% of the work has been completed upto 30.12.2016.

ii. R&D project titled "Development of Hybrid-High rate biomethanation reactor using locally available media for treating waste water and solid waste" at Tamil Nadu Agricultural University (TNAU), Coimbatore is in progress. The physical progress along with financial expenditure has been reviewed by the RDSPAC in its meeting held on 14.07.2016.

Biofuels Programme

8.28 The Ministry of New & Renewable Energy is primarily involved in the development of National Policy on Bio-Fuels besides research, development and demonstration, strengthening the existing institutional mechanism and overall coordination of development of biofuels. During the year Ministry organised one meeting of the Biofuel Steering Committee under the chairmanship of the Cabinet Secretary to provide effective guidance and to oversee implementation of the National Policy on Biofuels on a regular and continuing basis.

8.29 Ministry has been supporting academic and research institutions, industries and non-governmental organization to carry out R&D on production of second generation biofuels. During the year two Research & Development projects supported by the Ministry have been completed. They are (1) Sorghum Stover based Bio-refinery for Fuels and Chemicals at National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram and other involved institutes (i.e. MNNIT, Allahabad TERI, New Delhi IICT, Hyderabad) under which a process has been optimized for production of cellulose using Penicillin janthinellum by solid state fermentation and the technology for production demonstrated at pilot scale (10 kg) process for sorghum stover hydrolysis using commercial enzymes optimized and hydrolysis demonstrated at pilot scale (200 L level) and also an alcohol fermentation of the Sorghum stover (SS) hydrolysate generated using commercial enzymes demonstrated at pilot scale (15L) with sugar supplementation and process for recovery of lignin from pretreatment liquors has been developed. Acid precipitation was found to the most efficient for recovery

of lignin from the pretreatment liquor; and (2) Development of pre-treatment strategies and bioprocess for improved production of cellulytic enzymes and ethanol from crop by-product for demonstration at pilot plant at University of Delhi South Campus, New Delhi, under which a process for development of environmentally benign pretreatment and detoxification strategy from corncob and rice straw has been developed. The pretreated substrate on hydrolysis with cellulolytic enzymes showed 80% saccharification efficiency with approximately 80 g/L sugars. The enzymatic hydrolysate on fermentation with yeast produced 4 % ethanol. The whole process has been scaled up and demonstrated at a scale of 100 L in a 300 L bioreactor at Technology Based Incubator.

8.30 During the year, Ministry is implementing and monitoring 4 R&D projects throughout the country. These are (1) Stabilization and up gradation of biomass derived bio-oils over tailored multifunctional catalysts in a dual stage catalytic process to produce liquid hydrocarbon fuels and its application studies at The Energy & Resources Institute (TERI), New Delhi; (2) Improved production of Biogas and Bio-CNG from Ligno-cellulosic Biomass at DBT-ICT Centre for Energy Biosciences, Institute of Chemical Technology, Mumbai; (3) Hydro-pyrolysis of lignocellulosic biomass to value added hydrocarbons at Indian Institute of Petroleum, Dehradun; and (4) Direct Conversion of Sugarcane Bagasse to auto fuels by Catalytic hydrous pyrolysis in the presence of carbon monoxide at University of Petroleum and Energy Studies, Dehradun.

8.31 During the current year, Biofuel Division also involved various state government officials and other stake holders for developing activities related to promoting biofuels in various states and other concerned ministries. Manufacturers and other experts were also involved in framing policy for projects on second generation ethanol in the country. MNRE conducted three consultative workshops in association with state biofuel development boards on biofuel with special reference to backward and forward linkages of biodiesel programme in the state of Chhattisgarh; Karnataka; and Rajasthan during the year.

Hydrogen Energy and Fuel Cells

8.32 The Ministry has been supporting a broad based Research, Development and Demonstration (RD&D) Programme on different aspects of hydrogen energy technologies that includes production of hydrogen, its storage and utilisation for stationary, motive and portable power generation applications using internal combustion engine and fuel cells and also for other applications. As on 31.12.2016, a total of 26 RD&D projects on different aspects of hydrogen energy and fuel cells are under implementation. Details of these projects have been posted on the MNRE website (http://mnre.gov.in/schemes/new-technologies/hydrogen-energy/ongoing-rdd-projects/).

8.33 Major achievements during the year 2016-17 were as under:

Production

1. IISc Bangalore is implementing a project on scale up studies concerning oxy-steam gasification of biomass for production of fuel cell quality hydrogen. The project, sanctioned in March 2016, aims to set up a plant with hydrogen production capacity of 6 kg per hour.
2. NIT Calicut has developed a fluidized bed reactor for thermo chemical biomass gasification and characterized various locally available feed stock for their efficacy for hydrogen production. (See photograph)

Fluidised Bed Biomass Gasifier developed at NIT Calicut

3. IIT Kharagpur and Indian Institute of Chemical Technology (IICT), Hyderabad have commissioned one bio-reactor of 10 m^3 capacity each for hydrogen production through biological route using distillery effluent and kitchen waste respectively. (See photograph)

4. R&D Centre of Indian Oil Corporation at Faridabad has established a facility for hydrogen refueling that includes a 30 Nm^3/hr capacity electrolyser, a buffer storage, a compressor and high pressure storage for 550 bar. This facility is being used for providing hydrogen for field trials of two mini buses developed jointly by IIT Delhi and Mahindra & Mahindra under another R&D project supported by the Ministry. This facility is also to be used for refueling of two fuel cell buses developed by Tata Motors. (See photograph)

Storage

1. IIT Kanpur was sanctioned a project on storage of hydrogen in Metal Organic Frameworks (MOF). This aims at developing MOFs suitable for hydrogen storage near ambient temperature with storage capacity of about 3 wt% and having stability of at least 500 cycles.

2. K.V. Pendharkar College of Arts, Science & Commerce was sanctioned a project on development of carbon nano-materials with hydrogen adsorption as well as desorption capacity of more than 8.75 wt%.

3. Vivekanand Global University, Jaipur was sanctioned a project titled "Mass Production of Modified Carbon Nano Tubes (CNTs) for Hydrogen Gas Storage".

4. Banaras Hindu University, Varanasi continued the research in hydrogen storage in solid state hydrogen storage materials (hydrides) under the mission mode project.

Applications

1. Indian Institute of Technology Delhi (IITD) along with Mahindra & Mahindra (M&M) and Air Products are engaged in field trials of 15 hydrogen fuelled three wheelers at Pragati

10 cu.m Pilot plant for biohydrogen production at IIT Kharagpur

Maidan in New Delhi. The vehicles have successfully completed trials up to 12000 km so far out of 30,000 km, envisaged under the project.

2. IIT Delhi in association with M&M has developed two mini buses powered by hydrogen fuelled internal combustion engine. These buses are undergoing field trials up to 1,00,000 km in IOCL R&D Centre's Faridabad campus. (See photograph)

Hydrogen Bus developed by IIT Delhi and Mahindra & Mahindra

3. IIT Delhi has successfully converted a Compressed Natural Gas (CNG) fuelled multi-cylinder spark ignition engine (28 kW) to operate with hydrogen fuel for stationary power applications. The engine will undergo field trials at a chlor-alkali industry site that will be mutually identified

High Pressure storage tube (Left) and Compressor (Right) at IOCL R&D Centre Faridabad

Fuel Cells

1. IIT Guwahati's project related to development of bio-electrodes for bio-fuel cells was concluded. Under this project, fuel cell constructed using the developed bio-electrodes demonstrated a power density of 46 μW/cm ^{2}.

Report of the Steering Committee

8.34 The Steering Committee on Hydrogen Energy and Fuel Cells submitted its report titled "Hydrogen Energy and Fuel Cells in India – Way Forward" in June 2016. Further on the recommendations of the Steering Committee, a team of experts was constituted, which recommended the following 8 mission mode projects to be taken up on priority:

1. HCNG fuelled bus demonstration in select city bus fleet;
2. Hydrogen fuelled IC engine bus demonstration;
3. Design and development of 20kW Low Temperature Polymer Electrolyte Membrane (LT-PEM) fuel cell with high indigenous content;
4. Design and development of indigenous type III carbon composite cylinders for compressed hydrogen storage;
5. Indigenization of high strength steel cylinders for high pressure ground hydrogen storage;
6. Augmentation of the Testing and Certification facilities for HCNG and hydrogen fuelled vehicles at the existing centre(s) of automobile testing ;
7. Three wheeler / auto running on gaseous hydrogen fuelled IC engine using alloy hydride / intermetallics for hydrogen storage ; and
8. Wind energy based electrolyser for hydrogen and oxygen production for cryogenic rocket propulsion

8.35 The lead institutions/organizations identified by the team of experts to carry out these 8 projects have been requested to develop the detailed project proposals. It is expected that by March 2017, these proposals will be firmed up.

9
SPECIALISED INSTITUTIONS

SPECIALIZED INSTITUTIONS

9.1 The Ministry has set up three specialized technical institutions. The erstwhile Solar Energy Centre (SEC), now converted into an autonomous institution named National Institute of Solar Energy, is located at Gwalpahari, Gurugram in Haryana, the erstwhile Centre for Wind Energy Technology (C-WET), has now been converted into an autonomous institution named National Institute of Wind Energy (NIWE), is located at Chennai, and Sardar Swaran Singh National Institute of Bio-Energy at Jalandhar, Punjab. Indian Renewable Energy Development Agency Limited (IREDA) is a 100% government owned company, registered as a non-banking financial company with the Reserve Bank of India functioning under the administrative control of the Ministry.

9.2 In addition, Solar Energy Corporation of India, a Central Public Sector Undertaking assists the Ministry in the implementation of the various activities of Jawaharlal Nehru National Solar Mission for development, promotion and commercialization of solar energy technologies in the country.

NATIONAL INSTITUTE OF SOLAR ENERGY

Background

9.3 National Institute of Solar Energy (NISE), an autonomous institution under the Ministry of New and Renewable Energy, an apex National R&D Centre in Solar Energy, has been conducting research and development work in solar photovoltaic and solar thermal areas and is coordinating research & development activities in solar energy of the Ministry of New and Renewable Energy. The Institute has also been involved in (a) Solar Resource Assessment, Testing & Standardization, Monitoring of Solar Power Projects, maintaining a Data Bank for use by various stake holders, (b) carrying out Research & Development in Hybrid Systems and storage techniques/system (c) implementing several R & D projects under International Cooperation, (d) keeping track of latest global developments based on technology forecasting and fore-sighting relating to Solar Energy and related technologies including storage techniques, etc. (e) Training, Skill Development, co-ordinating and organising Surya Mitra Programme, (f) organizing Training Programmes for scientists, engineers and energy planners from third world and other countries, and (g) Consultancy.

Major Facilities at NISE and Activities Undertaken during 2016-17

9.4 The National Institute of Solar Energy (NISE) has undertaken the following activities during 2016-17:

SOLAR RADIATION RESOURCE ASSESSMENT

9.5 Solar Radiation Calibration Laboratory (SRCL) continued the calibration of solar radiation sensors operating in the field in north India as per International standards, having their traceability to World Radiometric Reference (WRR) scale set up by World Radiation Centre (WRC) during 2016-17. The various international standards that are being used at the laboratory for calibration are ISO 9847, ISO 9059 and ISO 9060. During the year SRCL has achieved the calibration of 45 sensors from SRRA Phase-1 Program & Calibration of 3 sensors under its commercial calibration mode. The details are given in following table:

S. No.	SRRA (Phase-1) Stations	No. of Sensors Calibrated at SRCL	
		Pyranometer	Pyrheliometer
1.	Rajasthan (12 SRRA stations)	24	12
2.	Leh, Jammu & Kashmir	2	1
3.	Bilaspur, Chhattisgarh	2	1
4.	NISE, Gurugram, Haryana	2	1
5.	Private Organization	3	0

SOLAR PHOTOVOLTAIC SYSTEMS AND DEVICES DIVISION

9.6 NISE has been carrying out research and development, testing and certification, performance evaluation, technology up gradation, training, etc. of solar photovoltaic lighting systems, pumping systems, electronics, battery, system design and power plants. It has set up the following facilities at NISE campus:

RESEARCH AND DEVELOPMENT

Study on Performance and Reliability of PV Modules installed in the country

9.7 The joint project of NISE and NCPRE, IIT Bombay undertaken to study the field performance of SPV modules installed over period of time ranging from 20 years to recent installations in different climatic conditions of India was continued during 2016-17. Performance data collected from different locations is being analysed to understand the reliability and process of degradation of PV modules under Indian field conditions. 5 papers were published in International Scientific Journals and Conferences during the current year. The project report is under preparation.

Net metering of NISE

9.8 NISE has more than 800 kWp SPV power plant capacity installed in the campus. NISE is going to become NET ZERO Energy campus by January 2017. The total power consumed by NISE can be taken from PV power plant during the day time. NISE has already installed NET metering for the PV power plant installed in the campus.

Secondary Reference Solar Cell Calibration

9.9 NISE along with IIT Bombay, IACS Kolkata and Fraunhofer Institute & PTB-Germany, Germany has been working to develop a secondary reference solar cell calibration facility in the country. Under this project a Round Robin testing of solar cells is going on at NISE, IIT Bombay and IACS Kolkata, in India and Fraunhofer Institute, Germany. Measurement comparison of four secondary reference solar cells has been completed at NISE and IIT Bombay.

Performance Comparison of Thin Film Module in India and USA, A Joint Project between NISE and NREL, USA

9.10 National Institute of Solar Energy and NREL have embarked on a project to compare the performance of sister thin-film modules deployed in India and in Colorado, USA. NISE

NISE becomes of Net Zero Energy Campus at NISE on Sunday, the 1st January, 2017.
Inauguration by Shri Ankur Gupta, Principal Secretary, New & Renewable Energy, Government of Haryana on 6th January, 2017

purchased a set of modules and shipped 6 of these modules to NREL. The thin-film modules were deployed in real outdoor condition in December 2013. The modules were then deployed outdoors where they were individually maximum power point tracked. Performance evaluation including current-voltage (IV) curves at a regular interval of time of these modules is under way. First joint technical report with NREL is already published.

SERIIUS Project

9.11 Under the Solar Energy Research Institute of India and the United States (SERIIUS) project NISE's is carrying out the reliability and performance studies of various technology modules under different climatic zones in India. The main deliverables from NISE under PV module reliability testing are as follows:

I. Identification of climatic zones and environment conditions
II. Model the performance studies of various technology modules under different climatic zones
III. Prepare general specifications of PV modules and components
IV. Develop models using time dependent performance reliability indicator
V. Dust effect and mitigation in different climatic zones of India.

TESTING AND PERFORMANCE EVALUATION

Indoor Solar Cells and Photovoltaic (PV) Test Facility

9.12 The Indoor Solar Cells and Photovoltaic (PV) Test facility (PVTF) at NISE is involved in testing and evaluation of solar Cells, PV modules, storage batteries, balance of systems and complete

PV systems including lighting systems, solar rickshaws, road studs, solar AC, solar home lighting systems and PV grid-hybrid systems. The International quality system conforming to IEC 17025 has been evolved in the laboratory and the PV module testing laboratory has got NABL accreditation for conducting the testing of PV modules as per IEC 61215 and BIS standard.

9.13 A state of the art Class AAA solar cell tester has been installed and commissioned in the Lab. This system is capable of characterisation of all technology solar cell of size up to 30cm x 30cm under STC and different test conditions. The system is being used for validation of cell efficiency claims made by R & D Institutions, Universities and industry. Ten solar cells from Bharat Electronics Limited have been tested for their STC performance.

9.14 The facility is well equipped to take up the testing of large size modules i.e. up to 300cm x 300cm. During the year the indoor PV module testing laboratory at NISE has taken up the STC performance measurement of approx. 1000 modules from different manufacturers and four samples were tested as per the standards IEC 61215, IEC 61730-1&2 and two samples were tested as per IEC 61701.

Outdoor PV Module Testing Facility

9.15 The Outdoor PV Module Testing Facility has been set up for performance evaluation of different technology modules on real time basis in the field under Indian climatic condition based on IEC 61853 standard. A new multi-channel PV PM system has been commissioned for evaluation of a number of modules and arrays simultaneously under the same environment conditions. A new set up of Electroluminescence camera has been designed for solar PV module with the help of NCPRE, IITB. This lab has published more than 20 papers in this year.

Power Electronics Lab

9.16 NISE has established power electronics lab for testing and evaluation of solar inverter/charge controller/Pump controller/PCU of capacity up to 50 KVA. 48 inverters and pump controllers of different capacities were tested during the year 2016-17.

Battery Test Lab

9.17 The Battery Test Lab has been testing secondary cells and batteries as per IEC/BIS standards using the advanced equipment capable of testing samples up to a range of 0-100V and more than 2500Ah in capacity. In addition to the routine tests, type tests, life cycle water loss test and endurance tests on batteries are conducted on the batteries. More than 400 battery samples, pertaining to different technologies and applications, were examined during 2016-17. The Battery Test Lab has been recently upgraded with a Chroma Battery Tester having the range of 0-100 Volt. Further testing and R & D equipment are being added to the Lab to enhance its capabilities.

SPV Lighting System Laboratory

9.18 During the year the SPV Lighting System laboratory at NISE was upgraded. Programmable power supply, power meter, data acquisition system and DC electronic load, and lux meters were commissioned and a PV array simulator for performance testing of charge controller and

small inverters is likely to be installed during the year. The Lab has taken up the performance evaluation of three solar lanterns, 21 solar home lighting, 46 street lighting systems, 18 solar Power Pack: AC, three solar Power Pack: DC, three charge controllers. 15 manufacturers were provided guidance to design and develop different kind of PV systems by way of developmental testing. These systems were evaluated as per MNRE end user specifications.

Solar Water Pump Testing Facility

9.19 NISE is involved in research and testing and certification of SPV water pumping systems as per MNRE's specifications and guidelines and user requirements. It has a testing facility for SPV water pump systems, for performance evaluation and analysis, optimization of different types of pumps (AC & DC and surface & submersible pumps), of capacities ranging from 0.5 HP to 10 HP for different heads from 10 m to 100 m.

9.20 In the year 2016-17, NISE has tested 78 different types of SPV water pumping systems so far. Fully automatic in-door and outdoor SPV water pump testing facility was commissioned in July 2016 at NISE which is capable to test eight no's of SPV water pump samples at a time. It takes 7 days for outdoor and 2 days for indoor with the use of array simulator for different day profiles taking temperature and irradiance correction into account to complete the testing of pumping system. The other testing activities undertaken by NISE are:

- Performance evaluation and study of different types of Controllers based on their MPPT operation.
- Study on suitable selection of different pumps based on head and optimum array sizing in different climatic zones of India.
- Collaboration with renowned industries for technical advancement and knowledge sharing.
- Currently working on Standard of SPV water Pump testing.

500 kW Photovoltaic Power Plant

9.21 A 500 kW solar PV power project has been set up in the campus of NISE with five different PV technologies in order to evaluate the performance of SPV power plants in the Indian conditions and to meet the electricity requirements of the NISE Campus. Order for the turnkey supply, installation and commissioning of the 500 kWp Solar Photovoltaic Power plant was placed during 2014-15. The 500 kWp grid connected SPV power plant will be commissioned and will start feeding power into the grid by the first week of January, 2017.

Solar Design Simulation Lab

9.22 Solar Design Simulation Lab, a new initiative of NISE, has been set up for the development of project proposal, consultancy, training and other research and development purposes during this year. This Lab is a full-fledged functioning lab, comprising of audio visual facility for the demonstration. There are different software's available in this laboratory which can be used for the design of PV power plant. Following software are available at the Lab:

1. PVSYST V6.4.3, Switzerland
2. PVSOL Premium 7.5, Valentin software, Germany

3. TSOL Pro 5.5 Valentin software, Germany
4. SAM (System Advisor Model)- NREL USA
5. RET Screen, Canada
6. Archelios Pro, France

9.23 The Solar Design Simulation Lab has been providing consultancy on different SPV projects and training the people of different backgrounds such as industries, educational institutions, etc. This lab trained senior engineers and managers from SJVN, Fishery Department, Andhra Pradesh and international trainees through ITEC and seven system design programs at NISE and educated more than 80 participants within eight months during the current financial year.

SOLAR THERMAL TECHNOLOGIES

9.24 NISE has been carrying out research and development, testing and certification, performance evaluation, technology up gradation, training, etc. of solar thermal technologies for cooking, heating, cooling, power generation, process heat applications, desalination, etc. The following facilities have been set up at NISE campus:

Solar Thermal Research and Development Projects

9.25 Research and development activities were continued for performance evaluation and system optimization of the 100 kW High Efficiency Solar Thermal Triple Effect Absorption System, Prototype 15 kW Absorption System with Air Cooling, Prototype 5 kW Adsorption System and Multi Condensation Desalination System. NISE have designed and getting installed a Photovoltaic based cold storage system with thermal storage (Ice) that can provide cooling for preservation of various vegetables for 24 hrs a day. The setup will be installed during the current financial year.

