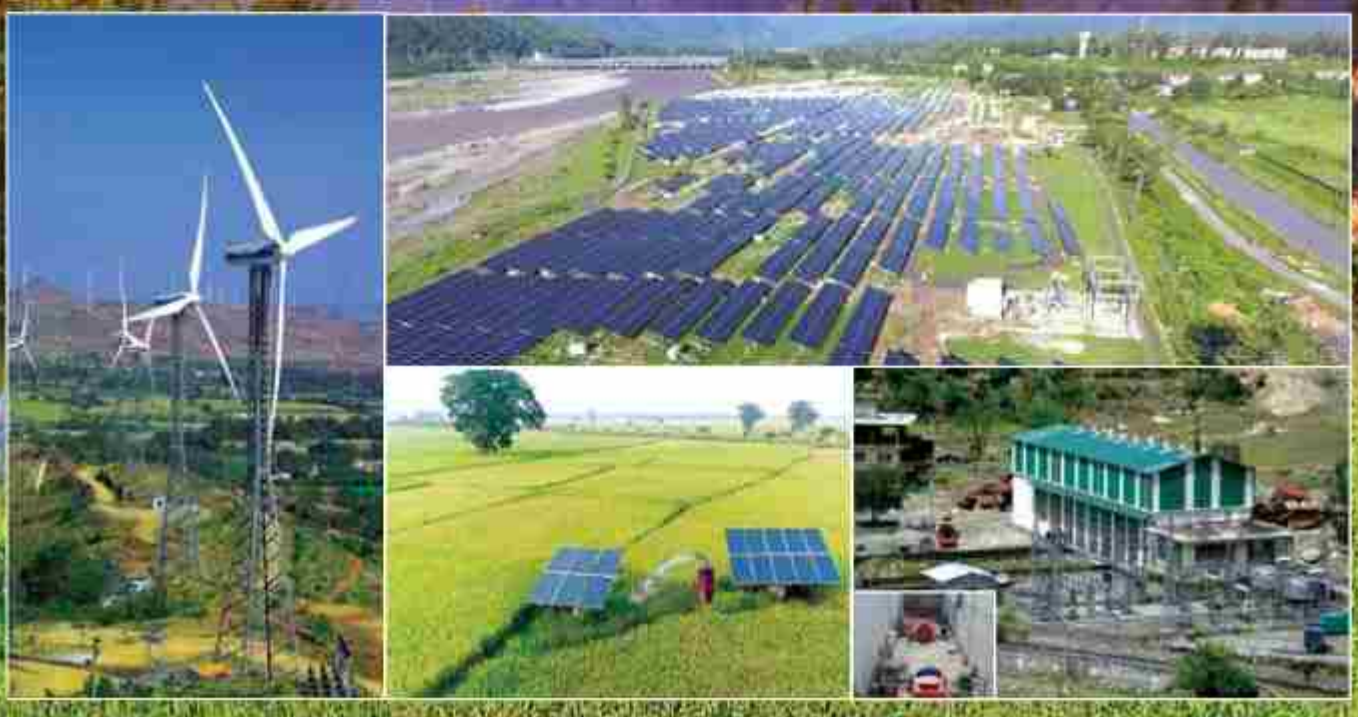
1: OVERVIEW



OVERVIEW

1.1 Over the years India has successfully created a positive outlook necessary to promote investment in, demand for and supply of renewable energy. In addition to grid power, decentralized distributed electrification using renewable energy technologies provides economical options for meeting lighting, cooking and productive energy needs in rural areas.

1.2 In the year 2015, the Government of India announced a target for 175 GW cumulative renewable power installed capacity by the year 2022. A capacity of 62.84 GW has been set up by December 2017 and this constitutes 18 per cent of the total installed capacity. Now India has 4th and 6th global position in wind and solar power deployment respectively.