Solar Thermal Test facilities for CST

9.26 NISE has created a test facility for characterization and testing of all types of concentrating technologies. This includes Hot water/ Steam based Test Set Up, Thermic fluid based Test Set Up, FPC and ETC, Cooker Test Facility as per BIS standard and MNRE Specifications. One Flat Plate Collectors, one Evacuated Tubular Collector, one Compound Parabolic Concentrator and one 4 m^2 paraboloid dish have been tested and certified during this year.

1 MW Solar Thermal Power Plant

9.27 On 7th March 2015, NISE took over the 1 MW Solar Thermal Power Plant based on parabolic tough collector and Linear Fresnel Reflector technologies set up in collaboration with IIT Bombay for operation and maintenance, data collection, long term performance evaluation and research and development on various components of the solar thermal power generation. Operation and maintenance of the plant was undertaken during the year.

Mobile Test Set Up

9.28 Mobile test facility has also been procured for testing/evaluation of performance of different thermal technologies in actual working/field conditions in India. The scientific teams

have visited and studied the performance and degradation in the performance of different concentrated solar thermal technologies being used for process heat application under UNDP-GEF projects in different parts of the country.

CO-ORDINATION OF NATIONAL RESEARCH ACTIVITIES IN SOLAR ENERGY

9.29 The NISE has been involved in scrutinizing the R&D project proposals submitted to the Ministry at the initial stage, getting the experts' comments, arranging RDPAC and RDSPAC meetings and recommending proposals to the MNRE for sanction. It has also been responsible for monitoring the on-going R&D projects through expert visits, organizing reviews, suggesting mid-course corrections, and monitoring and verifying claims as an independent, un-biased agency. Recently, a new trend has been set at NISE by conducting review of the on-going R&D projects in PV and ST through an interactive meeting at NISE of the internal and external experts as well as all the PIs. These meetings would be held every six months to have close monitoring of the projects.

Solar Photovoltaic R & D Projects

9.30 Since April 2016, around 70 new project proposals have been received in PV for evaluation and further processing. The proposals in PV are divided into two broad groups namely a) PV cells & materials and b) PV systems and applications with more number of proposals belonging to the systems and applications category. These are internally screened before sending to external experts for further evaluation. Results of evaluation for around 35 project proposals in PV have already been submitted to the Ministry. These have been further evaluated at the meetings of RDPAC and RDSPAC. The results of evaluation of the remaining 35 proposals would be sent to the Ministry before the end of the financial year 2016-17. The NISE has also continued to update the existing panel of experts as per the response from the evaluators.

Solar Thermal R&D Projects

9.31 During the year, 38 new projects in the area of Solar Thermal Energy were received for financial support from the Ministry. Expert comments on all the R&D projects were obtained and submitted to MNRE for further processing. A review/ monitoring committee meeting was organized at NISE for 13 on-going R&D projects funded by MNRE which was attended by all PIs, Experts and NISE Scientists for mid-term correction / action and the recommendations submitted to MNRE.

9.32 As a part of NISE's outreach programme, under the institute serial publication series, two new volumes (Volume-2, Volume-3) of the book entitled "Advances in Solar Energy" were published during the year with an objective to provide quality literature in the field of Solar Energy to all the stake holders.

TRAINING AND SKILL DEVELOPMENT

9.33 National Institute of Solar Energy (NISE) has been assigned with the responsibility to execute the various Skill Development programs in the field of solar energy technologies throughout the country. NISE is conducting Solar Energy training for the past two decades for National and International Participants. NISE is regularly inviting people from Solar Energy industry and interacting with them to identify the skill gaps in the new recruits of the solar energy industry. The following training programmes were conducted during the year so far.

a. 55 training programs on solar photovoltaic and solar thermal energy technologies for the senior Defence staff, BSF officers, MSME officers, HAREDA officers and Chartered Engineers were conducted during 2016-17. NISE has planned to conduct a training programme on solar energy technologies in the N-E region, funded by Ministry of New and Renewable Energy during the current year.

b. NISE has been organizing "Suryamitra" skill development program, sponsored by the Ministry of New and Renewable Energy, in collaboration with State Nodal Agencies (SNAs) and other institutions/ Implementing Agencies (IAs), at various locations across the country. The duration of this skill development program is 90 days. It is a residential program and it is free for participants which includes boarding and lodging. More than 200 academic and premier institutions/ organisations such as engineering colleges/ polytechnics/ ITIs are partnering with NISE to train 50,000 Suryamitras (i.e. 50,000 ITI certificate/ diploma holders) in the 5 years (FY 2015-16 to FY 2019-20). In order to achieve the target of 7,000 Suryamitras in 2016-17, NISE has organized/ will be organizing 250 programs across the country. Of these NISE conducted 2 on campus Suryamitras training programme for 60 diploma holders during the year. In order to connect potential solar product customers and Suryamitras, NISE has developed a GPS based Mobile app called Suryamitra App, which can be downloaded from app play-store in mobile phones. The beta version of the app is under testing and will be launched shortly.

c. **Solar Energy Training Network (SETNET)** : NISE has established the Solar Energy Training Network (SETNET) institutions across India to build skills and capacities to ensure the availability of qualified solar energy professionals to meet the national solar deployment targets. Through a competitive process, NISE has identified 35 SETNET partners across the country, which are empanelled by NISE to provide the skill development courses.

d. **International Training Programmes** : A three week training program focussing on the solar photovoltaic and thermal technologies under Indian Technical and Economic Cooperation Program (ITEC) was conducted for international participants during 2016-17. Another ITEC training program will be starting in February 2017. NISE is also conducting advanced solar energy training program for Focal point countries (ISA/IRENA countries) funded by MNRE. Two programs on solar are planned for ASEAN countries during the current financial year.

HYDROGEN ENERGY & FUEL CELLS FACILITY

9.34 Under the project entitled "Demonstration & Performance Evaluation of various technologies of Hydrogen Energy at NISE the Institute has been operating and maintaining the solar based hydrogen generation cum dispensing facility for regular generation and dispensing of Hydrogen and carrying out the performance test on individual sub-systems and components.

9.35 The production of Hydrogen (capacity 5Nm^3/hr) from Electrolysis of water using power generated from a Roof Top Solar PV Power Plant of 120 kWp is being obtained on regular basis. Five Dual Fuel vehicles, developed by M/s Mahindra & Mahindra are under trial runs which run on Hydrogen dispensed by the facility at a pressure of 350 bar. NISE has complied with PESO and received multiple clearances for Generation of Hydrogen, Storage of Hydrogen at 500 bar, and Dispensing of Hydrogen at 350 bar.

9.36 NISE has proposed to test and evaluate performance of three wheelers using Metal Hydride based hydrogen storage developed by BHU, Varanasi. NISE will setup a facility for metal hydride based hydrogen charging to these vehicles.

9.37 NISE is in the process of finalising agreement with M/s Tiger Power, Belgium for demonstration of hydrogen & fuel cell based power supply system to be tested and demonstrated for reliability at Indian conditions.

9.38 Fuel cell testing laboratory is being set up and the infrastructure development activities have been started. Procuring of equipment has been completed and laboratory will become operationalized soon.

CONSULTANCY AND INCUBATION SERVICES

9.39 **Consultancy and Quality Verification Services**: NISE has been providing consultancy on solar photovoltaic & solar thermal technologies, projects and power plants to different stake holders in the country. NISE has provided consultancy to Ministry of Food Processing, Ministry of Defence, Kandla Port Trust, ISRO, Doordarshan, NLC, NEEPCO etc. NISE is also providing expertise to corporate and industry to set SPV power plants. NISE in FY 2016-17 has prepared Solar PV Feasibility Reports to more than 25 projects sites in India.

9.40 **Incubation**: NISE has set up an incubation facility by providing space and financial support for initial few months to the aspirants/ people coming up with innovative ideas in the field of solar energy.

NATIONAL INSTITUTE OF WIND ENERGY (NIWE)

9.41 The main activities of National Institute of Wind Energy (NIWE) include research and development to achieve and maintain reliable and cost-effective technology; Wind & Solar Radiation Resource Assessment; preparation of standards for wind turbines testing and certification of wind power systems; information dissemination; human resource development; and offer various consultancy services to customers. The major activities of NIWE during this period are given below:

Offshore Wind Program

9.42 NIWE has initiated offshore activities in Gujarat. The following works have been carried out at Gulf of Khambhat

(i) Offshore Sub-Structure for LiDAR at Gulf of Khambhat, Gujarat (first of its kind in India)

(ii) Dye penetration Test at Critical Weld Joints on offshore Substructure

(iii) Requisite clearances for Installation of support structure for mounting LiDAR

9.43 The offshore wind resource measurements, first of its kind in the country, will be carried out using LiDAR for a period of two years. The data obtained from the LiDAR based wind measurements will provide useful pointers in demarcating the potential offshore wind zones for development of offshore wind energy in India. NIWE is in the process to conduct geophysical and geotechnical studies and surveys both off Gujarat and Tamil Nadu coasts to better understand the subsea profile data. The Geophysical and Geotechnical studies will will be done for varying water depths ranging between 15 to 35 meters. The subsea soil profile data obtained from the investigations will be useful for wind turbine stakeholders / manufacturers in designing the megawatt class offshore wind turbine foundations to foster the growth rate of offshore wind turbine technology in the country.

ENERGY MANAGEMENT SYSTEM

9.44 NIWE has undertaken the project for installation of Energy Management System (EMS) including the remote data collection from the wind turbines installed at Wind Turbine Research Station (WTRS), Kayathar, in association with Central Scientific Instruments Organization (CSIO), Chennai. The EMS has been successfully installed at NIWE, Chennai and has total of 17 nodes. The data generated from the RMS will be useful for carrying research relevant studies for the benefit of the scientific fraternity.

Onshore Wind Resource Assessment

9.45 The objective of the nationwide Wind Resource Assessment (WRA) programme is to quantify the wind resource availability in the country with a view to generate power from wind. The programme envisaged setting up of dedicated wind monitoring stations at carefully chosen sites across the country under various WRA programmes of 50m 80m, 100m and 120m height. The programme is of continuous nature. The data collected under the programme is being used widely to establish wind farms in the country and all the wind farms established in the country till now is based on the reference data collected under this national programme of wind resource assessment. The data collected also serves as data bank for the preparation of national wind atlas and other research purposes. As on 30.12.2016, 809 dedicated wind monitoring stations have been established and 30 Wind monitoring stations are under operation. During the period April 2016 – December 2016, 1 new wind monitoring station has been commissioned in Tamil Nadu. 107 sites have been registered for wind measurement by private sector from various states in India. The wind data from over 44 private Wind Monitoring stations have been analyzed. 41 consultancy projects were undertaken for a variety of clients from public/ government/private sector during this period. Initiated the work of Web portal updation of Wind Resource Assessment data for MNRE stations for free accessing of data. To understand wind shear profile and collect long term wind profile for assisting wind power forecasting five 120m tall guyed wind monitoring stations have been installed at Lamba (Gujarat), Akal (Rajasthan), Jagmin (Maharashtra), Jogimatti (Karnataka) and Kayathar (Tamil Nadu)

Offshore Wind Resource Assessment

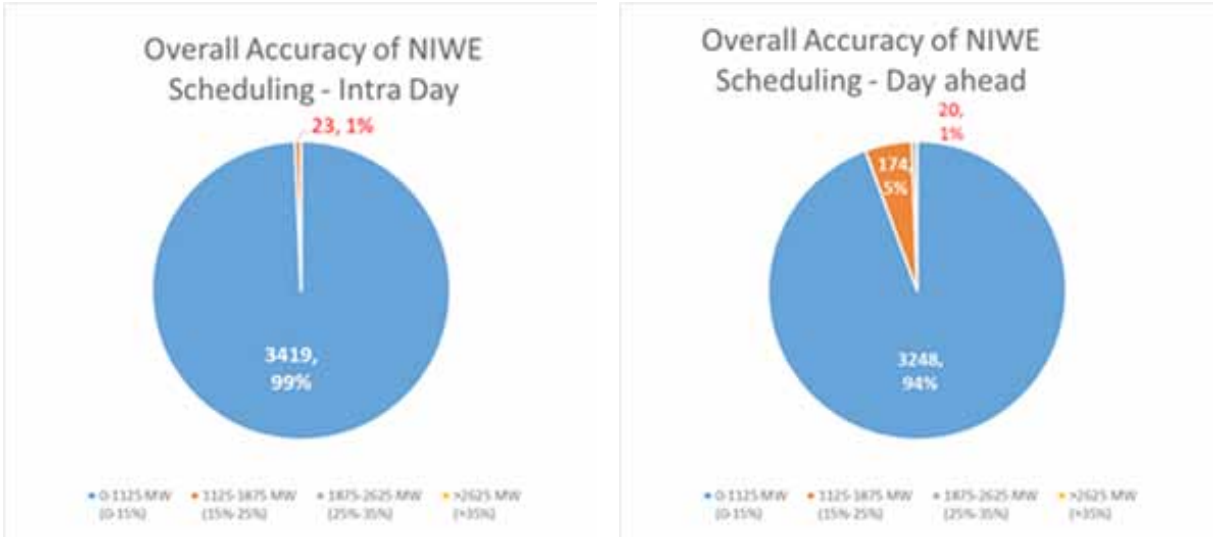
9.46 NIWE has carried out offshore wind energy potential pre-feasibility in South India in collaboration with RISO, DTU, the area from 77° to 80° Eastern longitude and 7° to 10° Northern latitude using Advanced Synthetic Aperture Radar (ASAR) during the years 2002 to 2011. The ocean wind speed maps are retrieved and processed at Risø DTU. The results show wind energy density from 200 W/m2 to 500 W/m2 at 10 m height above sea level. In order to validate the satellite study, a 100m lattice wind mast was installed and commissioned at the tip of Dhanushkodi, Rameswaram. Data from this wind monitoring station at 10m, 50m, 80m, 100m and 102m is being collected since October 2013. The results seem to be promising and looks consistent in between years. NIWE is under preparation of the detailed data analysis report and the same will be released soon.

100 m lattice wind mast at Dhanushkodi, Rameshwaram

Wind Power Forecasting

9.47 In order to utilize the maximum of renewable resources and to increase the evacuation of wind power generation, a demo 51 MW wind power forecasting project was initiated in 2013 in association with Vortex Spain through an Indo-Spanish collaboration facilitated by MNRE, Government of India. Wind Power forecast is being done based on wind data obtained from a European Metrological Agency (ECMRWF-European Centre for Medium range Weather Forecasting).NIWE is giving day ahead scheduling to SLDC. During April 2016 to October 2016 the following activities have been carried out.

- Fine tuning of numerical prediction system, wind speed forecasting model using WRF and Development of Algorithm on optimizing day ahead wind scheduling.
- Initiated scheduling services.
- Dedicated system has been created to view latest scheduling in TNSLDC.
- Implementation of NCMRWF numerical system in NIWE.
- Created power curve using NCMRWF numerical system at 25 km resolution for 10m & 50m hub height for 103 sub stations.
- Creation of actual generation data monitor system.
- Customized hub height power curve for 103 sub stations.
- Validation of created power curve model.



Intraday and Day ahead Scheduling Accuracy

Design and Development of a Photonic System

9.48 As a R&D project, Memorandum of Understanding (MoU) has been signed between NIWE and GayatriVidya Parishad – Scientific and Industrial Research Centre (GVP-SIRC) for " Design and Development of a Photonic System for real time remote monitoring of Wind and other

Air Parameters". GVP has designed and developed a photonic system and the same is being validated with the 120m met mast and other remote sensing instruments results.

Standards & Certification

9.49 NIWE is involved in the preparation of Indian standards on wind turbines by supporting Bureau of Indian Standards (BIS). Six Indian standards on wind turbines have already been finalized and three of them are already published.

9.50 This year, NIWE has completed two type certification projects (Renewal). Based on the directives from MNRE, Internationally accredited certification services are already made available in India by NIWE through a Tri-party co-operation agreement among NIWE, M/s TUV RheinlandIndustrie Service GmbH, Germany, an Internationally accredited Certification Body for Wind Turbines and M/s TUV Rheinland (India) Private Limited, Bengaluru. During the year, based on the said Co-operation, NIWE has carried out the following Certification Projects along with M/s. TUV Rheinland:

- Manufacturing Inspection for Hub & Nacelle Assembly Unit, and wind turbine tower unit for an Indian wind turbine manufacturer in connection with Type Certification of their wind turbine model.
- Manufacturing inspection for production unit of the converter manufacturer.
- Presently, the three Engineers NIWE working in S&C Unit have been authorized as Certification experts for NIWE – TUV Rheinland Projects by the German accreditation body viz., DAkkS.
- Dr.S. Gomathinayagam, Director General, NIWE, Shri. A. Senthil Kumar, Director & Head, S&C participated in meetings held with officials of M/s. Fraunhofer Institute for Wind Energy and Energy System Technology IWES at Bremerhaven, Germany and also participated in "Berlin Energy Transition Dialogue 2016" held at Berlin, Germany during the period from 15.03.2016 to 18.03.2016.
- Shri. A. Senthil Kumar, Director & Head, S&C and Shri. S.Arulselvan, Assistant Engineer, S&C participated in the meeting of Certification Body – Wind Turbines and other meetings during 21.06.2016 to 24.06.2016 at M/s. TUV RheinlandIndustrie Service GmbH, Cologne, Germany.

9.51 During the year, two RLMM lists have been issued. Six new wind turbine models including one new Indian wind turbine manufacturer have been included in the said lists in addition to the various update on the existing wind turbine models (more than 50 nos.) and manufacturers

Wind Turbine Testing

9.52 NIWE has established a test facility at Wind Turbine Test Station (WTTS), Kayathar, where wind turbines can be tested according to International Standards. WTTS is presently equipped to undertake Type Testing (TT) of wind turbines and to conduct the testing of wind turbines as per the requests of customers / manufacturers and the following tests are normally carried out as per International standards IEC 61400-12-1, 13, 1. The tests are also carried out at field sites subject to the site meeting the requirements of IEC Standards. NIWE's Wind Turbine Test Station (WTTS) near Kayathar in Tamil Nadu was established with the technical assistance of Riso National Laboratory, Denmark under Danish International Development Agency

(DANIDA) grant and with partial financial assistance and guidance from the Ministry of New and Renewable Energy (MNRE), Government of India. The following Testing activites were done during 2016-17;

- Type Testing of GVSL 1700 kW wind turbine at Kampaneari Pudhukudi (Village), Tenkasi (Taluka), Tirunelveli District, Tamilnadu of M/s GARUDA VAYU SHAKTI LTD. The measurements have been completed and final test reports issued to the Customer and the project has been closed.
- Type Testing of INOX 2000 kW wind turbine at Kidi village, Babra Taluk, Amreli (Dist), Gujarat of M/s. INOX WIND LTD. The measurements have been completed and final test reports issued to the customer and project has been closed.
- Power Curve Measurement of Regen 1500 kW wind turbine at Vagarai Village, Dindigul (Dist), Tamilnadu near Dharapuram of M/s. REGEN POWERTECH PVT LTD. The Measurements have been completed and final test reports issued to the customer and project has been closed.
- Type Testing of XYRON 1000 kW wind turbine at Richadewda, Ratlam District, Madhya Pradesh of M/s. XYRON TECHNOLOGIES LTD. The instrumentation work is under progress.
- Site Calibration for Power Curve Measurements of GE /1700/103, 1700 kW wind turbine (during Low Wind Season) at Badval, Kadapa District, Andhra Pradesh. The measurements has been completed.
- An agreement was signed between NIWE and M/s. ATRIA WIND POWER (SAVARKUNDLA) PVT LTD for Site Feasibility Study (SFS) for Power Curve Measurements of its model INOX DF/2000/113, 2000 kW wind turbine at Savarkundla, Amreli District, Gujarat.

Wind Turbine Research Station

Grid integration of 75 kWT solar with 200 kW WEG

9.53 NIWE has established a dedicated research station at Kayathar where 27 years old first generation 9 nos of 200 kW, 2000 kW and 600 kW Wind Turbines are in operation and being utilized research purposes. The following projects are also undertaken at the research station;

- Experimental demonstration study of Transient behaviour of WEG in the wind farm grid
- Development and Installation of Mircro Thruster Augmented WEG
- Independent Hybrid Wind –Solar System
- Installation of R&D Wind Turbine (2000 kW DFIG)

Small Wind Energy & Hybrid System

9.54 MNRE has identified thrust areas for R&D in small wind energy systems and the proposals from academic institutions / manufacturers identified for funding, NIWE is extending technical support in the execution of these R&D projects. Also NIWE conduct Small Wind Turbine Testing and presently testing of 3 Nos. of small wind turbine ranging from 600 W to 15 kW as submitted by the manufacturers are underway. Out of these, one Small Vertical Axis Wind Turbine of 15 kW (grid-connected, shown below) first of its kind by NIWE is undertaken for testing.