1.3 Renewable energy has started playing an increasingly important role for augmentation of grid power, providing energy access, reducing consumption of fossil fuels and helping India pursue its low carbon developmental pathway. Ahead of COP 21, India submitted its Intended Nationally Determined Contribution (INDC) to the UNFCCC, outlining the country's post-2020 climate actions. India's INDC builds on its goal of installing 175 gigawatts (GW) of renewable power capacity by 2022 by setting a new target to increase the country's share of non-fossil-based installed electric capacity to 40 percent by 2030 (with the help of international support). The INDC also commits to reduce India's GHG emissions intensity per unit GDP by 33 to 35 percent below 2005 levels by 2030, and to create an additional carbon sink of 2.5 to 3 billion tonnes of carbon dioxide through additional tree cover.

1.4 Launched in January 2010, the National Solar Mission (NSM) was the first mission to be operationalized under the National Action Plan on Climate Change (NAPCC). Using a three-phase approach, the mission's objective is to establish India as a global leader in solar energy, by creating the policy conditions for solar technology diffusion across the country as quickly as possible. The initial target of the mission of installing 20 GW grid-connected solar power plants by the year 2022 was enhanced to 100 GW to be achieved by the same target year.

1.5 A range of policy instruments has been adopted to implement this mission. The revised tariff policy requires all states to reach eight percent solar RPO by the year 2022. The first phase of the mission opted for a "reverse bidding mechanism;" reverse bids (discounts) on benchmark tariffs set by the Central Electricity Regulatory Commission (CERC) were invited from prospective project developers. Solar water heaters and rooftop systems have been promoted in certain commercial and residential areas through regulatory intervention such as mandates under building by-laws and incorporation in the National Building Code. Off-grid and rooftop solar applications have been promoted through provision of subsidies from the central government. Research and development is also being encouraged through approvals of R&D projects and the establishment of Centers of Excellence by the Ministry. These measures led to decline in solar power prices in India much more than expectations. Overall, NSM is proceeding well according to schedule. During the year, one of the major focus area of action was to address barriers confronting large-scale adoption of solar power, including available land, low-cost finance, domestic manufacturing capacity, and skilled manpower.

1.6 Various policy measures undertaken included guidelines for procurement of solar and wind power though tariff based competitive bidding process, repowering of wind power projects, standards for deployment of Solar Photovoltaic systems/ devices, identification of large government complexes/ buildings for rooftop projects; provision of roof top solar and 10 per

cent renewable energy as mandatory under Mission Statement and Guidelines for development of smart cities; amendments in building bye-laws for mandatory provision of roof top solar for new construction or higher Floor Area Ratio; infrastructure status for solar projects; raising tax free solar bonds; providing long tenure loans; incorporating measures in Integrated Power Development Scheme (IPDS) for encouraging distribution companies for net-metering.

1.7 During 2017-18, a total 5602.65 MW capacity has been added till 31.12.2017 as given in **Table 1.1**

Table 1.1 Achievement in grid connected renewable power

	Achievement (MW) (April - December, 2017)	Cumulative Achievements (MW) (as on 31.12.2017)
Wind Power	568.71	32848.46
Solar Power - Ground Mounted	4492.05	16070.07
Solar Power - Roof Top	271.49	982.30
Small Hydro Power	38.30	4418.15
Bio Power (Biomass & Gasification and Bagasse Cogeneration)	232.10	8413.80
Waste to Power	0.00	114.08
Total	**5602.65**	**62846.86**

1.8 Major highlights are herein under:-

i. Now, in terms of wind power installed capacity, India is globally placed at 4th position after China, USA and Germany.

ii. India's offshore wind potential has been recognised under the National Offshore Wind Policy under which NIWE has been authorised to allocate offshore wind blocks to developers on the basis of open international competitive bidding. First LiDAR installed and commissioned off Gujarat coast for gathering wind resource data.

iii. Competitive bidding in the wind power had a positive impact on wind tariffs. The first wind auction conducted in February 2017 led to a fall in tariff. The third wind auction rolled out in the beginning of October 2017 was also oversubscribed and led to further reduction in wind tariff and resulted in lowest tariffs of Rs. 2.44/KWh.

iv. In December 2017, Government of India issued guidelines for procurement of wind power through tariff based competitive bidding process. These guidelines are applicable for procurement of wind power from grid-connected projects.

v. Kurnool Solar Park in Andhra Pradesh with 1GW capacity was commissioned, this makes the Park the World's Largest Solar Park.

vi. 650 MW capacity commissioned in Bhadla Phase-II Solar Park in Rajasthan.

vii. 250 MW capacity commissioned in Phase –I of Neemuch Mandsaur Solar Park (500 MW) in Madhya Pradesh.

viii. 3 new solar parks have been approved this year in Rajasthan (1000 MW), Gujarat (500 MW) and Mizoram (23 MW).

ix. Solar tariff has declined to lowest level of Rs 2.44 /kWh.

x. In August 2017, Ministry of New & Renewable Energy has notified, Guidelines for Tariff Based Competitive Bidding Process for Procurement of Power from Grid Connected Solar

PV Power Projects, which clearly specify the Technical Requirements for Grid Connected Solar PV Power Plants, thereby ensuring the quality of material/ equipment being used in solar PV projects.

xi. In order to ensure quality of material/ equipment being used in solar PV projects, MNRE, on 05.09.2017, has brought out a Quality Control Order titled "Solar Photovoltaics, Systems, Devices and Components Goods (Requirement for Compulsory Registration) Order 2017".

xii. 982.30 MWp solar roof top power projectscommissioned.

xiii. Concessional loans of around 1375 million US dollars from World Bank (WB), Asian Development Bank (ADB) and New Development Bank (NDB) have been made available to State Bank of India (SBI), Punjab National Bank (PNB) and Canara Bank for solar rooftop projects.

xiv. Under the Suryamitra program, total of 72 nos. of programs with 2208 Suryamitras have been organized in FY 2017-18(till 31.12.2017).

xv. Under Green Energy Corridor project, projects worth Rs. 6766 crore have been awarded and approx. Rs. 1400 crores have been disbursed to the States from the Government of India share.

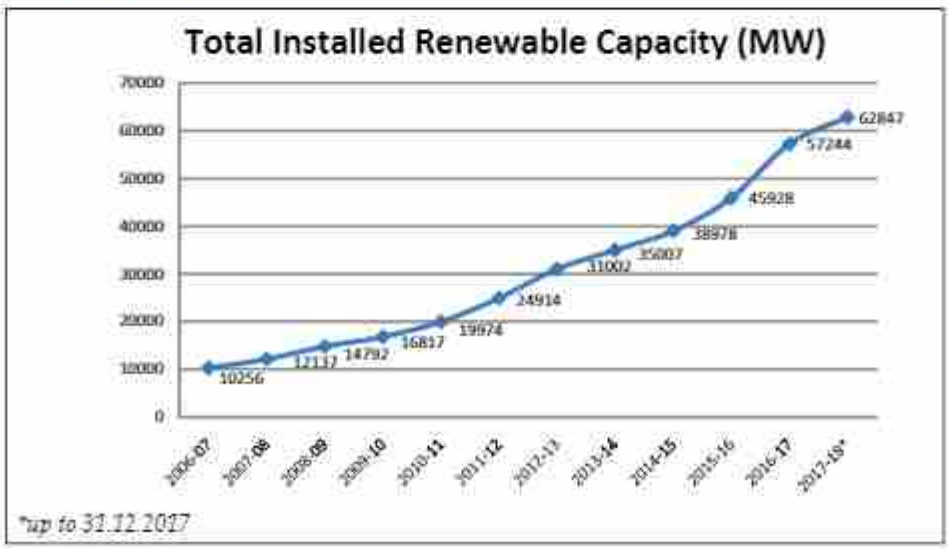
xvi. 32649 Solar Pumps for irrigation and drinking water purposes installed.