Testing of 15 kW small vertical axis wind turbine

Knowledge Sharing and Management

9.55 NIWE has created a new unit to provide avenues for training NIWE staff in new software and new domain knowledge. As a part of this measure the following activities have been started.

9.56 **Software Work Group & Technology Think Tank (TTT)**: Workgroup facility provides a platform for usage of soft tools in simulation which are interdisciplinary in engineering & physics domains. TTT is a program where resource personnels from NIWE's different units taking centrestage and introduce new ideas, share information and knowledge beneficial to others. Participation is open to all renewable energy stakeholders. Till now about 85 new topics have been discussed.

9.57 **Internship & Apprenticeship Program**: NIWE supports apprenticeship, students internship and project to enable the student to better understand the technology and also to stimulate them to come up with new ideas for research and technology development. New areas are identified for the students to work and create knowledge and more than 70 students have done their internship and projects at NIWE.

9.58 **NIWE'S Newsletter – PAVAN**: NIWE is regularly publishing a well received quarterly bilingual (English and Hindi) NIWE newsletter "PAVAN", which disseminates information about the activities & services of NIWE, wind energy news, technical articles and information on wind energy related events. During this financial year, 48th to 51st issues have been published and distributed among stakeholders and the 52nd issue will be published shortly.

Training Programmes

9.59 During the year 2016-17, three national training has been counducted where in about 100 participants have been training and also trainined 56 internatioal participants from 29 countries (Afghanistan, Azerbaijan, Cambodia, Democratic Republic Congo, Egypt, Ethiopia, Ghana, Gambia, Guyana, Iran, Jordan, Kenya, Lesotho, Mauritius, Myanmar, Malawi, Nepal, Nigeria, Oman, Paraguay, Philippines, Poland, Sudan, Syria, Tanzania, Tunisia, Uganda, Uzbekistan and Vietnam) through three International training courses.

Participants making Small Wind Turbine visiting Wind Turbine Manufacturing factory

9.60 Special One day technical workshop on "Small wind Energy and Hybrid Systems & its relevance to Telecom Towers" on 1st July,2016 at Pune for the various stakeholders in the small wind

Participants making Small Wind Turbine

Participants visiting Wind Turbine Manufacturing factory

hybrid field. The workshop aimed to focus on the Telecom area as a new frontier to reachout for the application of Small Wind Energy and Hybrid Systems. The 20 Mtr Wind Atlas for the country was released in the Workshop.

VISITORS TO THE CAMPUS

9.61 To create awareness and to motivate towards research on wind energy, achieving the indigenization and also to create awareness about the activities and services of NIWE, schools and college students are encouraged to visit the campus. During the period, about 500 students from 13 schools and colleges visited NIWE facilities and learned about Wind Energy Technology. The visits were organized with a presentation explaining about the energy, environment and its impact with wind energy development and status along with showcasing the renewable energy facilities available in the campus. 14 Nepal Delegates from Electricity Authority, Govt of Nepal and 2 NPC India coordinators was also visited NIWE on 29.04.2016.

Secretary, MNRE visit to NIWE

9.62 The President of NIWE Mr. Upendra Tripathy, I.A.S, Chairman, Governing Council, NIWE and Secretary, MNRE had visited NIWE on 18th February 2016 and inaugurated the Video conferencing facility in the campus also opened the Name Board of NIWE. He had also given

Technical workshop on Small Wind E& Hybrid Systems and its relevance to Telecom Towers organized by NIWE at Pune

Inauguration of video conferencing facility at NIWE

Secretary MNRE inaugurated the boundary wall and new name board of NIWE Campus

an inspiring address to all NIWE Staff members and interacted the with the participants of 17th International Training Course.

Visit of German Minister and Consulate General of Gernmany

9.63 Dr. Habeck, German Minister and Mr. Fabig, Consulate General of Germany in Chennai along with German Delegates visited NIWE Campus on 18th October 2016. Director General, NIWE had showcased the NIWE facilities and its individual departmental activities to the German Minister and the delegates.

FOUNDATION DAY CELEBRATION

9.64 NIWE is celebrating its Annual Foundation Day every year on 21st March and this year celebrated as Open Day for the various Schools / Colleges and general public to visit NIWE facilities followed by an invited lecture from experts. Competitions were conducted for school children organized by NIWE jointly with World Wide Fund (WWF) India. As part of the celebrations, various competitions were conducted for school children wherein more than 600 students from 30 schools across Tamil Nadu participated in the competitions and winners were awarded.

Dr. Habeck, German Minister and Mr. Fabig, Consulate General of Germany in Chennai along with German Delegates visted NIWE Campus on 18th October 2016

GLOBAL WIND DAY CELEBRATION

9.65 Global Wind Day was celebrated on 15th June 2016 with various competitions for students at the NIWE Campus. On 14th June 2016, the celebration began with a special "Capacity building training workshop" for school & college teachers and a total of 61 teachers from 55 schools attended the workshop. The celebration on 15th scheduled with Drawing, Quiz and Poster Making on Renewable Energy for school students. The event engaged over 56 School Children from various parts of the State along with their teachers at NIWE campus and shared basic knowledge about wind and renewable energy.

SOLAR RADIATION RESOURCE ASSESSMENT

9.66 MNRE has sanctioned a project for the establishment of nation-wide network of Solar Radiation Resource Assessment (SRRA) stations to make available good quality measured solar radiation data to meet the specific challenges in the implementation of JNNSM. **An exclusive SRRA unit was established at NIWE** to collect and analyze solar and other relevant meteorological data crucial for planning and implementation of solar power plants. The scope of the SRRA project is to assess and quantify the ground data of solar radiation, data processing & quality assessment of data collected, modeling and making of Solar Atlas of the country.

9.67 The following are the major activities;

1. Micrositing visit carried out at :

i) Raipur 1MW SPV plant of CREDA, Chhattisgarh for relocating Bilaspur SRRA station.

ii) Chandrapur (Govt, Engg. College), Maharashtra for establishing SRRA station under MEDA Consultancy Project.

iii) Parbhani (Agricultural University), Maharashtra for establishing SRRA station under MEDA Consultancy Project.

iv) Badi Sid, Rajasthan for relocating the Bodana SRRA station to the SECI 10MW SPV plant.

v) Bikaner and IIT Jodhpur new campus at Karwad for relocating Mathania and existing IIT Jodhpur SRRA stations.

2. The BSRN panel accepted to bring 4 SRRA stations under BSRN network. BSRN have allotted station numbers to all the 4 SRRA stations and included the 4 stations in their network.
3. `Quality Controlled data of 46 SRRA stations to 20 Clients were provided under SDSAP-2013 policy.
4. Calibration of 16 pyranometers and one Pyrheliometer of SRRA project.
5. Calibration of 14 pyranometers and 2 pyrheliometers were carried out under commercial mode.
6. Launching of online solar energy training under PPP mode and workshop on "Utilization of Solar-Wind Energy for Specific Institutions" organized on 13.12.2016.

AWARDS & HONORS FOR NIWE

9.68 Citation and Shield received for NIWE from Parivarthan Jan Kalyan Samiti during All Indian Raj Bhasha Conference and Workshop 2016 held at Kovalam, Trivandrum held during 26 -28 May, 2016.

9.69 Citation and Shield received for NIWE from "All India Official Language Conference & Brainstorming Camp" being organised in Munnar (Kerala) by "Rajbhasha Seva Sansthan" held during 1 - 3 June 2016.

9.70 "Education Leadership Award" by the 8th DNA & Stars Industry Group Present Innovation Education Awards on 18th February 2016 at Taj Lands End, Bandra, Mumbai.

9.71 "Education Leadership Award" in the ABP News National Education Awards on 23rd June 2016 at Mumbai organized by the World CSR Day & World Sustainability Congress.

NIWE was awarded citation and shield by Rajbhasha Seva Sansthan

NIWE Official Facebook and Twitter pages

9.72 NIWE Facebook page, 'www.facebook.com/niwechennai' and Twitter page, 'www.twitter.com/niwe_chennai' has been created to manage social activities of NIWE. The General News, Nationwide announcements and official photographs are being regularly updated.

SOLAR ENERGY CORPORATION OF INDIA

Introduction

9.73 Solar Energy Corporation of India Ltd. "SECI" is Section- 3 Company with 100 percent Government ownership, under the administrative control of the Ministry of New and Renewable Energy (MNRE).

9.74 The company was set up as an implementing and executing arm of the National Solar Mission (NSM) for development, promotion and commercialization of solar energy technologies in the country. In 2015, the Government has broadened its mandate to cover all segments of renewable energy viz. geo-thermal, off-shore wind, tidal energy etc. apart from solar energy.

9.75 SECI is active in the solar and wind energy segments presently, and undertakes wide ranging activities such as implementation of Government of India schemes, project development, decentralised solar systems, power trading, R&D initiatives etc.

9.76 It is a profit-earning PSU and has registered a turnover of Rs. 579 crore and net profit after tax of Rs.19.10 crore during Financial Year 2015-16.

Organization

9.77 SECI's Board of Directors is headed by Chairman and comprises of Managing Director, four functional directors and a Government nominee part-time Director. Shri Upendra Tripathy, ex-Secretary, MNRE, who was also Chairman of SECI, has attained superannuation in the current financial year. Shri Rajeev Kapoor, Secretary, MNRE has been appointed as Chairman of SECI with effect from 27.12.2016. The post of Government nominee part-time director was held by Shri Tarun Kapoor, Joint Secretary, MNRE, till 17.08.2016 and is vacant thereafter.

Shri Rakesh Kumar, Director (Power Systems), has also attained superannuation in the month of November, 2016. Appointment to the posts of Director (Solar) and Director (PS) are awaited.

9.78 Dr. Ashvini Kumar is the Managing Director of SECI. The position of Director (Finance) is held by Shri C. Kannan and the position of Director (HR) is held by Shri Rajeev Bhardwaj at present.

Achievement highlights for the year 2016-17

750 MW VGF Scheme under JNNSM Phase-II, Batch-I

9.79 SECI has implemented the first VGF scheme of 750 MW, under JNNSM Phase II, Batch I for setting up large scale ground-mounted solar PV projects on pan-India basis. After a transparent selection and award process, project capacity of 680 MW could successfully be commissioned and projects are under commercial operation. State-wise details of commissioned projects are given in **Table 9.1.**

Table 9.1: State-wise capacity commissioned under 750 MW VGF Scheme

State	Capacity
Rajasthan	355 MW
Gujarat	40 MW
Maharashtra	25 MW
Madhya Pradesh	220 MW
Karnataka	10 MW
Tamil Nadu	10 MW
Odisha	20 MW
Total	680 MW

9.80 SECI has released VGF amount of Rs. 583.38 crore to developers (till 31.12.16) under the scheme.

40 MW Project in Rajasthan commissioned under 750 MW VGF Scheme

2000 MW VGF Scheme of JNNSM Phase II, Batch III

9.81 The second batch of VGF scheme of 2000 MW capacity (JNNSM Phase II, Batch III) is under implementation by SECI. Tenders are being brought out on state-specific basis, either in solar parks being developed in the states or outside solar parks, where the same are not available.

9.82 Under this scheme, developers would be paid tariff of Rs. 4.43 per kWh or the discounted tariff discovered through e-reverse auctioning, for 25 years by entering into a PPA with SECI. Power from these projects would be sold to various discoms/Bulk consumers/state utilities by SECI at Rs.4.50 per kWh (including trading margin of 7 paisa per unit).

9.83 SECI has issued Request for Selection (RfS) documents for 2510 MW capacity in 7 states/UTs. Letters of Intent (LoI) have been issued for 2295 MW. Power Purchase Agreements (PPA) have been signed for 2295 MW. 250 MW capacity has been earmarked for bidding with Domestic Content Requirement (DCR) so far. State-wise status of tendering is given in **Table 9.2.**

Table 9.2: State-wise status of tendering under 2000 MW VGF Scheme

S. No.	State	RfS issued	LoI issued	PPA signed
1	Maharashtra	500 MW	500 MW	500 MW
2	Uttar Pradesh	325 MW	325 MW	325 MW
3	Andhra Pradesh	500 MW	400 MW	400 MW
4	Chhattisgarh	100 MW	100 MW	100 MW
5	Karnataka	1000 MW	970 MW	970 MW
	Total	2425 MW	2295 MW	2295 MW

**Puducherry (35 MW) and Himachal Pradesh (50 MW) tenders would be undertaken under 5000 MW VGF scheme after getting clarity on some policy aspects.*

5000 MW VGF Scheme

9.84 On the lines of the 2000 MW VGF Scheme, another VGF scheme of 5000 MW capacity (Phase-II, Batch-IV) has been approved by MNRE, to be implemented in four tranches of 1250 MW capacity each, spread over four years, viz. up to FY 2018-19. The first and second tranches have been taken up for implementation presently. However, efforts are being made for preponement of the implementation process in consultation with MNRE.

9.85 This scheme provides for purchase of solar power by SECI from selected developers at a fixed tariff of Rs. 4.43 per kWh for 25 years and supply to Discoms at Rs. 4.50 per kWh. The projects are being set up either in the solar parks being developed by states or are non-solar park based.

9.86 Under this scheme. RfS documents have been issued for 2900 MW capacity in 6 states. LoI have been issued for 970 MW. PPAs have been signed for 970 MW. State-wise tendering status is given in **Table 9.3**.

4. Solar Parks

9.87 SECI has been designated as MNRE's agency for handling the scheme for development of solar parks, for providing infrastructural support for setting up of solar projects, such as developed land and power evacuation facility, to project developers. Till date, 34 solar parks totalling 20,000 MW capacity have been granted administrative approval by MNRE.

Table 9.3: State-wise status of tendering under 5000 MW VGF Scheme				
S. No.	**State**	**RfS issued**	**LoI issued**	**PPA signed**
1	Gujarat	400 MW	250 MW	250 MW
2	Odisha	300 MW	270 MW	270 MW
3	Andhra Pradesh	750 MW	-	-
4	Maharashtra	500 MW	450 MW	450 MW
5	Karnataka	200 MW	-	-
6	Rajasthan	750 MW	-	-
	Total	**2900 MW**	**970 MW**	**970 MW**

9.88 Of the total capacity, field works are in progress for 10,070 MW, whereas field work is likely to start in 3-6 months for another 2200 MW. Balance capacity is in initial phase of development.

9.89 CFA of Rs. 633.39 crore has been released by SECI (till 31.12.16) for development of these parks.

9.90 The solar parks in Andhra Pradesh, Karnataka, Madhya Pradesh, Kerala, Uttar Pradesh and Himachal Pradesh are being implemented through JVCs of SECI with the state designated agencies. Most of these parks are under construction. Anantpur solar park has been part-commissioned (250 MW).

9.91 Details of the JV companies incorporated are given in **Table 9.4**.

5. Grid-connected Rooftop Programme

9.92 SECI has been successfully implementing MNRE's Solar Rooftop Schemes across the country, aimed at mitigating diesel consumption and savings in electricity procured from the Discom. Under this scheme, several rounds of open tendering have been carried out by SECI and out of

Table 9.4: Details of the JV companies incorporated by SECI for Development of Solar Parks			
Name of Company	**JV Partners**	**Capacity (MW)**	**Location(s)**
Andhra Pradesh Solar Power Corporation Private Limited	SECI, APGENCO & NREDCAP	4000	Anantpur, Kadapa, Kurnool in Andhra Pradesh.
Karnataka Solar Power Development Corporation Private Limited	SECI & KREDL	2000	Tumkur in Karnataka.
Rewa Ultra Mega Solar Limited	SECI & MPUVNL	2750	Rewa, Neemach, Agar, Mandaur, Rajgarh, Shajapur, Chhatarpur, Morena in Madhya Pradesh.
Lucknow Solar Power Development Corporation Limited	SECI & UPNEDA	600	Kanpur Dehat, Mirzapur, Allahabad and Jalaun in Uttar Pradesh.
Renewable Power Corporation of Kerala Ltd.	SECI & KSEB	200	Kasargod in Kerala.
Himachal Renewables Ltd.	SECI & HPSEB	1000	Pooh, Kibber, Hikkim, Hull, Losar in Himachal Pradesh.
Total		10550	

Projects commissioned under Grid connected Rooftop Schemes

200 MW allocated, about 64 MW capacity has been commissioned across India under existing schemes (in 5 phases). This includes a special scheme for CPWD buildings. About 71.13 crore has been released as subsidy under these schemes (till 31.12.2016).

9.93 Targeting an exponential growth in the rooftop solar segment, SECI has recently released one of the world's largest tenders of 500 MW capacity for installation of rooftop solar projects, targeting the residential, hospitals, institutions and social sector. The aim of this tender is to get benefit of cost reduction and development of pan India eco-system. The projects under this scheme shall be implemented in 3 categories: Capex model: 200 MW; RESCO: 200 MW; MSME (Capex): 100 MW. There is provision of 30% CFA for General Category States & UTs. 70% CFA is available for Special category states. Under this scheme, Letters of Allocation (LoA) for 432.7 MWp have been issued to successful bidders, and acceptance by developers has been received for over 370 MWp.

9.94 In close succession to this tender, another tender of 1000 MW capacity for rooftop solar projects has been issued by SECI, targeting the government and public sector buildings, under a target-based incentive scheme.

9.95 Under this scheme, there is provision of up to 25% incentive on project cost for 80% - 100% of target achievement. This scheme is meant to cover all Ministries/Government buildings

including Public Sector Undertakings (Both Central and State). This scheme shall be implemented through open competitive process. Out of the total capacity, 700 MW likely to be RESCO mode and the remaining 300 MW shall be implemented under CAPEX mode. 2.5 MW capacity has already been allocated for South Delhi Municipal Corporation buildings and LoIs have been issued.

Canal Top/ Canal Bank Scheme

9.96 In order to explore alternative to land with a view to increase penetration of solar power, a pilot scheme involving Canal-top and Canal-banks scheme was launched by MNRE with a total capacity of 100 MW. SECI was designated as the Nodal Agency for implementation, and the role of the company has been to oversee the implementation of projects in various states and provide CFA based on progress related milestones. Projects are being developed in 8 states viz. Punjab, Uttar Pradesh, Uttarakhand, Gujarat, Andhra Pradesh, Karnataka and West Bengal, and are under different stages of implementation. 16 MW capacity has been commissioned. CFA of Rs. 73.86 crore has been disbursed by SECI (Till 31.12.2016).

Defence Establishment Solar Scheme

9.97 With a view to encourage defence establishments to set up solar power projects, the Ministry launched a VGF scheme with a total target capacity of 300 MW. SECI was designated as the implementing agency. In order to facilitate development of projects, SECI has been actively interacting with various organizations including Ordnance Factory Board, Military Engineering Services, Border Security Forces, Cantonment Boards and Air Force Stations, etc. Feasibility assessments have been carried out for many of these establishments. SECI has conducted the tendering process for 3 projects with cumulative capacity of 22 MW, viz. OFB- Ambajhari (5 MW), OFB- Bhandara (2 MW) and Bharat Electronics Ltd. (15 MW). All the projects are under construction. OFB- Ambajhari and OFB- Bhandara projects are ready for commissioning on receiving go-ahead from Discoms. BEL project is targeted for commissioning in Feb, 2017. CFA of Rs. 3.75 crore has been disbursed by SECI (Till 31.12.2016).

CPSU Scheme

9.98 As a part of various Government initiatives, MNRE targeted CPSUs to motivate them to set up solar power projects. The target capacity of the scheme was 1000 MW and it envisaged to provide a CFA of Rs.1 crore/MW and Rs.0.5 crore/MW to CPSUs for developing solar power projects based on use of domestically manufactured solar cells/modules and domestically manufactured solar modules, respectively. SECI has been designated as the Nodal Agency for implementing this scheme. Out of 1037.26 MW sanctioned under the scheme by MNRE. 261.5 MW capacity has been commissioned and work has started for another 433.5 MW capacity by various CPSUs. CFA of Rs. 427.26 crore has been released by SECI (till 31.12.2016).

Scheme for 1000 MW Wind Power

9.99 MNRE has sanctioned a scheme for Setting up of 1000 MW CTU connected Wind Power Projects in June, 2016, to be implemented by SECI. Under the scheme, SECI would select the developers through a tariff-based competitive bidding process. PTC has been selected as the trading intermediary between developers and Discoms, through competitive bidding. The trading company would sign Power Purchase Agreements (PPAs) with Wind Power Developers

(WPDs) and Power Sale Agreements (PSAs) with buying DISCOMs/State Utilities/bulk consumers for 25 years.