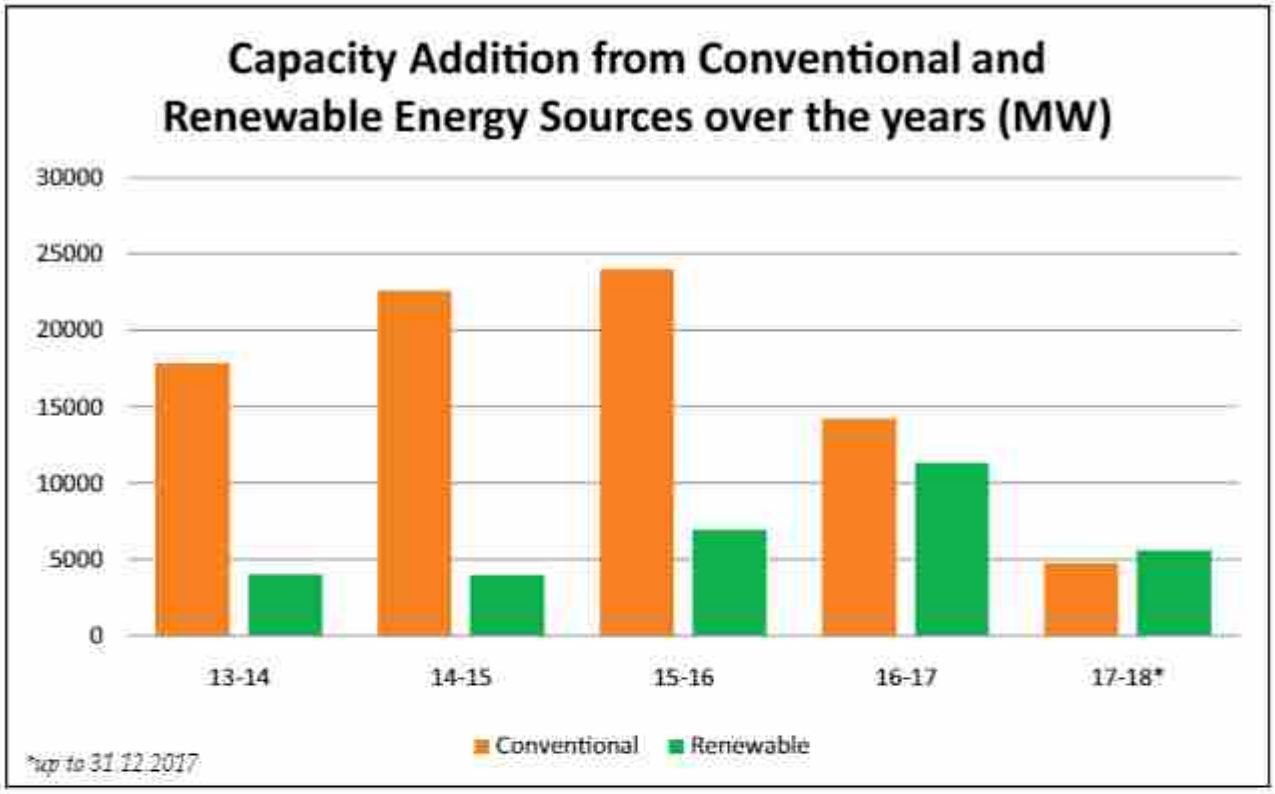
xvii. 23656 MW of solar projects have been tendered and LoI for 19,340 MW issued.

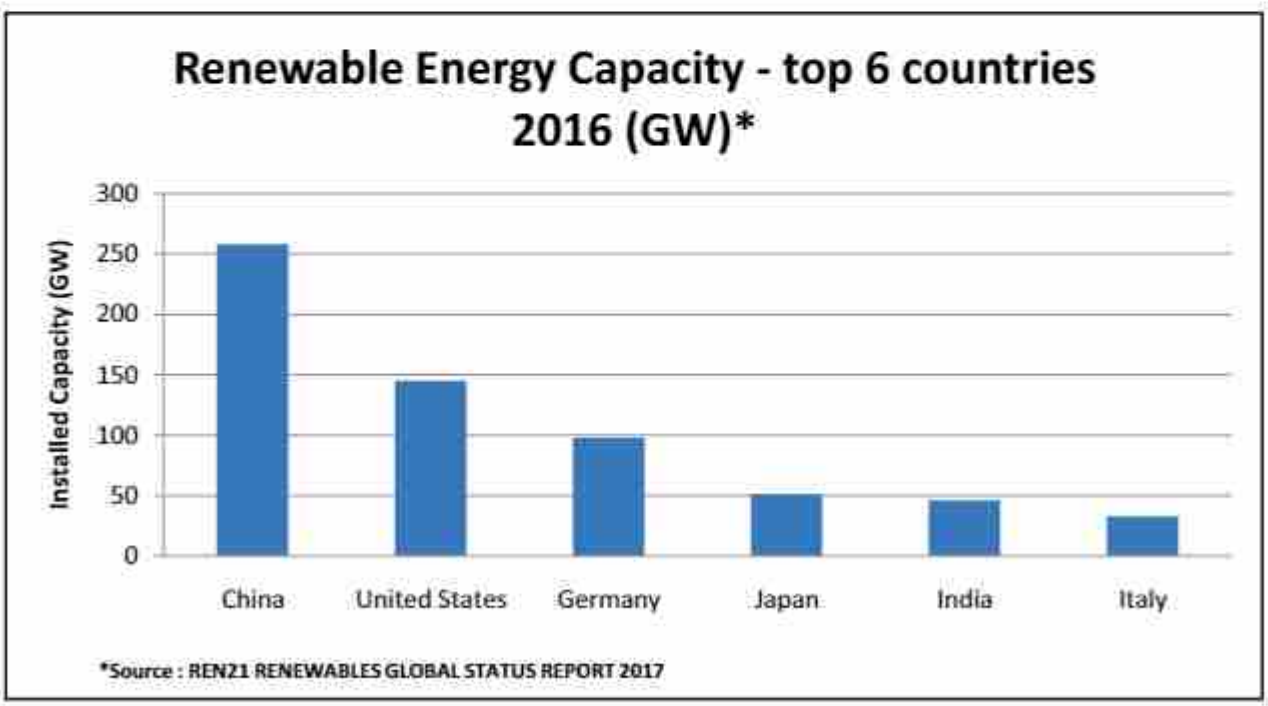
xviii. 20125 biogas plants installed.