9.100 RfS for selection of wind power project developers has been issued. Bids have been received and techno-commercial evaluation is in progress.

Off-Grid Solar

Solar Lanterns

9.101 1,35,000 nos. of Solar Lanterns have been delivered in the states of Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Jharkhand, Manipur, Meghalaya, Mizoram, Nagaland, Odisha, Telangana, Tripura, Uttarakhand, Uttar Pradesh and West Bengal. A tender for development and supply of 50000 nos. of solar lanterns with lithium ion battery has also been floated for supply to backward districts of various states

Solar Streetlights.

9.102 Under the Sansad Adarsh Gram Yojana, SECI had brought out tender for installation of 500 streetlights in Varanasi, Uttar Pradesh. The contract has been awarded and project is under implementation

Solar Lamp Kits.

9.103 SECI has undertaken bid process management for manufacturing and supply of 5 lakh solar lamp kits on behalf of IIT- Mumbai, which would be supplied to school children in various states. RfS has been issued and techno-commercial evaluation of bids is under progress.

Solar Home Lighting Systems

9.104 SECI has been assigned the work for supply of 16000 nos. of solar home-lighting systems in 985 villages of Arunachal Pradesh under Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY). RfS documents have been issued and bids are scheduled to be opened on 13.01.2017.

Project Management Consultancy Services

- Project Management Consultancy (PMC) is developed as an important revenue-generating activity of the company. SECI has taken up assignments on turnkey basis for several clients, mostly CPSUs, in order to enable them in meeting their Green Energy Commitments made to the Hon'ble Prime Minister during RE-Invest 2015. PMC assignments of IREDA (50 MW), Coal India Limited (200 MW), Indian Ports Association (110 MW), Bharat Electronics Limited (15 MW), Bharat Dynamics Limited (5 MW) etc. are in advanced stages of implementation.

PMC Projects: 50 MW IREDA

- The project is located in the solar park in Kasargod, Kerala. The project has been part-commissioned (20 MW) and construction for the balance capacity is in advanced stages.

PMC Projects: 50 MW THDC

- The project is also located in the solar park in Kasargod, Kerala. RfS documents for selection of EPC contractor were issued. Bids have been received and techno-commercial evaluation is under progress.

PMC Projects: 1000 MW CIL

- RfS has been floated for implementation of 2X100 MW of Solar PV projects in Madhya Pradesh through e-tendering followed by e-reverse auctioning mode. Clearance for award has been finalized. LoA is expected to be issued after receiving go-ahead of CIL/ subsidiaries.
- Discussions are in progress for implementation of another 800 MW capacity. Feasibility studies are in progress.

PMC Projects: 200 MW CIL

- RfS documents were issued for selection of EPC contractors for implementation of 2X100 MW of Solar PV projects in Madhya Pradesh through e-tendering followed by e-reverse auctioning mode. Recommendation for award has been finalized by SECI. LoA is expected to be issued after receiving go-ahead of CIL/subsidiaries.
- Preliminary feasibility reports have been submitted for implementation of another 600 MW capacity.

PMC Projects: 15 MW BEL, 5 MW BDL

- The projects are located in Medak and Bhanur areas of Telangana, respectively. Projects has been awarded and construction works are in progress. The BEL project is targeted to be commissioned by Feb, 2017 and the BDL project by May, 2017.

PMC Projects: 110 MW in Major Ports

- Vizag Port (10 MW): Construction works are in progress. 7.5 MW capacity has been synchronised and the balance capacity is under execution.
- Paradip Port (10 MW): The project had to be retendered after the selected EPC contractor backed out of the project. Contract has been awarded in Nov, 2016 and site development activities are in progress.
- New Mangalore Port (4 MW): The project has been commissioned in December, 2016.

4 MW New Mangalore port under SECI PMC Works

Project at Vishakhapatnam port under SECI PMC Works

SECI 10 MW Project at Jodhpur, Rajasthan

- Kamrajar Port (240 kW): RfS was floated for 1 MW capacity. However, due to downsizing of capacity, the project has been re-tendered. Bids are under evaluation.
- Kolkata Port (2 MW): RfS was floated by SECI in March, 2016. However, no bids were received, and the project has been retendered with change in scope of work.

PMC Projects: Rooftop segment

- Banaras Hindu University: SECI signed an MoU with BHU for installation of rooftop and ground-mounted solar power projects. Under the MoU, feasibility assessment of 8 MW capacity has been completed by SECI. Tendering activities would start shortly.
- GAIL, Pata (UP): A 5.76 MW project has been awarded to SECI for implementation in PMC mode. RfS was issued and after techno-commercial evaluation of bids, award recommendations have been forwarded to GAIL for their approval. This would be the second largest rooftop solar project in the country.

SECI Own Projects

9.105 **10 MW Jodhpur**: SECI is developing its own projects' portfolio wherein the first solar PV project of 10 MW capacity was commissioned in Jodhpur, Rajasthan on 31.3.2016. The Project is functioning satisfactorily and is being monitored closely for performance analysis. Since commissioning, the project has generated 14.4 million units of electricity (Till 31.12.2016).

9.106 **1 MW A&N**: SECI is also developing 1 MW capacity of rooftop solar projects in Andaman & Nicobar Islands under its ownership, which is under execution. Power will be supplied to government buildings at a levelised tariff of Rs. 4.64/kWh for 25 years, which has been approved by the Joint Electricity Regulatory Commission (JERC).

9.107 **5 MW Tuticorin**: SECI has proposed to develop a 5 MW solar PV project at VO Chidambaranar port under its ownership. Feasibility studies have been conducted. Application has been forwarded for grant of connectivity to State Transmission Company. Tender documents are under preparation.

9.108 For further development of SECI's portfolio, setting up of 500 MW projects in solar energy and in solar-wind hybrid technology is under active consideration. Feasibility studies are being carried out for setting up of solar-wind hybrid projects and floating solar projects in various locations

Grid-connected Projects by SECI

9.109 SECI is developing its own portfolio wherein a project of 10 MW capacity has been commissioned in Jodhpur, Rajasthan. The Project is functioning satisfactorily, and is being monitored closely for performance analysis. Since commissioning in March, 2016, the Project has generated 7.4 million units of electricity (Till Aug, 2016).

Power Trading

9.110 SECI has a Category II Trading License from Central Electricity Regulatory Commission (CERC) to carry out power trading on pan-India basis. It is an active power trader, carrying out trading on both intra-state and inter-state levels. SECI trades in solar power generated from projects under 750 MW JNNSM Batch II, Phase I scheme and the Indo-Pak border solarisation scheme. 1769 million units have been traded across 15 states from projects under the schemes mentioned (till 31.12.2016).

9.111 For the 2000 MW and 5000 MW VGF scheme projects, Power Sale Agreements have been signed for 2995 MW (till 31.12.2016).

R&D Projects

Solar-wind hybrid demonstration project at Kaza

9.112 SECI is setting up a 2.5 MW capacity demonstration plant at Kaza, Himachal Pradesh, in collaboration with HPSEB, showcasing the performance of hybrid solar-wind technology alongwith large- scale battery storage in cold desert environments. A 50:50 JV company of SECI and HPSEB, "Himachal Renewables Limited" has been formed for the purpose. RfS has been issued and bids are under evaluation.

Information Technology

9.113 Company has developed a new corporate website and secure E-mail connectivity. In order to improve upon efficiency and bringing transparency in procurement processes, STQC certified e-tendering & e-auction system of Telecommunications Consultants India Limited is deployed.

SECI is also in the process of rolling out a mobile app to provide a comprehensive view of progress made in the solar energy sector on pan-India basis

Human Resource Management

9.114 SECI total permanent staff was 69 (as on 31.12.2016). 5 number of personnel policies were enacted and/or reengineered and updated by the Board of SECI in 2015-16. Keeping in line

with the continuous efforts of the Human Resource department to propagate knowledge and skill enhancement, 57 employees were sent for various training programmes during 2015-16 to enhance their competencies by acquiring new knowledge and getting acquainted with the latest developments in the renewable energy sector. The Industrial Relations during the year remained harmonious and peaceful.

Equity support from Govt. of India

9.115 SECI has been set up with an Authorized Share Capital of Rs. 2000 crore and Rs. 304 crore has been released by the Govt. of India as budgetary support. During Financial Year 2015-16, a turnover of Rs. 579 crore and net profit after tax of Rs.19.10 crore have been registered. SECI has paid dividend of Rs. 1.91 crore to the Government for the first time.

Awards & Accolades

- SECI has been conferred with the CBIP AWARD 2017 for the 'Best Agency for promoting Renewable Energy' for outstanding contribution to the Nation in the development of clean renewable energy.
- SECI was conferred with 50th Top PSU organisations with innovative HR Practices in the recently organised Asia Pacific HR Congress at Bangalore.
- SECI has received National Award as Top Performer under the category of "Banks/Financial Institutions" in the First National Workshop on Rooftop Solar Power at Vigyan Bhawan. The award was presented by Shri Piyush Goyal, Minister of State (IC) for Power, Coal and New & Renewable Energy

SARDAR SWARAN SINGH NATIONAL INSTITUTE OF BIO-ENERGY (SSS-NIBE)

9.116 SardarSwaran Singh National Institute of Bio-Energy (SSS-NIBE), Kapurthala (Punjab) is an autonomous Institution of the Ministry of New and Renewable Energy.Govt. of India spread over a sprawling campus of about 75 acres.The objectives of the Institute are to carry out and facilitate research, design, development, testing, standardization & technology demonstration

Recently completed SSS-NIBE

eventually leading to commercialization of RD&D with a focus on bioenergy, biofuels & synthetic fuels in solid, liquid and gaseous forms for transportation, portable & stationary applications, development of hybrid/integrated energy systems, to undertake & facilitate human resource development and training in the area of bioenergy.At present the institute has a strength of ten regular posts including three scientists & the Director General. The process of recruitment of 16 scientists is currently ongoing. The Institute is marching towards development into a Global Centre of excellence in the Bioenergy

9.117 The following scientific and administrative activities were undertaken during the year 2016-2017:

Thermochemical Conversion Division

9.118 The testing and certification of improved biomass cook stove is continuing, four cook stoves submitted by manufactures have been tested so far following BIS protocols. Some technical inputs were also given to the manufactures. One natural draft cook stove model has been designed and developed at the Institute with different possible modifications using locally available materials and is in the process for approval, The photographic view of the model developed along with the technical details are given as below:

Biochemical Conversion Division

9.119 A DST-SERB project entitled "Process development for enhanced biobutanol production using butanol-tolerant isolate" is going on under which about 12 spore forming strict anaerobic solventogenic bacteria has been isolated and being checked for high yield of biobutanol production and solvent tolerance. One of the bacterial strains gave a butanol yield of 0.28 g/g and total solvent (butanol and ethanol) yield of 0.43 g/g in glucose containing medium.

9.120 A DBT sponsored Indo-Brazil project is in progress under which the energy demands of increasing demographics sugarcane bagasse is being used for the production of Bioethanol.

Natural Draft Gasifier Cookstove Model

Material of Construction: GI/SS

Weight (kg): 9.3

Height (cm): 30

Diameter (cm): 11

Thermal Efficiency (%): 30.25

Power output (kW): 2.2

TPM (mg/MJd) : 332.2

CO (g/MJd) : 3.2

Body Temprature (°C) : 41.83

Various pre-treatments like acid, peroxide using sugarcane bagasse as feedstock are been undertaken so as to achieve high yields of Bioethanol and other value-added products. Development of thermotolerant yeast strain is going on for enhanced xylose utilization and ethanol production. Yeast strain K. marxianus NIRE-K1.2 and NIRE-K3.2 have been developed through evolutionary adaptation with enhanced xylose utilization including 3 to 4-folds higher xylose uptake rate. Optimization of various parameters to attain maximum reducing sugar content by enzymatic hydrolysis is in progress. Different types of pre-treatment for efficient cellulosic ethanol production from paddy straw was studied including, alkali (NaOH), hot water pre-treatment, hydrothermal pre-treatment, glycerol thermal pre-treatment and urea pre-treatment is in process. A thermophilic consortium developed at the institute has been applied for digestion of lignocellulosic biomass including water hyacinth, paddy straw, garden grass and kitchen waste. In the algal biofuel lab, the photosynthetic algal microbial fuel cell (PAMFC) was designed to produce electricity from algal biomass. To utilize the photosynthetic activity of microalgae, the microbial fuel cell is modified with the features which favor the growth of algae in the anode chamber, the work is in process.

Chemical Conversion Division

9.121 Under this division hydro-processing of waste cooking oil using CaO-rich modified catalyst is in progress. High quality silica extraction from rice husk and straw using chemical processes is ongoing. Fractional distillation of fuels, quality testing for in-house R & D and for others on payment basis with respect to properties, efficiency and emission are also ongoing. Two R &D projects one each with Tunisia(bilateral) on algal biomass to biocrude production and another with UK along with several Asian Countries (multilateral) on rice straw valorization have been submitted and under consideration funding agencies.

Awards

9.122 Dr Sachin Kumar, Scientist-C has been awarded B-ACER fellowship for one year by DBT to work as postdoctoral fellow in USA, and is currently on study leave.

Publications

9.123 More than 20 publications such as Research papers in Journals, book chapters, conference proceedings, etc. have been published during the year 2016-17.

9.124 Important Activities

1. 26th meeting of the Governing Council was held in 29th June, 2016.
2. Shortlisting of the candidates applied for the 16 nos. scientific posts has been completed.
3. Second international conference on recent Advances in Bioenergy Research (ICRABR-2016) was successfully organized during Feb 25-27, 2016 at SSS-NIBE, Kapurthala where participants from more than 7 countries participated in the event.
4. Hands on Analytical and Molecular Techniques: One Week National Training Program on 'Extremophilic and Microbial Processes for Biofuels' during Aug 01-05, 2016 at the Institute.

4 MW New Mangalore port under SECI PMC Works

Project at Vishakhapatnam port under SECI PMC Works

5. The Institute observed Hindi Diwas and Pakhwara (14th September 2016 to 28th September 2016); Vigilance Awareness Week (31st October 2016 to 5thNovember 2016); Swachh Bharat Mission (2nd October 2016); Organ donation camp & Independence Day Celebration (14th & 15th August 2016).

30 MW out of a 50 MW Solar Power Project at Kasargod Solar Park set up by IREDA has been commissioned

INDIAN RENEWABLE ENERGY DEVELOPMENT AGENCY LIMITED

9.125 Indian Renewable Energy Development Agency Limited (IREDA) is a Mini Ratna (Category – I) Government of India Enterprise under the administrative control of Ministry of New and Renewable Energy (MNRE). IREDA is a Public Limited Government Company established as a Non-Banking Financial Institution in 1987 engaged in promoting, developing and extending financial assistance for setting up projects relating to new and renewable sources of energy and energy efficiency/conservation with the motto: "ENERGY FOR EVER"

Lending Operations

9.126 During the financial year 2016-17 (up to 31.12.2016), IREDA has sanctioned loans to the tune of Rs.7027.19 crore (corresponding previous year Rs.4864.14 crore) and disbursed Rs.4850.24 crore (corresponding previous year Rs.2315.29 crore) against the annual target of Rs.10,000 crore and Rs.6100 crore for sanction & disbursements respectively. The above said sanctioned loan (includes co-financed projects/takeover loans) would support capacity addition of 1751.30 MW. The sector wise breakup of sanctions and disbursements for the said period are given below in **Table 9.5**.

Table 9.5 Sector-Wise Break-Up of Sanctions and Disbursements During the Year 2016-17 up to 31.12.2016

(Rs. in crores)

Sector	Loan Sanction	Disbursement
Wind Power	1980.10	1996.83
Hydro Power	279.65	204.04
Cogeneration and Biomass Power	41.38	86.43
Solar Energy	3325.52	985.52
Bridge Loan	27.10	21.00
Bill Discounting	23.45	23.45
Energy Efficiency	295.00	6.63
Miscellaneous (STL+ Manu-facturing+ Waste to Energy+ NCEF)	1055.00	1526.35
TOTAL	7027.17	4850.25*

30 MW Cogeneration project of M/s.Gobind Sugar Mills Limited at Lakhimpur Kheri of Uttar Pradesh

9.127 The sector-wise break-up of cumulative sanctions and disbursements during the year 2016-17 up to 31.12.2016 is given in the **Table 9.6**:

Table 9.6 Sector-Wise Break-Up of cumulative Sanctions and Disbursements since inception up to 31.12.2016

(Rs. in crores)

Sector	Cumulative Loan Sanction	Cumulative Disbursement
Wind Power	19152.20	11481.50
Hydro Power	7455.26	3846.26
Cogeneration and Biomass Power	5107.26	3351.18
Solar Energy	9619.11	4069.38
Bridge Loan	88.58	112.89
Bill Discounting	33.10	33.11
Energy Efficiency	1271.10	339.59
Miscellaneous (STL+ Manufacturing+ Waste to Energy +NCEF)	2933.47	2813.05
TOTAL	45,660.08	26,046.96

** It includes the amount sanctioned by IREDA during the earlier years.*

MoU with MNRE

9.128 Based on the audited accounts of financial year 2015-16, the Memorandum of Understanding (MoU) rating expected to be "Very Good". IREDA has also signed MoU with the MNRE for the year 2016-17.

Resource Mobilizaton

9.129 As on date, paid up capital of IREDA is Rs.784.60 crore with a net worth of Rs.2440.72 crore based on the audited accounts for the period ended September 30, 2016. During April-December, 2016. IREDA raised resources to the tune of Rs.991.72 crore from 1st April, 2016 to 31st December, 2016 from various external sources i.e. Kreditanstalt fur Wiederaufbau (KfW), Japan Cooperation Agency (JICA) & Agence Francaise De Developpement (AFD), Asian Development Bank (ADB) and European Investment Bank (EIB).

Dissemination of Information

9.130 IREDA has continued to create awareness of its financing policies towards promotion of Renewable Energy Technologies / Energy Efficiency & Conservation (EEC) and also their potential benefits through print media.

Human Resource Development

9.131 The Human Resource Management performance level of IREDA has been consistent despite the fact that it consciously maintains a very lean workforce. In order to enhance and augment the knowledge and skills of the work force to achieve its targets and goals for the future, IREDA invested 275 man-days in technical and non-technical training of the employees during the period April-December, 2016. The morale of the employees continued to remain high during the year, facilitating smooth working of the Company and contributing to the achievement of its goals/targets. IREDA continually strive to make efforts to achieve employee satisfaction.

9.132 During the year IREDA has recruited 24 Executives in different disciplines taking the total strength of IREDA to 158.

Corporate Social Responsibility / Sustainable Development / R&D activities

9.133 The Company has spent Rs.6.25 crore during the FY 2015-16 on CSR activities which works to 1.94% of average net profit of last 3 years. Projects aggregating to Rs.3.65 crore were sanctioned and in progress of completion at the end of the financial year 2015-16. The unspent amount on CSR initiative shall be spent upon the completion of the project. During the year, the Company has undertaken CSR initiatives in the fields of environmental sustainability including contribution to Clean Ganga, skill development, promotion of health especially to the persons with disabilities, provided benefits to the armed forces widow and their dependents. During the period April – December 2016, following activities/projects were undertaken by the Company under its CSR initiative as shown in **Table 9.7.**

Table 9.7 CSR Initiatives undertaken by IREDA during 2016-17		
Sr. No.	Description	Rs. in Lakh
1.	Installation of Solar PV Street Lighting System in three Villages of Pali Parliamentary Constituency, Rajasthan, to be implemented by M/s. Rajasthan Electronics and Instruments Limited (REIL).	49.70
2.	Setting up 5 Vyayamshala / Yoga Kendras under IREDA's CSR Budget.	12.00
3.	Setting up a Computer Training Facility with 40 Work Stations at Jaipur Military Station under CSR Fund of IREDA through Army Wives Welfare Association (AWWA)	31.45
4.	Conducting Impact Assessment Study on 3 Projects under IREDA's CSR Initiatives in Bhadohi, Phoolpur and Vrindavan in the state of Uttar Pradesh through M/s. IRCON Infrastructure & Services Limited	2.79
5.	"Simultaneous Intervention of Renewable Energy Systems and Skilling for Smart Model Villages", in 5 Villages in Haryana adopted by the Hon'ble President of India to be implemented by Skill Council for Green Jobs.	44.72
6.	Setting up 4 Smart Classes in Kaushambi Public School, Kaushambi, Uttar Pradesh, under CSR Fund of IREDA to Kamdhenu Charitable Society	7.44
7.	Contribution to 'Swachh BharatKosh'.	100.00
8	Installation of 50 Solar PV Street Lighting Systems in Shravasti Parliamentary Constituency in Uttar Pradesh to be implemented through M/s. Rajasthan Electronics and Instruments Limited	10.90
9	Installation of 150 Solar Powered LED Street Lighting Systems in Bhadohi Parliamentary Constituency in Uttar Pradesh to be implemented through M/s. Rajasthan Electronics and Instruments Limited (REIL).	32.70
10	Installation of 200 Solar Powered LED Street Lighting Systems in rural area of Pilibhit Parliamentary Constituency, Uttar Pradesh to be implemented through M/s.Central Electronics Limited (CEL)	43.00
11	Installation of 200 Solar Powered LED Street Lighting Systems in rural area of Gautambudh Nagar, Parliamentary Constituency in Uttar Pradesh	43.00
12	Installation of 120 Solar High Mast LED Lights and 300 Solar PV Street Lighting System in Varanasi North, Varanasi South and Varanasi Cantt. Legislative Assembly Constituencies, Uttar Pradesh, through M/s.Energy Efficiency Services Limited	210.24

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10 : SUPPORT PROGRAMMES

SUPPORT PROGRAMMES

INFORMATION AND PUBLIC AWARENESS PROGRAMME

10.1 The objective of Information & Public Awareness Programme is to disseminate information on New and Renewable Sources of Energy (NRSE) systems/devices through a variety of media like electronic, print & exhibition as well as outdoor media, thereby popularizing and creating awareness about such systems and devices. It also brings to the fore benefits, technological developments and promotional activities taking place in the renewable energy arena from time to time. The role of the Programme, for inculcating the importance of renewable energy amongst masses, has been assuming increasing significance in recent times.