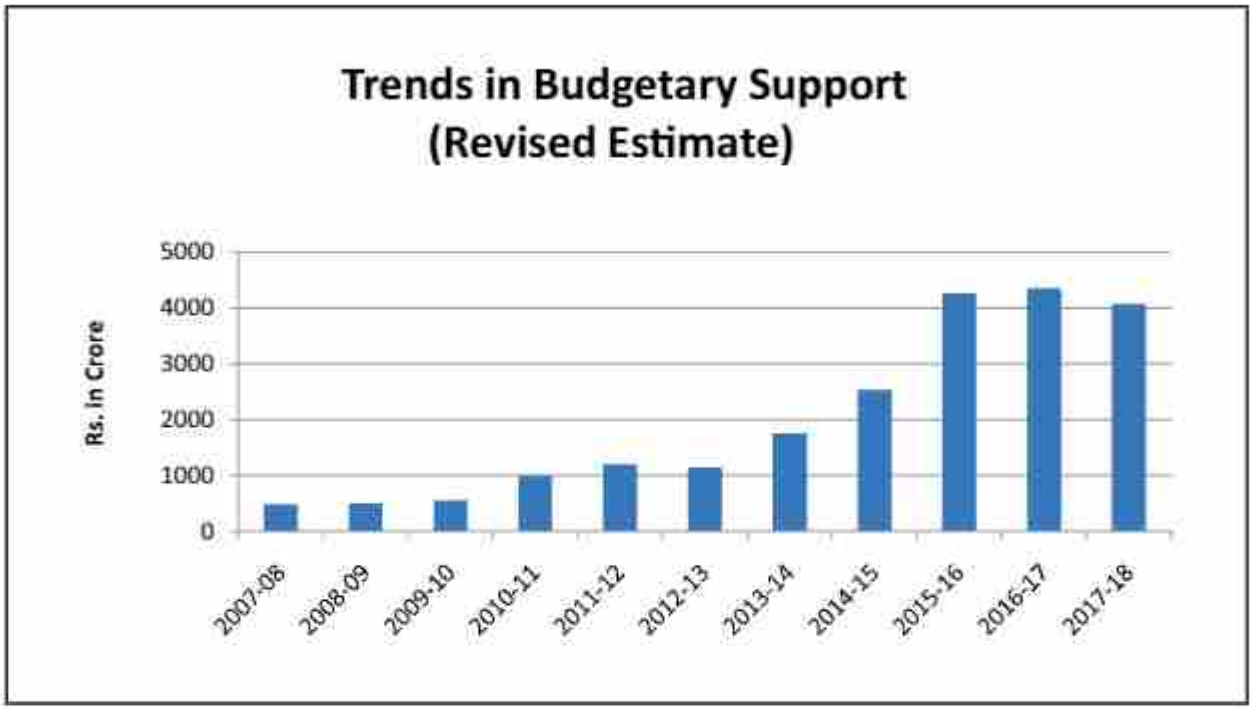
1.9 Research and Development continued to remain major focus area. Major programmes were supported in the area of Solar Photovoltaic, Solar Thermal, hydrogen, fuel cells and wind-solar hybrid systems.In solar, high efficiency crystalline silicon solar cells of 18% efficiency was achieved in lab scale under a project at IIT, Bombay. Support for developing solar cells using other materials, storage and power electronic system was provided to R&D/academic institutions. Support for developing solar thermal system and component was provided for technology development and demonstration for utilizing solar energy for thermal and power generation applications. One such project, 1MWe Solar Thermal Power Plant with 16 hours thermal storage has set up at Mount Abu by World Renewable Spiritual Trust (WRST), Mumbai. Research and Development in hydrogen and fuel cells focused on technology development and demonstration for hydrogen production and storage for stationary and transport applications.