10.2 The programme is implemented mainly through State Nodal Agencies, Directorate of Advertising & Visual Publicity (DAVP), National Films Development Corporation, Doordarshan, All India Radio (AIR), etc.

Publicity Through Print Media

Newsletter

10.3 Ministry's bi-monthly newsletter "Akshay Urja" was published in English and Hindi separately, with a focus on national/international renewable energy developments, technological developments, manufacturer's details, renewable energy education, etc. A total of 20,000 copies of each issue of the newsletter are distributed amongst various stakeholders.

Brochures/Booklet

10.4 Two Booklets on 'SPV Off-grid Programme' and 'Working Paper on International Solar Alliance' were printed as well as one Folder on 'Solar Rooftop Systems' designed and printed for creating awareness and publicity. A booklet of MNRE Model MoU, PPA (RESCO Project) is under process for designing & printing.

Display Advertisements in Newspapers

10.5 During the period five display advertisements were released in English, Hindi and regional languages newspapers through DAVP from time to time to create awareness highlighting the activities and achievements of the Ministry.

Publicity Through Electronic Media

10.6 Production and broadcasting of Radio Sponsored Programme (RSP) titled "Akshay Urja Aur Hum"of this Ministry, having a duration of 15 minutes, on various technologies, systems and devices of renewable energy is being broadcast on every Tuesday and Friday, 2016 through National Film Development Corporation in Hindi and 19 regional languages (Assamese, Bengali, Gujarati, Konkani, Kannada, Kashmiri, Khasi, Malayalam, Manipuri, Tamil, Marathi, Mizo, Nagamese, Nepali, Oriya, Punjabi, Telugu, Urdu and Garo) from 94 Radio Stations (37 Vivid Bharati, 20 FM Rainbow, 4 FM Gold and 33 Primary Channels/Local Stations) of All India Radio.

10.7 Publicity campaign of video spot of 30 second duration "On Screen Digital Cinema Advertising Media" in 1500 cinema halls through NFDC in 33 State/UTs for two times of each spot in each show for four shows in a day for a period of 30 days has been done during the year.

10.8 Production of 7 video spots of 30 seconds duration each on Solar Cooker , Solar Pump Set, Solar Water Heater, Solar Home Lighting Systems, Solar Roof Top Systems, Unnat Chulha and Bio Gas have been completed during the year.

10.9 Production of 7 video films on renewable energy systems & devices through NFDC is in progress.

Publicity through Exhibitions and Outdoor Media

10.10 Ministry participated directly in three exhibitions namely 'Govt. Achievement & Schemes Expo-2016', 'World Sustainable Development Summit' and 'PETROTECH-2016 during the year.

10.11 The Ministry provided financial support to State Nodal Agencies (SNAs) for various district/ State-level exhibitions in different States/Union Territories of the country. NRSE systems, devices, working models and translites were displayed in Hindi, English and regional languages. Ministry also participated directly in several exhibitions/ events during the year.

10.12 Under the "Information & Public Awareness Programme", State Nodal Agencies (SNAs) were provided central financial assistance for taking up various publicity activities like advertisements, orientation camps and outdoor publicity through hoardings, bus back panels, kiosks, wall paintings and bus stop shelters in their regional languages.

10.13 Ministry provided financial support to the State Nodal Agencies for participation in IITF-2016 to create awareness about renewable energy amongst visitors.

PLANNING AND COORDINATION

10.14 The Planning and Coordination Division is responsible for overall planning and budgeting of plans, schemes/programmes of the Ministry and matters related to reforms, policy measures, fiscal concessions, etc. Its work involves maintaining a close liaison with different Programme Divisions of the Ministry and with other concerned Ministries/Departments/States, State Nodal Agencies, etc on a regular basis.

10.15 Major activities handled by the Division during 2016-17 include preparation of reports to Standing Committee on Energy related to the Ministry's Demand for Grants and other specific subjects selected for examination, monthly reports of major achievements/ initiatives to PMO and Cabinet Secretariat, multi-sectoral inputs/briefs for various meetings, speeches of Minister/ Secretary, replies to VIP and other references/ questionnaires and Parliament Questions involving multiple schemes/ programmes, processing of pre-budget proposals relating to Central Excise and Direct Taxes and Outcome Budget 2016-17.

SEMINAR & SYMPOSIA

10.16 The Ministry has been providing financial support for organizing Workshops, Seminars and Conferences on renewable energy. These events provide a forum to professionals, students, policy makers, managers, economists, industry representatives etc. to interact and share their views on the promotion and propagation of renewable energy.

10.17 A total of 14 national, regional and international Seminars, Conference and Symposia were provided financial support by the Ministry during the year (till 31/12/2016).

HUMAN RESOURCES DEVELOPMENT

10.18 Enabling and empowering human resources for the development of a particular sector in the country needs a policy which can facilitate the available manpower in the country to work towards that particular Sector. The Human Resources Development (HRD) Department in any organization shoulders the responsibility of making such policy. With the aim of 175 GW Renewable Power by 2022, the need of trained and qualified manpower in Renewable Sector has increased unprecedentedly. Analyses done by Natural Resources Defense Council (NRDC) and Council on Energy, Environment & Water (CEEW) in 2015 & 2016, predicts that the Solar &Wind Energy Sector is likely to create 11,16,400 and 1,83,500 additional jobs by the year 2022 respectively.

10.19 In view of the required manpower in Renewable Sector, the Human Resource Development division of the Ministry, is engaged working in developing and promoting suitable framework in the country by supporting educational institutions working in Renewable Sector and other similar organizations to undertake such activities. The Ministry is implementing a comprehensive Human Resources Development Programme with following components:

i) Support to educational and other organizations to undertake short-term training programmes on various aspects of renewable energy with focus to skill development.

ii) Fellowships/stipend under

a. National Renewable Energy Fellowship Scheme: for M.Sc./M.Tech. students and Research Scholars (under PhD & PDF)

Hands on training programme at Gandhigram Rural University, Madurai

Outdoor laboratory facilities created at Lucknow University

b. National Solar Science Fellowship Scheme: for eminent scientists working in research institutes with an innovative idea in Renewable sector. A provision of research grant is also made in this scheme.

iii) Institution of Renewable Energy Chairs by providing endowment fund to Universities/ Institutions.

iv) Support to higher educational institutions and IREP Training Centers for lab and library upgradation.

v) Participation/support to Power Sector Skill Council, and Electronics Sector Skill Council and Skill Council for Green Jobs.

vi) Development of course/ study material.

vii) Support to CIIE Initiatives of IIM Ahmedabad for supporting innovation, incubation and entrepreneurship development.

viii) Support to State Nodal Agencies and DISCOMs.

10.20 This year, Ministry continued its support to students for undertaking courses in renewable energy in select educational institutions by way of providing fellowships/stipend under National Renewable Energy Fellowship Scheme. So far, Ministry has provided 140 fellowships for PhD, 211 fellowships for M.Tech and 41 fellowships for MSc courses. Against the 140 fellowships for PhD, 62 students have been awarded the PhD degree and these students are either engaged in further research work or teaching assignments in India or abroad. This has resulted in publication of 524 research papers in the national and international journals of repute so far besides presenting 135 papers in seminars. Two patents were also registered. 65 additional slots of NRE fellowships at M.Tech Level and 21 additional slots of NRE Fellowships

at PhD Levels have been allocated to seven new universities/institutes during the current financial year.

10.21 As part of the National Solar Science Fellows (NSSF), Ministry has provided only three fellowships so far against 10 slots. Only one fellow is continuing with the fellowship at present. Salient achievements of the three fellows are as follows:-

I. Dr. Madhuwanti Joshi - worked for full tenure of three years and filed following two patents:

i) Method and systems for a multi-port modular grid tie PV solar invertor

ii) A low cost bi-directional grid tie PV micro invertor

II. Dr. Aldrin Antony - His tenure will be ending in July 2017. To his credit goes indigenously designing and fabricating a single chamber PECVD system with three electrodes besides filing patent application (PCT/IN2016/050275) for solar module with selective colored coating. He is also in the process of filing one more patent application on nano-photonic coating during current financial year.

III. Dr. Chandan Banerjee - After working for 29 months the fellow had left the fellowship to join National Institute of Solar Energy. To his credit goes in filing following two patents:-

i) Production of nano-silicon nitride coated silicon solar cells with controllable reflectivity (Reference No.E-2/927/2016-KOL, Application No. 201631028208).

ii) Process for preparing catalyst-free 3-dimensional "Indium-Tin Oxide" capable of enhancing short circuit current in a solar cell made therewith (Reference No. E-2/926/2016-KOL, Application No. 201631028207).

10.22 In line with the Government's policy of Direct Benefit Transfer (DBT), the Ministry started transferring fellowship amounts, on monthly basis, directly to the fellows in their Aadhaar seeded bank accounts through PFMS.

10.23 Ministry has instituted Renewable Energy Chairs in five institutions, namely IIT, Roorkee; IIT Kharagpur; Anna University; NLIU, Bhopal; and MNIT, Jaipur.While Chair Professors are already working at IIT Roorkee and IIT Kharagpur, selection for Chair Professors at NLIU Bhopal, IIT Kharagpur and MNIT Jaipur is under process. The incumbent Chair Professors at their respective institutes are acting as focal point for the Ministry in effective implementation of NRE courses besides engaged in research and education in RE areas.

BIOMETHANE PILOT PLANT installed at IIT Kharagpur under lab and library upgradation component of HRD programme

10.24 Twelve institutions have been supported for laboratory and library upgradation so far. These institutions are IIT Roorkee, IIT Delhi, IIT Kharagpur, NIT Hamirpur, MNIT Jaipur, MANIT Bhopal, Lucknow University, Pune University, Pondicherry University, Anna University, Chennai, Mahatma Gandhi

Solar PV Technician training for ITI Students at MGIRED, Bengaluru

Institute of Rural Energy Planning and Development (MGIRED), Bangalore and Deenbandhu Chhotu Ram University of Science and Technology (DCRUST), Murthal, Haryana. This grant has helped these institutes to start new courses such as B.Voc. in Renewable Energy besides running M.Tech./M.Sc. Programmes. Two more universities namely Central University Tejpur and Pandit Deen Dayal Petroleum University, Gandhinagar are being provided this support during current financial year.

10.25 The Ministry continued supporting Central Electronics Limited, Sahibabad for organizing training courses of six months duration on solar PV. This year, Centre for Sustainable Development (CSD), Bangalore trained 85 persons in legal aspects of renewable energy through three training programmes. The Mahatma Gandhi Institute of Rural Energy & Development(MGIRED), Bangalore, under support of Ministry organized 19 training programmes for different target groups.

10.26 Ministry has continued Suryamitra Training programme of training 50,000 persons as Solar PV Technicians in the various states by 2020 as per Module 5 of syllabus on Renewable Energy (600 Hrs) under MODULAR EMPLOYABLE SKILLS (MES) of DGET.The trained persons are being skilled for acting as installation, commissioning and after sales services (Operation &Maintenance) providers with entrepreneurship skills in the field of renewable energy with special reference to solar energy. The National Institute of Solar Energy (NISE), a specialized institute in Solar Energy of the Ministry is coordinating this

Hands on training at Barefoot College, Tilonia

TABLE 10.1 PROGRESS OF SURYA MITRA TRAINING IN DIFFERENT STATES					
State/UTs	Targets of Suryamitras to be trained by March 2020	Number of Suryamitra training programmes required	Number of training programmes required per annum	Number of training institutes enrolled for providing training in 2016-17	Achievement by 31.12.2016
Delhi	500	17	3	1	0
Haryana	1000	33	7	1	131
Himachal Pradesh	500	17	3	0	36
Jammu & Kashmir	700	23	5	2	30
Punjab	2000	67	13	0	32
Rajasthan	2500	83	17	4	714
Uttar Pradesh	5000	167	33	9	681
Uttarakhand	500	17	3	4	312
Chandigarh	100	3	1	0	0
Goa	400	13	3	1	30
Gujarat	2000	67	13	7	714
Chhattisgarh	2000	67	13	6	370
Madhya Pradesh	4000	133	27	13	464
Maharashtra	4000	133	27	29	853
D. & N. Haveli	10	0	0	0	0
Daman & Diu	10	0	0	0	0
Andhra Pradesh	4000	133	27	21	397
Karnataka	2500	83	17	6	420
Kerala	2000	67	13	4	176
Tamil Nadu	2500	83	17	13	416
Puducherry	50	2	0	3	62
Bihar	2500	83	17	3	402
Jharkhand	2000	67	13	1	162
Odhsha	2500	83	17	9	935
West Bengal	2500	83	17	2	529
Sikkim	200	7	1	0	0
Assam	2500	83	17	5	190
Manipur	500	17	3	1	30
Meghalaya	250	8	2	0	0
Nagaland	200	7	1	1	0
Tripura	250	8	2	1	0
Arunachal Pradesh	200	7	1	1	0
Mizoram	200	7	1	0	0
Andaman & Nicobar	100	3	1	0	0
Lakshadweep	100	3	1	1	0
Telangana				7	299
All India	50270	1676	335	156	8385

programme through various institutes/SNAs in different states. A GPS based Mobile App called Suryamitra mobile App is also launched for registering requests for visit of a suryamitra for undertaking maintenance / repair and information exchange of Solar PV based systems. This innovative mobile app, while caters requirements of after sales service of installed systems also provide opportunities for so trained manpower for self-employment. This skill development programme is being implemented through more than 150 training centres/organizations spread in different States. By December 2016, 8385 Suryamitras have been trained. 7000 Suryamitras are to be trained during current financial year. The state-wise target and achievement by December 2016 is given in **Table 10.1.**

Hands on training during a Suryamitra training at MGIRED, Bengaluru

10.27 The Ministry has provided support to 34 SNAs and eight DISCOMs to engage consultants for survey, project development, implementation and monitoring of renewable energy projects.

10.28 Ministry continued its support to CIIE Initiatives of IIM Ahmedabad to support innovation and incubation in the field of renewable energy. CIIE Initiatives organized programmes like POWERSTART & Power of Ideas to support the startups in clean energy. So far, under this project CIIE has given Startup Support to 13 companies and Seed Support to 7 companies and has been working towards scaling up these startups.

ADMINISTRATION – e Governance, Vigilance, Library, Right to Information

E-GOVERNANCE

Role of NIC-MNRE

10.29 NIC-MNRE is providing State-of-the-art Solutions for Information Management and Decision Support in the Ministry. NIC-MNRE is providing network services and e-Governance support to the Ministry. It is one of the total solution providers to the ministry and is actively involved in most of the IT enabled applications and has changed the mind-set of the working community in the ministry to make use of the latest State-of-the-art technology in their day to day activities to provide better services to the citizens.

Targets / Objects / Goals Completed During This Year

SPIN - Solar Photovoltaic Installations (www.solarrooftop.gov.in)

10.30 The Government of India has announced a target of 100 GW of solar power by the year 2022. Out of this, 40,000 MW will come from "Grid Connected Rooftop and Small Solar Power Plants Programme" which aims to promote installation of grid connected solar rooftop systems in

residential, institutional, commercial and industrial sectors in the country. In order to achieve this mega target a lot of work is to be done right from promotion of Solar Grid Connected rooftop System, Empanelment agencies, submission of proposals, Sanctions, issue of subsidy etc. SPIN is the one stop portal for the exchange of information and integration of information and various services between different stakeholders of Rooftop Programme; Government-to-Customer (G2C), Government-to-Business (G2B) and Government-to-Government (G2G).

10.31 National Informatics Centre (NIC) has designed and developed SPIN with address www.solarrooftop.gov.in .

10.32 Solar rooftop calculator has been provided in SPIN for a layman for getting an estimate of the installation and through interest request form he can submit the request to the Ministry. Once it is submitted the empanelled agencies will follow up for the installation. The agencies can submit the application online for empanelment and the approval also made through online. NIC email and SMS are integrated in SPIN so that necessary communication to the agencies will be delivered automatically. Govt. agencies submit the proposal online and the corresponding sanctions are also being issued. Once project is completed Govt. agencies submits the completion report for disbursement of subsidy. Customers and Agencies can send feedback to the MNRE. SPIN is used by the Ministry for generating all types of monitoring reports related to the rooftop installation. In addition to this Geo tagging of each installation is made online.

10.33 Solar Power Generation Monitoring System (SPGMS) is a web-based online system which has been designed, developed and implemented to assist the Ministry of New and Renewable Energy (MNRE) in monitoring the progress of installations and power generations of Solar Photovoltaic /Solar Thermal projects located across the country supported by the Ministry.

10.34 Various pictographic (Bar/Pie chart) reports such as State wise/Month wise/Developer wise commissioned project, Technology used by project developers, variation of Solar Irradiance during the month, Net Exported Power by developers etc. are also generated.

Formal launching of the portal for Solar Rooftop Grid connected System developed by NIC, Ministry of New and Renewable Energy. The portal was jointly launched by the Secretaries of Ministry of Power Shri. P K Pujari and Mr. Upendra Tripathi of MNRE. Also seen Shri Deep Bansal, TD & HOD NIC Renewable Informatics Division, and Shri. Saji. K Abraham, TD, NIC and Shri. Santosh Vaidya, JS, MNRE

Concessional Custom/Excise Duty Exemption Certificate Monitoring System

10.35 A Web based application has been designed, developed and implemented for online submission of Total Bill of Material (BoM) and issue of Concessional Customs Duty Certificate (CCDC) and Excise Duty Exemption Certificate (EDEC) by this Ministry for availing duty benefits by the Solar Power Project Developers (SPPDs) for initial setting up of their solar power plants in India.

Website of the Ministry (http://mnre.gov.in)

10.36 Homepage of the website has been redesigned for better content management and appearance. Specific efforts were made from time to time to review, update and enhance the website of the ministry and also ensuring the compliance of guidelines for Government websites.

10.37 Website contains the information such as, all the Schemes/Programmes of the ministry during 2015-16 or onwards, List of channel partners/manufacturers/industries SPV, Solar Thermal, Solar water heaters, Biomass, Manufacturer of Small Hydro Power project, Major achievements, Grid interactive & off grid / distributed renewable power project, Citizen Charter, Sanctions/Liabilities list under different schemes, Demands for Grants, Outcome Budget, Results framework Documents, List of MOUs signed between India and other countries for cooperation in New and Renewable Energy, Press releases, Tenders & Advertisements, Akshay Urja bimonthly newsletter, Solar Thermal Newsletter, important events/developments etc. Website is regularly enriched by adding the new features. Paying due attention to ensure timely updation and making up to date the website.

10.38 **IntraMNRE portal** :- IntraMNRE, an Intranet portal developed and implemented for ministry officials with an aim to offer G2G and G2E services and provide wide ranging, precise, reliable information through the single window access system in an authorized manner. It will make Ministry a less paper office. Incorporating new modules further enriched web portal.

10.39 **Comprehensive DDO System**:- Comprehensive DDO system developed by NIC–MNRE maintained in the ministry to generate pay bills, GPF statement, Income Tax statement, Bank list, etc.

10.40 **Document Management Information System (DMIS)**:- DMIS is one of the initiatives of NIC under E-governance is being used in the Ministry. This system provides the facility to maintain record of movement of files/receipts electronically, monitor the pendency status and timely disposal of important cases. Necessary modifications were carried out time to time in the system to incorporate changes in organization reporting structure, by creating new users, by giving additional permissions to access files of other sections and create new sections. In-house training has been provided to ministry officials time to time as per their convenience.

10.41 Grant-in-Aid Utilization Certificate Information System:- Ministry provides grants under various schemes/Programmes to State Nodal Agencies (SNAs). SNAs are required to submit the utilization certificates to the ministry. An Information system developed has been maintained to monitor the status of utilization certificates. Various comprehensive detailed reports are generated through this application.

10.42 A studio based video conferencing (VC) system installed in the ministry is actively used on monthly basis for monitoring different Renewable Energy Schemes/Programmes with all State Nodal Agencies(SNAs), Solar Power Developers, manufacturers by Secretary, Joint Secretary, Advisor and Directors of the ministry. Approximately 15 International conferencing with USA, France, Germany, Sweden, World Bank, etc. were conducted successfully.

10.43 Ministry Officials are working / placed at three places (Block 14, Paryavaran Bhawan and Block 3, CGO Complex) in the same area. Network services are provided them through NICNET using Optical Fiber Cable from NIC-Hq to Network Operation Centre (NOC) established at NIC-MNRE Computer Cell using L3, L2 switch, Anti-virus & Patch Server and firewall, connecting about 350 Users with Email and Internet facility round the clock. Wi-Fi network was established for Director and above.

10.44 Conducted Proactive Governance and Timely Implementation (PRAGATI) VC sessions chaired by Hon' able PM held on every 4th Wednesday of the month.

10.45 Implemented SPPAROW for IAS officers and extended support for Digital Certificate installation and operational training on portal (https://sparrow.eoffice.gov.in) to concern.

10.46 Initiated and implemented Biometric Attendance System- An online portal for monitoring daily attendance marked by employee using biometric devices in the ministry.

10.47 Implemented Visitor Management System (e-VMS) in MNRE by configuring and mapping the 45 officials up to the level of Director using their login credentials.

IMPLEMENTATION of E-OFFICE

10.48 Government of India is adopting e-office in all Government functioning to achieve the goal of governance with accountability, transparency and innovation. The Ministry initiated actions to adopt e-office. The e-office software and requisite hardware were procured, trainings was imparted to all officers and staff and the implementation has started in MNRE.

VIGILANCE

10.49 The Vigilance Division of the Ministry of New and Renewable Energy (MNRE) is entrusted with taking anti-corruption measures in accordance with various rules, guidelines and instructions issued by the Government of India and the Central Vigilance Commission. The Vigilance wing of the Ministry not only looks after such activities within the Ministry but also for its three autonomous bodies, namely National Institute of Solar Energy (NISE), National Institute of Wind Energy (NIWE) and National Institute of Bio Energy (NIBE) as also for the Director level posts of its two Public Sector Undertakings namely Solar Energy Corporation of India (SECI) and Indian Renewable Energy Development Agency (IREDA) in its functioning. In addition to taking anti-corruption measures, the Division is entrusted with upkeep of Annual Performance Appraisal Reports (APARs) of all the officials of the Ministry including acting as custodian for APARs under SPARROW for IAS and CSS officers.

10.50 The summary of complaints, dealt by the Vigilance Division during 2016-17, is as follows:

A.	Total No of Complaints/fraud cases received during 2016 -36	
i.	Anonymous / Pseudonymous	11
ii.	Verified complaints	25
iii.	No. of complaints closed	24
iv.	Pending cases	7
v.	Transferred to State Govt. Uttarakhand	2
vi.	No. of complaints transferred to police	2
vii.	No. of complaints transferred to CBI (3 complaints in one case)	1

B.	OLD CASES	
i.	Related to SECI Officials	2 (Closed)
ii.	Pertaining to IREDA Officials	3 (2–Closed,1 sub judice)
iii.	Pertaining to Roof top solar project	1 (Closed)
iv.	MNRE Officials	1 (against two officials, final decision pending)

10.51 The Vigilance Awareness Week was observed in the Ministry from 31st October, 2016 to 5th November, 2016. Following activities were undertaken as part of Vigilance Awareness Week:

i) Administering the Integrity Pledge to all the staff and officers by the Secretary in MNRE on 31.10.2016 at 11AM.

ii) Expert lectures by two eminent persons on probity in public life and vigilance matters for the Ministry officials.

iii) Essay competition for the officials of the Ministry was organized on "Creating awareness on empowering People to fight corruption".

iv) Lecture competition for the officials of the Ministry various topics on curbing corruption and preventive vigilance.

10.52 Prompt actions were taken by reporting the fraudulent activities brought to the notice of the Ministry by public regarding fake recruitment through misleading websites to CBI and Indian Computer Emergency Response Team.

10.53 As part of preventive vigilance, a list of sensitive and non-sensitive posts of the Ministry has been prepared and Administration Division of the Ministry has been requested to follow the rotation policy in postings. In addition, e-tendering and developing standards for procurements were also emphasized besides reviewing the audit reports of last three years to see if some vigilance angle is involved.

Library

10.54 The Library of the Ministry of New and Renewable acts as a reference centre andknowledge house in the field of renewable energy. At present about 15220 books are available in the library covering very diverse areas including the subjects such asRenewable Energy, Climate Change, Natural Sciences, Sustainable Development, History, Sociology, Indian Literature, Computer Science, etc. In addition to these books, about 25 Administrative books have been added in the Library.The collection in the library also includes books of general interest like food, cookery, sculpture, painting, mountaineering etc.

10.55 The Library Committee constituted in the Ministry scrutinizes and recommends the books for procurement by the library.

10.56 The library is currently subscribing to 43 periodicals in Hindi, English and Bengali languages. Besides, as per requirement, a total number of 29 newspapers in Hindi and English languages are also being subscribed by the library.The library is providing Current Awareness Service through newspapers clippings among its users.

RIGHT TO INFORMATION ACT

10.57 The Ministry is implementing the Right to Information (RTI) Act, 2005 as per the laid down guidelines of Department of Personnel and Training (DoPT), Central Information Commission

and Ministry of Home Affairs. The Procedure / other details regarding seeking information under RTI Act 2005 are available at the MNRE website www.mnre.gov.in .

10.58 The Ministry has designated CPIOs and Appellate Authorities to respond the RTI applications and first Appeals in accordance with subjects assigned to them. A list of CPIOs and First Appellate Authorities is given in **Table 10.2**. The RTI Unit of this Ministry headed by a Director / Dy. Secretary coordinates all the physical and online applications. Respective CPIOs and First Appellate Authorities reply to RTI applications / Appeals within the stipulated time lines to the extent possible.

10.59 The progress report in terms of RTI applications/First Appeals received, disposed-off as well as pendency during the period (01.01.2016 – 31.12.2016) is given below.

			(Figures in Numbers)
Item	Received	Disposed off	Pending as on 31.12.2016
RTI Applications	1012	769	243
First Appeals	175	91	84

Table 10.2. Names and Designation of the CPIOs and Appellate Authorities in MNRE under Right to Information Act 2005.

S. No	Subject	CPIO	Appellate Authority
1	I & PA	Shri Jatender Singh, Under Secretary	Dr. A. K. Tripathi, Scientist 'G'
2	Development of Solar City Programme & Energy Efficiency and Solar Green Building	Dr. A. K. Tripathi, Scientist 'G'	JS (In-charge)
3	Climate Change related initiatives including Clean Development Mechanism (CDM), Renewable Purchase Obligations (RPO) related issues, REC Policy, Re-INVEST related documents, INSPA, NCEF, Hydrogen, Fuel Cell and IREP	Shri Dipesh Pherwani, Scientist 'B'	Dr. P.C. Maithani, Scientist 'G'
4	Waste to Energy, Greening of Islands, Innovative Financing for Renewable Energy Projects, Externally Aided projects on Energy Access (partly funded by UNDP/GEF, DFID and GIZ)	Shri Vijay Kumar Bharti, Scientist 'B'	Shri. V. K. Jain, Scientist 'G'
5	National Biogas Programme, Biogas Training Centres and Biogas R&D	Shri P.M Barik, Scientist "B'	Shri G. L. Meena, Scientist 'G'
6	Grid connected PV & ST (Solar Thermal Power Projects) II, SECI related Work, GBI, VGF Scheme	Shri Shobhit Srivastava, Scientist 'C'	Shri B.L Ram, Scientist "G"
7	Solar Thermal Group – Flat Plate/ Evacuated Tube Collector / Non concentrating Collector Systems – Water/ Air Heaters, driers, direct cooking system and All issues relating to Solar Water Heating Application relating to Regional Testing Centre	Shri Sohail Akhtar, Scientist 'G'	Shri Santosh Vaidya, JS

8	Small Hydro Projects (Private Sector)Watermills, Small Hydro Projects (Government Sector) of Uttarakhand, North East and Arunachal Pradesh), Mini -Micro Hydel	Shri S. K Shahi, Scientist 'C'	Shri B.K. Bhatt, Scientist 'G'
9	National Solar Mission, , Solar RPO (Renewable Purchase Obligations), REC (Renewable Energy Certificate), Solar Park, Defence Schemes,	Shri Devendra Singh, Under Secretary	Shri Dilip Nigam, Scientist 'G'
10	Biomass Cookstove and SSS-NIBE,	Dr. Preeti Kaur, Scientist 'D'	Dr. B. S. Negi, Scientist 'G'
11	R&D Coordination and Biogas Power (Off Grid Programme),	Shri Rakesh Kumar, Scientist 'B"	Dr. B. S. Negi, Scientist 'G'
12	Biomass gasifier based Energy Projects for rural area, industry including grid connected,	Dr. D.K.Khare, Scientist 'F'	Shri Santosh Vaidya, JS
13	International Relations (IR)	Shri Sachin Tulsi Under Secretary	Dr. D. K Khare, Scientist 'F'
14	Vigilance	Ms. Sunita Dhewal, Under Secretary	Dr. P. C. Pant, Scientist 'F'
15	HRD and Energy Storage	Shri Rohit Thakwani, Scientist 'B'	Dr. P. C. Pant, Scientist 'F'
16	Solar Thermal Group- Solar Concentrator and Solar Cookers	Dr. R.P. Goswami, Scientist 'F'	Shri Santosh Vaidya, JS
17	Biofuels and Battery Operated Vehicles (BoV)	Shri S.R. Meena, Scientist 'C'	Shri S.K. Jagwani, Scientist 'F'
18	Off shore wind Energy, Small Wind Energy, Wind Resources Assessment, Fiscal Incentive (CCDC and EDEC) (Concessional Custom Duty Certificate, Excise Duty Exemption Certificate)	Shri P.K Dash Scientist 'C'	Shri G Upadhyay Scientist 'F'
19	Solar (R&D) (ST & SPV),	Shri Anil Kumar, Scientist 'C'	Shri I.P Singh, Scientist 'F'
20	Planning and Coordination, IREDA	Shri Rahul Rawat, Scientist 'B'	Dr. Pankaj Saxena, Scientist 'F
21	Parliament Work	Shri A.K. Singh Under Secretary	Dr. Pankaj Saxena, Scientist 'F'
22	Solar Off-Grid, Solar Pump, Solar Street Lights, Solar Home Light Systems, Energy Access relating to Solar Pumps, Micro Grids	Tarun Singh, Scientist 'C'	Dr. G. Prasad, Scientist 'F'
23	Solar Scheme for Farmers, Re- Invest RE Act & Policy,	Shri Rohit Thakwani, Scientist 'B'	Shri Girish Kumar, Scientist 'E'

24	Geothermal, Green Energy Corridor, Ocean / Tidal , Grid Interactive Policy	Shri Anubhav Uppal Scientist 'B'	Shri Girish Kumar, Scientist 'E'
25	Solar Rooftop	Shri Hiren Borah, Scientist 'C'	Ms. Veena Sinha, Director
26	Biomass Power Schemes and Policies, Bio Energy Mission	Ms. Priya Yadav, Scientist 'B'	Ms. Seema, Director
27	Administration	Shri Arvind Pokhriyal, Under Secretary	Ms. Seema, Director
28	Akshay Urja Shop, RTI, Hindi, Library, , SADP, Web Management, Cyber Security NIC Matters, Public Grievance, CPGRAMS,	Ms. Alka Joshi, Dy. Secretary	Ms. Sutapa Majumdar, EA
29	Seminar & Symposia	Ms. Alka Joshi, Dy. Secretary	Dr. A.K Tripathi, Scientist 'G
30	Grid Connected PV & ST I (HVVA related and all others) Canal Top Solar Project, Nodal Officer to handle areas like Industrial Cluster, Industrial Diesel Replacement, Installations, along with the R.E. Coordination Work with Ministry of Railways, Food Processing and Petroleum.	Shri Devendra Singh, Under Secretary	Shri Ruchin Gupta, Dy. Secretary
31	Internal Finance Division (IFD)	Shri C.M. Bhatla, Dy. Secretary	Shri J B Mahapatra JS & FA
32	O/o Minister of State (IC), NRE	Shri Sachin Tulsi, Under Secretary	Shri Santosh Vaidya, JS
33	Wind Energy, Wind RPO (Renewable Purchase Obligations), REC (Renewable Energy Certificate)	Shri Neeraj Kumar, Scientist 'C'	Shri Jeevan Kumar Jethani, Scientist 'D'
34	PAO	Shri Kedar Nath, Sr. AO	Shri Sanjay Pandey, Controller of Accounts
35	Budget	Ms.Usha Bhashyam, Accounts officer	Shri Sanjay Pandey, Controller of Accounts
36	Regional Office - Bhubaneswar	Shri B.K. Panda, Scientist 'E'	Shri Sohail Akhtar, Scientist 'G'
37	Regional Office- Guwahati	Shri D. R. Das, Scientist 'G'	Shri Sohail Akhtar, Scientist 'G'

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11:
INTERNATIONAL RENEWABLE ENERGY COOPERATION

INTERNATIONAL RENEWABLE ENERGY COOPERATION

11.1 The Ministry of New and Renewable Energy has been interacting with both developed and developing countries for cooperation in field of Renewable Energy with the following two aims:

a) Learn from and adapt technological advancements and best practices in policy and implementation from advanced countries; and

b) Share and exchange knowledge and expertise of Indian Policy Planners, scientists, Implementers and Business community in the renewable energy with counterparts in foreign countries and establishing institutional linkages between institutions of India and other countries through bilateral/multilateral cooperation framework.

11.2 During the year 2016-17, the Ministry took various initiatives to promote cooperation with other countries in the field of renewable energy. Memorandum of Understanding (MoUs)/ Programme of Cooperation (POC) / Agreements / Letter of Intent (LoI) etc. were signed and Bilateral / Multilateral Meetings / Joint Working Group Meetings were convened and participated by MNRE. Visits at the level of Hon'ble Minister and senior officers were undertaken for the purpose of Bilateral/Multilateral meetings, signing of MoUs etc. as per following details:

Signing of Memorandum of Understanding / Letter of Intent / Agreements etc.

11.3 Presently, there are 47 Memoranda of Understanding (MoUs)/Agreements /Letter of Intent (LoI) in Renewable Energy Sector with 36 countries. The Joint Working Groups (JWG) set to oversee identification, selection and formulation of joint activities for implementation and other activities. Interaction with such countries is also done through Joint Commissions / Joint Committees / Joint Working Groups of other Ministries like Ministry of External Affairs, Ministry of Environment & Forests, Ministry of Commerce & Industry and Ministry of Power etc. Mutually agreed project and activities for cooperation is also established with many countries at bilateral level even though no specific MoU has been signed with them. In addition, India has been collaborating under various multilateral / trilateral cooperation frameworks like South Asian Association for Regional Cooperation (SAARC), Association of South-East Asian Nations (ASEAN), Brazil-Russia-India-China-South Africa (BRICS), India-Brazil-South Africa (IBSA) etc.

11.4 The Ministry gets support from various international / multinational funding agencies, like World Bank, New Development Bank, KfW, United Nations Development Programme (UNDP), Asian Development Bank (ADB), United Nations Industrial Development Organization (UNIDO) and Global Environment Facility (GEF), who are providing project based assistance for renewable energy programmes in India.

11.5 During the year 2016-17, the Ministry provided financial and technical support for setting up of pilot projects of Solar Home Systems, Solar Pumps, Solar Mini-grids, Solar street lighting and solar plants in schools / clinics in nine countries from Africa and Latin America namely, Antigua and Barbuda, Burkina Faso, Cabo Verde, Comoros, Gambia, Guinea Bissau, Senegal, Madagascar and Sierra Leone. The National Institute of Solar Energy (NISE) is coordinating for installations. In addition, setting up of Biomass Gassifier system in Guyana with financial support from Ministry of External Affairs (MEA) has also been taken up.

11.6 The Ministry also provides support for specialized training programmes in African and other developing countries involving National Institute of Solar Energy (NISE). International Training programmes are conducted in the field of Solar Energy, Wind Energy, Small Hydro Power & Biomass at Indian apex institutes, viz., National Institute of Solar Energy (NISE), Gurgaon, National Institute of Wind Energy, Chennai, Alternative Hydro Electric Centre (AHEC), IIT, Roorkee and Indian Institute of Science (IISc), Bangalore under ITEC programme of Government of India.

11.7 During the year 2016-17, a Memorandum of Understanding (MoU) was signed between Ministry of New and Renewable Energy, Government of India and the Ministry of Education of the Government of the Republic of the Union of Myanmar on 29th August, 2016 at New Delhi, India.

11.8 During 2016-17, visits of delegations/ senior officers / representatives of International Organizations to MNRE took place, for discussing matters relating to bilateral cooperation, expanding cooperation activities in renewable energy, including technical / financial assistance. Names of important dignitaries / delegations / officers, visited MNRE for the above purpose during 2016 – 2017 are given below:

(i) H.E. Dr. Martin Ney, German Ambassador in India met Hon'ble Minister of State(IC), NRE in New Delhi on 1st April, 2016.

(ii) H.E. Mr. Gunnar Bragi Sveinsson, Foreign Minister of Iceland met Hon'ble Minister of State(IC), NRE in New Delhi on 5th April, 2016.

(iii) An UAE delegation led by H.E. Saeed Al Tayer, MD & Chairman of Dubai Electricity and Water Authority (DEWA), Dubai, UAE met Secretary, MNRE in New Delhi on 8th April, 2016.

(iv) Mr. Wolfgang Neumann, CEO, Energy Globe Foundation, Austria met Hon'ble Minister of State(IC), NRE in New Delhi on 18th May, 2016.

(v) Mr. Yuri Afanasiev, UN President Coordinator and UNDP Resident Representative in India met Hon'ble Minister of State(IC), NRE in New Delhi on 6th June, 2016.

(vi) A delegation led by H.E. Mr. Malik Samarawickrama, Minister of Development Strategies and International Trade, Sri Lanka met Hon'ble Minister of State(IC), NRE in New Delhi on 4th July, 2016.

(vii) H.E. Mr. Adewale Adeyemo, US Deputy National Security Advisor, International Economic Affairs, met Hon'ble Minister of State(IC), NRE in New Delhi on 28th July, 2016.

(viii) H.E. Mr. John Kerry, Secretary of State, U.S. Department of State met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 30th August, 2016 New Delhi.

(ix) H.E. Ms. Harinder Sidhu - High Commissioner, Australia High Commission, New Delhi met Secretary, MNRE on 22nd August, 2016 New Delhi. (v) H.E. Mr. Jim Carr, Hon'ble Minister of Natural Resources, Govt. of Canada met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 8th September, 2016 New Delhi.

(x) H.E Mr Alexandre Ziegler, Ambassador of France to India met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 16th September, 2016 New Delhi.

(xi) H.E. Mr. Tovar da Silva, Ambassador of Brazil met Secretary, MNRE on 1stSeptember, 2016,at New Delhi.

(xii) Mr. Greg Johannes, Secretary, Department of Premier and Cabinet in the Government of Tasmania met Secretary, MNRE on 5th September, 2016 at New Delhi.

(xiii) H.E. Ms. Nina Vaskunlahti, Ambassador-Designate, Finland met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 3rd October, 2016 at New Delhi.

(xiv) H.E. Ms Rachel Kyte, Special Representative to the UN Secretary General and CEO of Sustainable Energy for All met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 3rd October, 2016 at New Delhi.

(xv) H.E. Mr. Ibrahim Baylan, Hon'ble Minister of Policy coordination and Energy, Government of Finland met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 5th October, 2016 at New Delhi.

(xvi) Mr. Nasrul Hamid, MP, Hon'ble State Minister for Power, Energy and Mineral Resources of Bangladesh met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 5th October, 2016 at New Delhi.

(xvii) H.E. Mr. Matti Anttonen, Minister for Foreign Affairs of Finland met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 8th November, 2016 at New Delhi.

(xviii) H.E. Dr Teresa Ribeiro, Portuguese Secretary of State for Foreign Affairs and Cooperation met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 25th November, 2016 at New Delhi.

(xix) Mr. Masayoshi Son, CEO, Soft Bank met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 3rd December, 2016 at New Delhi.

(xx) H.E. Mr. Joki Widodo, President of Indonesia met Hon'ble Minister of State (IC) for Power, Coal, New and Renewable Energy and Mines on 12th December, 2016 at New Delhi.

11.9 In order to keep the Ministry abreast of the latest developments, bilateral discussions in renewable energy sector were undertaken as mentioned below:-

(i) Hon'ble Minister Shri Piyush Goyal, Minister of State (Independent Charge) for Power, Coal and New & Renewable Energy and mines led a high level delegation to United Kingdom (UK) and United States of America (USA) from April 19 – 22, 2016.

- Minister held a series of bilateral meetings on 19 April 2016 with his Ministerial counterparts from the Government of UK with Lord Bourne, Parliamentary Under Secretary of State for Energy and Climate Change, Lord Jim O'Neill, Commerce Secretary to the Treasury and Mr. Nick Hurd of the Department For International Development (DFID). The meetings focused on deepening the India-UK relationships in the fields of power, renewable energy as well as enhancing technological and financial collaborations between the two countries. He also met Dame Fiona Woolf, acting Lord Mayor of London, followed by an interactive roundtable with investors.
- Hon'ble Minister interacted closely with a select group of high impact individuals to understand the investor sentiments and steps needed to improve the ease of doing business. He had discussions during interactive session at London Stock Exchange with several experts and investors which focused on deepening the financial market ties between the two countries.

Shri Prakash Javadekar, Minister of State (IC) for Environment, Forest and Climate Change, Shri. Piyush Goyal, Minister of State (IC), for Power, Coal and New & Renewable Energy met Mr. John Kerry Secretary of State, USA at New York on April 21, 2016

- Hon'ble Minister, Shri Prakash Javadekar, Minister of State (IC) for Environment, Forest and Climate Change, Hon'ble Minister, Shri. Piyush Goyal, Minister of State (IC), for Power, Coal and New & Renewable Energy along with Secretary, MNRE and Special Secretary, MoEF & CC met Mr. John Kerry Secretary of State, USA to disucss bilateral issues. Hon'ble Minister confirmed that India is committed to the renewable energy target of 175000 MW and briefly highlighted the road map/plans for the same.
- During his visit to USA during 21-22 April, 2016, Hon'ble Minister had meetings with Mr. Stephen Schwarzman, Chairman, CEO & Co-Founder, Blackstone Group regarding investment opportunities in India. He also held meetings with Mr. Jack Kutner, CEO Big Belly, Mr. Richard Kauffman, Chairman of Energy and Finance, Office of the Governor of New York, Mr. Saurabh Agarwal of Warburg Pincus and Mr. Alfred Griffin, President of the New York Green Bank. The Minister also addressed a meeting of large number of American investors and developers in the field of Renewable Energy that was jointly organized by Confederation of Indian Industry (CII) and US-India Business Council (USIBC).

Media Briefing at Indian Consulate, New York

- Hon'ble Minister met with the local media at the Indian Consulate, New York USA where he briefed them about various steps undertaken by Indian Government to improve energy

Meeting with Jack Kutner, CEO, Big Belly

Meeting with Mr. Richard Kauffman, Chairman of Energy and Finance, Governor of New York

The Minister met the local media at the Indian Consulate, New York, USA

access, rapid scale up of renewable energy, enhancing grid reliability, integration of renewable in the grid and the massive opportunity presented by the untapped demand in the Indian market.

- Hon'ble Minister, Piyush Goyal, Minister of Power, Coal, New and Renewable Energy, India co-chaired a Ministerial event of International Solar Alliance along with H.E. Ms. Ségolène Royal, Minister of Environment, Energy

Roundtable-I with Investors and Developers in Renewable Energy and Power

Meeting with Stephen Schwarzman, CEO, Blackstone

Round Table: International Solar Alliance: "The Trillion Dollar Opportunity"

and the Sea, in charge of International Relations on Climate, Government of France (President of COP21).

- Hon'ble Minister addressed the event jointly organised by CII, ISA and Terrawatt Initiative of France with a theme of "International Solar Alliance (ISA): The Trillion Dollar Opportunity". He also held bilateral meetings with Ministerial counterparts from Australia, Philippines and Bangladesh on the side-lines of the ISA event.
- He also formally launched two initiatives of ISA jointly with H.E. Mrs. Ségolène Royal, President of the COP 21 namely - a) Affordable finance at scale; and b) Scaling solar applications for agricultural use.

(ii) Secretary, MNRE led delegations to UK and USA as a part of delegation led by Hon'ble Minister of State (IC), Power, Coal, NRE and Mines and to attend the following events:

- Investors Meet 2016 in London on 20th April, 2016.
- The 3rd International Steering Committee Meeting of International Solar Alliance (ISA) on 21st April, 2016
- Side Event on ISA as well as the International Session on Solar Financing.

(iii) Secretary, MNREalong with Director (IR) attended the International Renewable Energy Agency (IRENA) Council meeting and other related side events in Abu Dhabi, UAE from 23-26 May, 2016

(iv) Officers from MNRE visited Japan, UAE, Germany, Belgium, Australia, China, UK, USA, Switzerland, Morocco, Finland, Sweden, South Korea and Thailand during the year.

11.10 The following International events were organized by Ministry of New and Renewable Energy during 2016-17:

(i) 3rd Joint Working Group (JWG) meeting on Renewable Energy between India–Bangladesh on cooperation in the field of Renewable Energy was held on 18th April, 2016.

(ii) Under U.S. – India Energy Dialogue, a meeting of New Technology and Renewable Energy Working Group (NTRE-WG) through DVC was held on July 11, 2016.

(iii) India-Philippines Joint Working Group meeting was held on 9th August, 2016 in New Delhi via Video conference.

(iv) India–US Strategic and Commercial Dialogue (S&CD) Clean Energy meeting was held on 17th August 2016 via Video Conference.

(v) India–US Clean Energy Finance Task Force Meeting was held on 30th August, 2016 in New Delhi.

(vi) 4th India-Sweden Joint Working Group Meeting on Cooperation in the field of Renewable Energy was held on 5th October, 2016.

(vii) Joint Working Group Meeting on Energy under the India–China Strategic Economic Dialogue (SED) held on 6th October, 2016 in MNRE. Ms Anju Bhalla, Joint Secretary, Ministry of Power presided over the meeting as Co-chair from Indian side and Mr. Wang Xiaolin, Vice Administrator of National Energy Administration, National Energy Administration as a Co-chair from Chinese side. A large delegation on industry representatives from China participated in the discussion. Representatives from the Ministry of Power including Central Electricity Authority (CEA), Ministry of Coal and Ministry of New and Renewable Energy including representatives from IREDA, along with private sector companies associated in renewable energy participated from the Indian side.

Joint Working Group Meeting on Energy under the India–China Strategic Economic Dialogue (SED) held on 6th October, 2016 in MNRE

Shri Upendra Tripathy, Secretary MNRE and Director (IR), MNRE attended the International Renewable Energy Agency (IRENA) Council Meeting at Abu Dhabi, UAE in May, 2016

Engagement with the International Renewable Energy Agency (IRENA)

India is one of the Founder Member of the International Renewable Energy Agency (IRENA) which is an intergovernmental organization that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a center of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

With a mandate from countries around the world, IRENA encourages governments to adopt enabling policies for renewable energy investments, provides practical tools and policy advice to accelerate renewable energy deployment, and facilitates knowledge sharing and technology transfer to provide clean, sustainable energy for the world's growing population.

India served as a Member of the IRENA Council and also Chaired the IRENA Council Meetings during 2015which is accountable to the Assembly and facilitates consultations and cooperation among Members and considers the draft work programme, draft budget and annual report.

IRENA is actively associated with MNRE and provides policy suggestions for scaling up of Renewable Energy target of 175 GW sets by India. IRENA is also preparing "REmap 2030 – India Country Report". Mr Sakari Oksanen, Deputy Director-General, IRENA, Abu Dhabi and Mr Nicholas Wagner, IITC, Bonn Centre, IRENA presented draft report in November, 2016 during the meeting with all stakeholders. MNRE is collaborating with IRENA on Global Atlas for Renewable Energy. IRENA has also helped in establishing International Solar Alliance (ISA).

The Minister of State for Power, Coal, New and Renewable Energy and Mines (Independent Charge), Shri Piyush Goyal and Mr. Richard Verma, US Ambassador in India after the exchange of instrument for the launch of US-India Clean Energy Finance Facility (IFEF) Initiative

(viii) India China Strategic Economic Dialogue : Both sides agreed to enhance their cooperation for promotion of renewable energy both in manufacturing of equipment and components and in generation of wind and solar energy. The Chinese side agreed for speeding up of cooperation in solar cell / module manufacturing in India. It has also been agreed to expand cooperation in promoting solar rooftop initiatives taken up by India by providing quality solar cells / modules and O&M services. The Indian side proposed that India offers huge investment opportunities in renewable energy sector, including in solar energy by way of participating in equity support, offsetting hedging cost, taking up of masala bonds, partnering in solar projects, etc. The Chinese investors have shown keen interest in financial investment and participation in large solar park projects in cooperation with Solar Energy Corporation of India (SECI).

(ix) Launch of the US–India Clean Energy Finance Facility (ICEF) Initiative:

- Minister for New and Renewable Energy, Piyush Goyal and US Ambassador Richard Verma in India launched new joint initiative of US-India Clean Energy Finance (USICEF) Initiative on 16th December, 2016 in New Delhi which would help in unlocking OPIC financing and mobilize public and private capital to expand access to distributed clean energy projects. White House Senior director John Morton and William Pegues, Managing Director, OPIC and representatives of the David and Lucile Packard Foundation, John D. and Catherine T. MacArthur Foundation, the William and Flora Hewlett Foundation, and Good Energies Foundation were also present during the USICEF launch event.

Success Story of bilateral cooperation

Village Electrification in Aggawen, Matrough Governate in Egypt

Ministry of New & Renewable Energy (MNRE), Government of India through bilateral co-operation programme between India and Egypt, one remote village in Egypt has been electrified through Solar PV Systems. The project was executed through an agreement signed between MNRE and Rajasthan Electronics & Instruments Limited (REIL), Jaipur (A Public Sector Enterprises) for implementation of the project. The project is supported by the Ministry of External Affairs, Government of India.

A remote village Aggawen, Matrough Governate in Egypt was identified by Ministry of Electricity & Energy Cairo, Egypt and REIL electrified the village successfully. Briefly as stated below:

The Project Highlights are as under:

- Cost of the Project : Rs. 23.78 Lac.
- Solar Home Lighting System (150 Wp) : 40 Nos.
- Solar System for clinic center (250 Wp) : 01 No.
- Solar System for Mosque (150 Wp) : 01 No.

- Letter of Intents were signed and exchanged between MNRE and OPIC in presence of Minister Piyush Goyal for the creation of a $20 million for US-India Clean Energy Finance (USICEF)Initiative, equally supported by the United States and India would support projects which, upon long-term financing and deployment, and would qualify for the support of long-term debt financing from OPIC.
- PACESetter Fund

  The Ministry of New and Renewable Energy MNRE and US Government launched PACESetter Fund Initiative during 2015. Under PACE Setter Funds initiatives jointly launched by US and India, contributing US$4 million each by both sides for supporting innovative off grid projects. The 1st cycle completed and awarded 9 projects and during the 2nd cycle announced and received expression of interest from 168 projects. Screenings of these projects are being initiated and awards would be announced shortly.

EXTERNALLY AIDED PROJECTS

11.11 There are two Externally Aided Projects that are concurrently being operated at the Ministry.

A) UNDP/GEF assisted Project on "Scale Up of Access to Clean Energy for Rural Productive Uses";

B) DFID assisted Project on Energy Access Policy Fund (EAPF).

11.12 A brief write up on each of the Project is as under:-

A) UNDP/GEF assisted Project on "Scale Up of Access to Clean Energy for Rural Productive Uses"

Project Brief

11.13 The key objective of the Project is to enhance the use of clean energy for rural productive uses/livelihoods in un-served and under-served areas in the selected districts of the three states Assam, Madhya Pradesh and Odisha for strengthening livelihoods, improving income generation and reduce usage of fossil fuel. The major deliverables of the Project are (i) Development and Deployment of key Renewable Energy Technology Packages for Rural Livelihoods (RETPRLs), (ii) Development of the Supply Chain for RE Technology Supply and Service Providers to enhance Rural Livelihoods, (iii) Providing Support in development of Policy and Regulatory Support for RE - Rural Livelihoods Applications, and (iv) Assess and Improve effectiveness of Financial Support Models for Decentralised RE – Rural Livelihoods Applications. The livelihood sectors identified for support under the Project are - horticulture, dairy, poultry, fisheries, handicrafts (bamboo/weaving) and other rural micro enterprises. The UNDP/GEF contribution for the project is USD 4.80 million whereas GOI/MNRE contribution is USD 10.0 million and the duration of the Project is 5 years with effect from August, 2015.

11.14 Physical Progress during 2016-17

- Establishment of State Coordination Cell (SCC) in SNA (OREDA)/ Technical Institution (IIT Guwahati & MANIT, Bhopal) for coordinating and overseeing implementation of pilot projects in the field by CLIAs (Cluster Level Implementing Agencies)/NGOs.
- Selection of CLIAs/NGOs for Implementation of Pilot Projects – Proposals were invited through an RFP for installation of pilot projects in identified districts in 3 states and were

jointly evaluated by a committee consisting of PMC/MNRE, SCC/SNA and UNDP. Financial Sanction has been issued for 12 projects to 7 CLIAs/NGOs in the state of Odisha. In addition to this, 13 proposals from Odisha and 44 proposals from other 2 states have also been shortlisted and are in the process of completing the required documentation and for registration on NITI Aayog's NGO - Darpan Portal.

- Establishment of Rural Entrepreneurial Hubs – the purpose of supporting this activity is to establish infrastructure for assembling, supply, after salesservice and training of technician/operators of RE systems/devices for rural livelihoods in identified districts of the states. Initially, 2 entrepreneurial hubs in each state is proposed to be provided financial assistance of Rs. 20.0 lakh linked with specified deliverables. 5 proposals (3 for Odisha and 1 each for Assam & Madhya Pradesh) have been shortlisted by the Evaluation Committee and completion of implementation plan & required documentation is under process.
- State/District Level Workshops and Other Capacity Building Events - 7 State/District Level Workshops and Other Capacity Building Events were organized which include:i) Inception Workshop in Delhi; ii) State Level Workshop in Bhubaneswar; iii) District Level Workshops,one each in Bhubaneswar and Sehore); and iv) Clinic Workshop, Annual Work Plan Meet and RE Technology Suppliers Meet in Bhubaneswar; v) Twothree-day Residential Training Workshop at NISE; vi) Twofour-day Residential Training Programme at Puducherry vii) 12 three-day training programme in Assam, Madhya Pradesh, & Odisha (4 each).
- A compendium on existing RE Rural Livelihood Application Packages is under preparation by OUAT, Bhubaneswar.
- Organised a meeting of Project Steering Committee (PSC) and five meetings of Project Executive Committee (PEC).
- Promotion of Small Solar Pumps for Enhanced Livelihood of Vegetable Growers in Odisha with remote monitoring.

B) DFID assisted Project on Energy Access Policy Fund (EAPF)

Project Brief

11.15 The key objective of the project is to support development of Energy Access Policy Framework and Financing Instruments for Off-grid solutions. As per DPR approved by DEA, 50% of the total DFID technical assistance is to be utilized for setting up pilot projects or for supplying of RE products in rural areas of 2 states – Odisha and Jharkhand. GoI/MNRE's contribution is for implementation of pilot projects in the field.

Physical Progress during 2016-17

11.16 Activities initiated under the project are as follows: -

i) Power Up Odisha - The aim of the study is to develop a vision document for Odisha's energy system in 2030 with an action plan to achieve the vision through policy strengthening and is being carried outby Forum for the Future.

ii) Knowledge Portal on Energy Access

The objective is to develop an online platform to access information on Energy Access, showcase success stories and benchmark products and services. The portal is being developed by IPE Global and is expected to be ready for testing by April 2017.

iii) Establishment of Pilot Project based on Smart Nano-Grid for Rural Energy Access

A Smart Nano Power Plant of 40 kW capacity has been set up in Chhotkei Village, Angul Distt. of Odisha by Sun Moksha and National Institute of Science and Technology (NIST) which aims to provide quality power to un-electrified villages. A residential workshop to educate government officials of various states was organised in May 2016 to motivate them to replicate in their respective states. In order to test robustness and scale up the model, it was decided to set up 2 more pilot projects – 1 each in Odisha and Jharkhand for which scoping study is being carried out by PwC and SunMoksha.

12: PROMOTION OF OFFICIAL LANGUAGE-HINDI

PROMOTION OF OFFICIAL LANGUAGE - HINDI

12.1 With a view to implement the Official Language Policy of the Government of India, a Hindi Section has been set up in the Ministry. Its functions are as under:-

(I) Implementation of the Official Language Policy of the Govt. of India.

(II) Translation work.

12.2 During the year 2016-17 concerted efforts were made to ensure proper compliance of the provisions of Official Language Act 1963 and Rules framed thereunder. For promotion of Official Language Policy and to create more conducive environment for the officials to do more work in Hindi, various programmes/schemes are being undertaken which include the following:

- Work is in progress to make the Ministry's revamped website bilingual.
- Notings of day to day nature have been printed on file covers bilingually.
- A digital board has been installed at the entrance of the Ministry and a new Hindi word is demonstrated daily. Inspirational quotes are also displayed.
- Standard Drafts and Standard Forms have been prepared in Hindi and placed on the Website of the Ministry for convenience of officers/staff.
- Two booklets on the progress made by India in the field of Renewable Energy were prepared in Hindi and English.
- Addresses of Nodal Agencies have been prepared in Hindi.
- All documents coming under section 3(3) of the O.L. Act 1963, eg. Press Release, Tender Notices, Rules, General Orders, Notification, Cabinet Notes, Parliament Questions and other Documents to be laid in the Parliament were prepared bilingually.
- Letters received in the Hindi were invariably replied to in Hindi and Rule (5) of the Official Language Rules 1976 was fully complied with.
- First working day of every month is celebrated as Hindi Divas in the Ministry. On this day mostly the work is done in Hindi.

12.3 During the year 2016-17, various measures were taken for effective implementation of Official Language Policy in the Ministry. Special emphasis was laid on increasing originating correspondence in Hindi. As per the Quarterly Progress Report for the quarter ended on 30th September, 2016, the percentage of Hindi correspondence with offices in Regions 'A' 'B' and 'C' was 74.12%, 73.43% and 58.44%respectively.

12.4 In order to review the progress made in the implementation of Official Language policy, quarterly meetings of Official Language Implementation Committee were held regularly. Discussions were held on quarterly progress reports received from various Sections/Divisions of the Ministry, and IREDA, SECI, NIWE, SSS-NIBE and NISE. The Sections/Divisions and other Organizations were advised to achieve the targets specified by the Department of Official Language.

12.5 'Hindi Fortnight' was observed in the Ministry during 14th to 30th September, 2016 to create awareness and to increase the use of Hindi in official work. During the fortnight, a message was issued from Hon'ble Minister (NRE) regarding progressive use of Hindi. A number of

Prizes were distributed by Shri Upendra Tripathy, former Secretary MNRE during Hindi Pakhwada

competitions were held which were well taken by officers and staff of the Ministry. Officers and staff members belonging to Hindi and non-Hindi speaking categories were given cash awards and certificates based on their performances by the Secretary, MNRE. Besides, Hindi Day/ Fortnight was also observed in various offices and Undertakings of the Ministry.

12.6 Hindi books are purchased in the Ministry every year. Besides, many Hindi journals are also purchased.

12.7 In order to promote the use of Hindi in official work, Literature and Glossaries were distributed among the officers and staff. All advertisements were issued bilingual.

12.8 Hindi Noting & Drafting Incentive Scheme of the Department of Official Language was continued during the year and five officers/staff were awarded under this Scheme.

Meeting of Hindi Advisory Committee

12.9 The reconstitution of Hindi Advisory Committee of the Ministry is under process.

Prakartik Urja Puraskar Yojna

12.10 To promote original book writing in Hindi or translated in Hindi related to the subjects of Non-Conventional Energy, Prakartik Urja Purskar Yojna is being implemented in the Ministry,

since 1988. Under this scheme, there is a provision to award a first prize of Rs.1,00,000/-, second prize of Rs. 60,000/- and third prize of Rs. 40,000/- for the books originally written in Hindi. For the books translated into Hindi the amount of first, second and third prize is Rs. 50,000/-, Rs.30,000/- and Rs.20,000/- respectively. Besides the cash awards an appreciation letter signed by the Secretary, MNRE is also given to the awardee.

Organization of Hindi workshops

12.11 During the year, four Hindi workshops were organized for the officers and staff of different categories to encourage the officers/staff to do their official work in Hindi. A number of officers/staff from the Ministry participated in these workshops.

Inspection of Subordinate Offices and Sections

12.12 With a view to assess the status regarding progressive use of Official Language, inspection of various offices and Autonomous Institutions/ PSU etc. is carried out from time to time by the officials of Hindi Section. Inspection of four sections of the Ministry was carried out during the year.

13: RENEWABLE ENERGY IN NORTH-EASTERN STATES

RENEWABLE ENERGY IN NORTH EASTERN REGION STATES

13.1 Special attention is being given to the development of the eight States in the North Eastern Region of the country through a separate budget allocation under various renewable energy programmes. Accordingly, the Ministry has allocated 10 per cent of the budgetary support for the deployment of biogas plants, solar thermal systems, solar photovoltaic systems, remote village electrification, small hydro projects, wind energy systems and energy parks. Against the allocation of Rs.413.00 crore from Gross Budgetary Support towards NE Region at RE stage, an amount of Rs.71.30 crore was released during the year upto 31.12.2016.

BIOGAS PROGRAMME

13.2 The National Biogas and Manure Management Programme (NBMMP) is being implemented in the North Eastern Region States through State Government Nodal Departments / State Nodal Agencies. The Khadi and Village Industries Commission (KVIC), Mumbai was also given separate targets for implementing the programme in the States of Assam, Nagaland, Meghalaya, Arunachal Pradesh, Tripura and Sikkim. The State-wise family type biogas plants installed in the NE Region during the year is given in **Table: 13.1**. A Biogas Development and Training Centre for all the NER States for providing training and technical support under the NBMM Programme is functioning at Department of Mechanical Engineering, Indian Institute of Technology, Guwahati, Assam.

Deenabandhu Biogas Plant installed for beneficiary - Shri. Sudhir Das at village-Baidyamura, Nalchar RD Block, Tripura

Table 13.1: Family Type Biogas Plants installed in North Eastern Region States under NBMMP		
Sl. No.	**Name of State**	**Plants installed upto 31.12.2016**
1	Assam	5610
2	Meghalaya	0
3	Mizoram	78
4	Nagaland	0
5	Sikkim	0
6	Tripura	60
7	Arunachal Pradesh	5

GRID SOLAR POWER PROGRAMME

13.3 Unlike Phase-I, NSM Phase-II aimed for achieving significantly higher scales of targets of 100 GW. Hence, Ministry has contemplated all possible options for implementation of the Mission. Selection of capacity for Phase-II, grid connected projects is being done via different schemes such as Bundling, Generation Based Incentive (GBI), Viability Gap Funding (VGF). This allocation of target capacity may be altered depending upon the availability of resources. The state-wise Solar Energy Potential and Solar Capacity installed in the North Eastern Region States is given in **Table 13.2**.

Table 13.2 State-wise Solar Energy Potential vs. Installed Solar Capacity in NE Region as on 31.12.2016.			
Sr. No.	**State/UT**	**Solar Potential (GWp) #**	**Installed Capacity (MW) as on 31.12.2016**
1	Arunachal Pradesh	9	0.27
2	Assam	14	11.18
3	Manipur	11	0.01
4	Meghalaya	6	0.01
5	Mizoram	9	0.10
6	Nagaland	7	0.50
7	Sikkim	5	0.01
8	Tripura	2	5.02
	TOTAL	**43**	**17.10**

SOLAR PARKS

13.4 The following solar parks have been approved in the under mentioned States of NE region as given in **Table 13.3**.

Table 13.3 Details of Solar Parks sanctioned in NE Region States

Sl. No.	State	Capacity (MW)	Name of the Solar Power Parks Developer (SPPD)	Land identified at
1	Assam	69	JVC of APDCL, APGCL	Amguri in Sibsagar district
2	Meghalaya	20	Meghalaya Power Generation Corporation Ltd (MePGCL)	West Jaintia Hills & East Jaintia Hills districts
3	Nagaland	60	Directorate of New & Renewable Energy, Nagaland	Dimapur, Kohima and New Peren districts

GRID CONNECTED ROOFTOP SOLAR POWER

13.5 Under the above mentioned scheme, Electricity Regulatory Commissions of Assam, Manipur, Meghalaya, Mizoram, Sikkim, and Tripura have notified regulations for feed-in-tariff. Manipur has come out with Solar Policy supporting grid connected rooftop systems.

OFF GRID SOLAR PV PROGRAMME

13.6 During 2016-17, the Ministry sanctioned 16 Solar power plants with aggregate capacity of 440 kWp and 400 Solar Street Lights (LED) at various locations in Rangia Sub Division in the state of Assam. Some major Off-grid Solar PV projects sanctioned for NE Region States during 2016-17 are as follows:

100 kW Solar Power Plant at Diyun

1000 LPD Water Heating System in Tawang, Arunachal Pradesh

- 4000 nos. Of SPV Street Lights in 508 nos. Of Villages in six Districts of Mizoram
- 7078 nos. Of Solar Home Systems for Handloom Weavers in the State of Manipur
- Five nos. Of 50kWp SPV power plant and 1000 nos. of SPV Street Lighting Systems (LED) in Amlarem Sub Division, West Jaintia Hills District, Meghalaya.
- 50kWp SPV power plant with battery backup and 50kWp SPV power plant without battery backup at Integrated Check Post at Agartala in the State of Tripura.

13.7 Under the ATAL JYOTI YOJANA programme, Solar LED Street Lights in rural, semi-urban and urban areas will be installed across the state of Assam, where the household electrification is less than 50% as per 2011 Census by March 2018. Details of all SPV systems and Stand Alone SPV power plants in the North Eastern region states as on 30.12.2016 is given in **Table 13.4.**

Table 13.4 Details of SPV systems and SPV power plants in the North Eastern region states as on 30.12.2016

S.no	State/UT	Solar Photovoltaic Systems				Stand Alone power plants (KWp)
		Lanterns Nos.	Home Lights Nos.	Street Lights Nos.	Pumps Nos.	
1.	Arunachal Pradesh	14433	18945	1671	22	600.10
2.	Assam	1121	6926	318	45	1605.00
3.	Manipur	4787	3900	1888	40	1241.00
4.	Meghalaya	24875	7844	1273	19	884.50
5.	Mizoram	9589	6801	5056	37	1719.00
6.	Nagaland	6766	1045	6235	3	1506.00
7.	Sikkim	23300	15059	504	0	850.00
8.	Tripura	64282	32723	1199	151	612.00
	Total	**1,49,153**	**93,243**	**18,144**	**317**	**9017.60**

A wind monitoring station in Manipur

Wind Resource Assessment Programme

13.8 The Wind Resource Assessment (WRA) Programme is an ongoing activity and is being coordinated by the National Institute of Wind Energy (NIWE), Chennai (erstwhile Centre for Wind Energy Technology (C-WET)) in association with State Nodal Agencies. So far, 52 Wind monitoring stations have been established in North Eastern region at 20 m, 25 m & 50 m level to carry out Wind Resource Assessment.

13.9 With the objective to assess the realistic potential, the Ministry had taken the initiative to carry out extensive wind resource assessment studies at North-Eastern Region by installing 200 wind monitoring stations ranging from 50 m to 80 m level with a cost sharing ratio of 90:10 among MNRE and concerned State Nodal Agency.

Small Wind Energy Hybrid Systems (SWES) Programme

13.10 Till date, a cumulative capacity of 383 kW Small Wind Energy Hybrid Systems had been installed in NE Regions including Sikkim. The State-Wise break-up are as shown in **Table 13.5.**

Small Hydro Power Programme

13.11 North Eastern States have a fairly good potential to develop small hydro power projects. Among the NE States, Arunachal Pradesh has the highest potential followed by Sikkim, Meghalaya and Mizoram. MNRE has been giving special emphasis for the development of small hydro projects in the NE region and a higher level of financial support has been provided under the SHP schemes. The State wise installed capacity vis-a-vis potential in North Eastern States & Sikkim is given in **Table 13.6.**

13.12 The Ministry has also issued "In –Principle" approval for the following SHP/MHP Projects in Nagaland. Central Financial Assistance (CFA) will be released only on approval/release of funds to these projects by State Government/ NEC and on fulfilling the terms & conditions of the SHP Administrative Approval.

6.8 KW Wind-Solar Hybrid System in West Kameng, Arunachal Pradesh

Table 13.5 Cumulative Installed Capacity of Small Wind Energy Hybrid Systems in NE Region		
Sl. No.	Name of State	Cumulative Installed Capacity upto 31.12.2016
1	Assam	5380
2	Meghalaya	0
3	Mizoram	270
4	Nagaland	0
5	Sikkim	130
6	Tripura	120
7	Arunachal Pradesh	0
	Total	**5900**

Table 13.6 STATE WISE NUMBERS AND AGGREGATE CAPACITY OF SHP PROJECTS(UPTO 25 MW) in NE Region

POTENTIAL, INSTALLED & UNDER IMPLEMENTATION (as on 31.12.2016)

Sl. No.	State	Potential		Projects Installed		Projects under Implementation	
		Nos.	Total Capacity (MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)
1	Arunachal Pradesh	677	1341.38	152	104.605	17	54.05
2	Assam	119	238.69	6	34.110	5	12.00
3	Manipur	114	109.13	8	5.450	0	0
4	Meghalaya	97	230.05	4	31.030	2	25.50
5	Mizoram	72	168.90	19	41.470	4	8.70
6	Nagaland	99	196.98	12	30.670	8	3.75
7	Tripura	88	266.64	17	52.110	0	15.00
8	Sikkim	13	46.86	3	16.010	2	0

Electrification/illumination of unelectrified border villages of Arunachal Pradesh under PM Package.

13.13 The Ministry is also implementing a project on electrification/illumination of unelectrified border villages of Arunachal Pradesh through completion and installation of new small hydro power projects and solar photovoltaic systems.

13.14 A package of Rs.550 crore was announced to provide electricity through solar power and small hydropower projects to all the villages along the state border.

13.15 The package has been divided into two parts:

Part – I: Part -I is for completing 46 ongoing small hydro projects in the State with support of Rs.274.42 crore. These funds have been provided by the Planning Commission directly to the State as Additional Central Assistance. This part would electrify 425 villages in border areas. Part-I is being monitored by Planning Commission. Planning Commission has released the entire fund.

Part – II: Part II is being implemented as a project for electrification / illumination of 1058 villages from small / micro hydel projects and solar photovoltaic systems with a total cost of Rs.275.58 crore. After approval of CCEA, the implementation of projects started from 1st December, 2008. The project is funded by MNRE. Part II of the project is being implemented by Ministry of New and Renewable Energy as a project for electrification / illumination of 1058 villages from small / micro hydel projects and solar photovoltaic systems with a total cost of Rs.275.58 crore, Ministry has so far released Rs.255.99 crore under the project. So far 976 villages have been electrified/illuminated under the package, out of this 453 villages have been electrified through MHP/SHP Projects and 523 villages has been illuminated through installation of SPV Home Lighting Systems.

Development of Solar Cities

13.16 Eight cities are being developed as Solar Cities from North-Eastern States.

13.17 Master plans have been prepared for all the 8 cities. In addition, Aizawl and Agartala cities are being developed as pilot solar cities, for which allocation have been made for Rs.2.50 crore for installation of renewable energy projects.

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14. GREENING OF ISLANDS

GREENING OF ISLANDS OF ANDAMAN & NICOBAR

Increased RE Deployment for Greening the Islands in Andaman & Nicobar and Lakshadweep.

14.1 Following 3 Programmes/Activities were initiated during the year 2016-17.

Scheme for Setting up of 40 MW Distributed Grid-Connected Solar PV Power Projects in Andaman & Nicobar and Lakshadweep Islands with Capital Subsidy from MNRE

14.2 **Objective** : The objective of the scheme is to develop Carbon Free Islands by phasing out use of diesel for generation of electricity and to contribute to the National Action Plan on Climate Change. The initiative will also help in reduction in cost of electricity generation which is at present over Rs. 25 per kWh.

14.3 **Spatial Coverage** : Distributed grid-connected solar PV power projects of an aggregate capacity of 40 MW would be established in different Islands in Andaman & Nicobar (about 40 MW at 4 -5 locations in Port Blair, 2-3 MW each at Havelock and Neil) including 5 MW floating solar in different Islands of Lakshadweep.

14.4 **Implementation Arrangement** : The scheme is being implemented through Central Public Sector Undertakings (CPSUs) viz., National Thermal Power Corporation (NTPC), Neyveli Lignite Corporation (NLC), Rajasthan Electronic & Instruments Ltd. (REIL), Solar Energy Corporation of India (SECI) on Build, Own and Operate (BOO) basis.

14.5 Ministry will provide 40% of the project cost discovered through competitive bidding process as grant directly to CPSEs implementing the projects. A&N and Lakshadweep Administrations will buy the electricity from the Implementing Agencies at a tariff determined by JERC/CERC taking into account the CFA.

14.6 A brief status of the projects being implemented by different agencies is given at **Table 14.1.**

Inter-Ministerial Group Constituted by MHA for the Holistic Development of Islands – Action for MNRE

14.7 The Inter-Ministerial Group (IMG), constituted under the Chairmanship of the Secretary (Border Management) has identified 10 Islands in Andaman & Nicobar and Lakshadweep for Holistic Development of islands in the country. NITI Aayog has issued a RFQ cum RFP for engaging a consultancy organisation for preparation of integrated concept plan and detailed master plan for development of each island with a focus on sustainability. MNRE will support deployment of RE systems/devices in the identified islands.

Bilateral Cooperation between MNRE and Swedish Energy Agency (SEA) on Micro Grids in Andaman & Nicobar Islands

14.8 MNRE and SEA are jointly developing pilot projects on RE based microgrids for supply of electricity in the identified locations in Andaman Islands. The size of the proposed pilot projects is expected to be in the range of 30 kW to 1500 kW. Six micro grids based pilot projects with an estimated investment of INR 36 crores (USD 5.4 million) developed by three Swedish Companies have been shortlisted for implementation. SEA has agreed to contribute INR 13

S No.	Implementing Agency	Target (MW)	Land Location (in Hectares)	Status
1	NTPC	Total – 25 MW Chidiyatapu – 8 MW Manglutang- 17 MW	19 Ha 38 Ha	• MoU signed between NTPC, A&N Administration and MNRE on 20 Oct. 16; • Land for the proposed 25 MW has been allotted and its Development is in progress; • Notice Inviting Tender (NIT) for selection of EPC Contractor has been issued for both the locations and Contracts for setting up the plants are expected to be awarded by March 2017 and commissioned by June 2018;
2	Neyveli Lignite Corporation Ltd. (NLC)	Total – 50MW Attam Pahad, Middle Andaman- 20 MW	41.56 Ha	• MoU signed between NLC, A&N Administration and MNRE on 10th May 2016; • Land for the proposed 20 MW has been allotted and its Development is in progress; • Notice Inviting Tender (NIT) for selection of EPC Contractors for setting up power plant and Energy Storage System has been issued and contracts for setting up the plants are expected to be awarded by March 2017 and commissioned by May 2018.
3	Rajasthan Electronics & Instruments Ltd. (REIL)	Total – 3 MW Havelock - 2 MW Neil Island -1 MW	3.47 Ha 1.6 Ha	• MoU signed between REIL, A&N Administration and MNRE on 8th July 2016; • Land for the proposed projects has been allotted and Topographical/contour survey of sites at Havelock & Neil Islands completed; • Notice Inviting Tender (NIT) for selection of EPC Contractors for both Islands is likely to be issued by March 2017 and contracts for setting up the plants are expected to be awarded by April 2017 and Project commissioned by Sept. 2017
4	SECI	1MW in Port Blair at Government Buildings	Solar Rooftop Projects	1 MW in Port Blair at Government Buildings - Project awarded to Ujjas Energy in May 2016 - Material started reaching the sites - Project completion date of 1 MW by 31st June 2017 5 MW RESCO Model – Bids have been invited to select the implementation agency.

crores (USD 1.9 million) as grant and MNRE will provide eligible subsidy for setting up of these pilot projects. The balance cost will be mobilised as contribution from the beneficiary organisation and/or term loan from the Financial Institutions.

14.9 The proposed pilot projects uses combination of RE Technologies with Energy Storage Systems and will be deployed in- i) Resorts in Havelock and Neil Islands; and ii) GB Pant Hospitals and BRAIT (Dr. B.R. Ambedkar Institute of Technology) in Port Blair. Innovative bifacial transparent PV panel technology with tracking system and DC micro grids for electrification are proposed to be introduced for improving the efficiency.

ANNEXURES

ANNEXURE I

Strength of Staff in MNRE including Regional Offices for 2016-17.

Group	A	B	C	Total
Sanctioned	122	85	77	284
In Position	82	61	68	211
Sc	10	15	28	53
St	2	2	3	7
Obc	5	9	7	20
Ph	-	1	-	1

Pay and Account Office, Ministry of New and Renewable Energy

Sanctioned Strength and in-position in respect of Pay & Accounts Office, Ministry of New & Renewable Energy as on 31.12.2016 are as under:-

Group	A	B	C	D	Total
Sanctioned	1	6	9	-	16
In Position	1	6	7	-	14
SC	1	1	1	-	3
ST	-	-	1	-	1
OBC	-	-	2	-	2
PH	-	-	-	-	-

SSS-NIBE

Information pertaining to the staff of Sardar Swaran Singh National Institute of Bio Energy (SSS-NIBE), an autonomous institute functioning under the administrative control of Ministry of New and Renewable Energy.

Group	Board Level	A	B	C	D	Total
Sanctioned	26*	21	1	4	-	26
In Position	10	5	1	4	-	10
SC	-	-	-	-	-	-
ST	-	-	-	-	-	-
Physically Handicapped	-	-	-	-	-	-

New Group-A posts of 16 Scientists have been created/approved, by MNRE for the Institute. The recruitment of these posts is under process

NIWE

Group-wise details of posts in NIWE as on 10.02.2016 are as follows:

No of Posts	Group				Total
	A	B	C	D	
Sanctioned	18	13	15	2	48
In Position	16	8	11	2	37
SC	3	2	4	1	10
ST	1	-	-	-	1
OBC	6	4	7	1	18
PH	-	-	-	-	-

IREDA

The Indian Renewable Energy Development Agency Limited (IREDA), a Public Sector Undertaking under this Ministry provides loans for setting up projects relating to renewable energy and energy efficiency. The Staff strength of IREDA as on 31.12.2016 are as under :

Group	Board Level	A	B	C	D	Total
Sanctioned	03	90	64	59	-	216
In-Position	03	100	18	27	-	151
SC	-	17	01	06	-	24
ST	-	05	02	01	-	8
OBC	-	15	03	03	-	22
Physically Handicapped	-	01	-	01	-	02*

**The employees are covered under "Persons with Disabilities (PwDs)", but for counting purposes, they have been included in their category (viz. General/SC etc.)*

SECI

Strength of staff in SECI as on 31.12.2016

Group	Board Level	A	B	C	D	Total
Sanctioned	03	90	64	59	-	216
In-Position	03	100	18	27	-	151
SC	-	17	01	06	-	24
ST	-	05	02	01	-	8
OBC	-	15	03	03	-	22
Physically Handicapped	-	01	-	01	-	02*

NISE

Information pertaining to the staff of National Institute of Solar Energy (NISE), an autonomous institute functioning under the administrative control of Ministry of New and Renewable Energy.

Group	A	B	C	D	Total
Sanctioned	25	16	0	0	45
In Position	2	0	0	0	2
SC	0	0	0	0	0
ST	0	0	0	0	0
PH	0	0	0	0	0

Note : The posts are sanctioned for the institute have all been advertised and the process for recruitment is on.

ANNEXURE II

Ministry of New and Renewable Energy Statement showing the pendency position of Audit Paras of C&AG Reposts as on 31.12.2016.

I. 12 of 2015 - Financing of Renewable Energy Projects by Indian Renewable Energy Development Agency Limited; and

II. PA 34 of 2015 Performance Audit of Renewable Energy Sector in India.

1.0 MW Solar Thermal Power Plant with 16 hr. Thermal Storage in Brahmkumari Ashram, Mount Abu

100 MW Solar PV Power Plant in Jodhpur

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सत्यमेव जयते

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