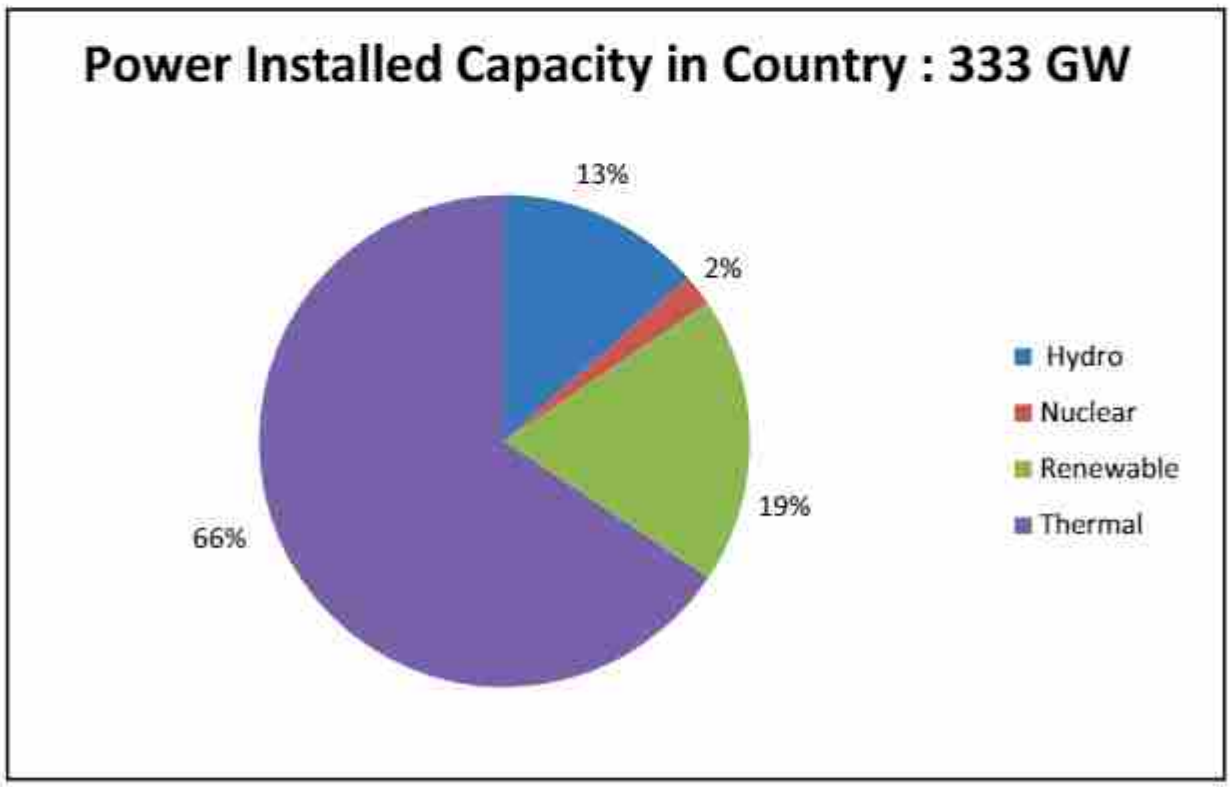
ACHIEVEMENT AT A GLANCE

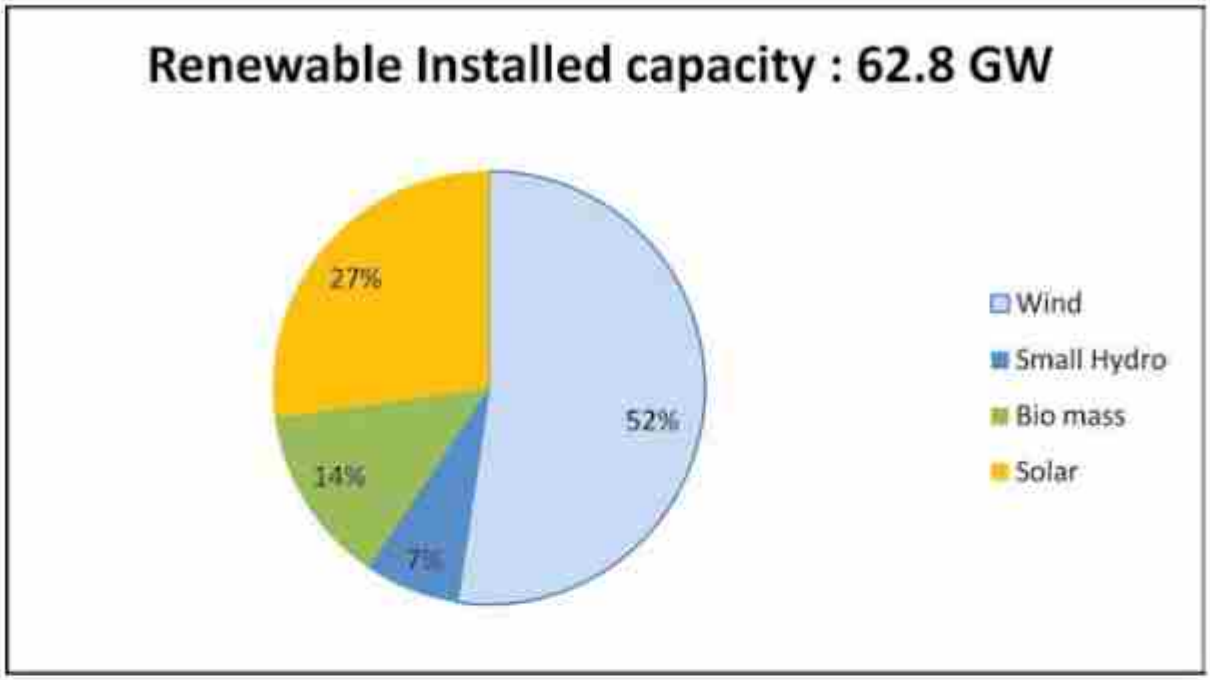


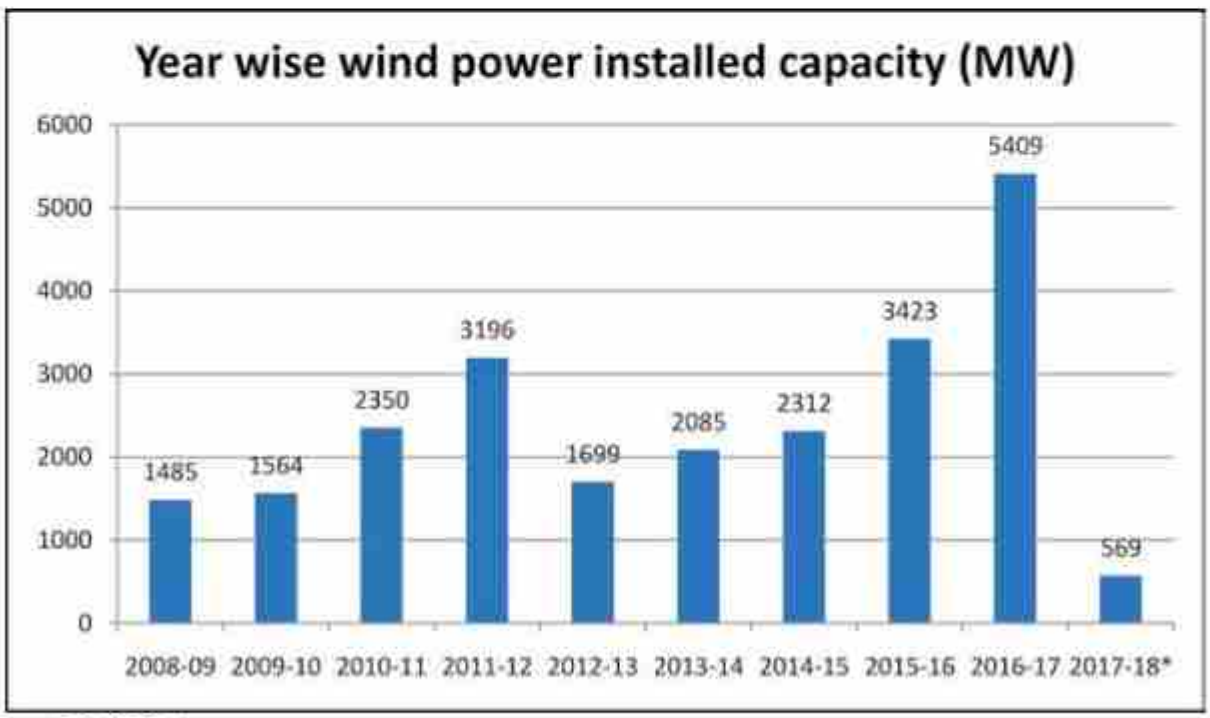

Capacity Addition from Conventional and Renewable Energy Sources over the years (MW)
30000
25000
20000
15000
10000
5000
0
13-14
14-15
15-16
16-17
17-18*
Conventional
Renewable
*up to 31.12.2017


Renewable Energy Capacity - top 6 countries 2016 (GW)*
Installed Capacity (GW)
300
250
200
150
100
50
0
China
United States
Germany
Japan
India
Italy
*Source : REN21 RENEWABLES GLOBAL STATUS REPORT 2017

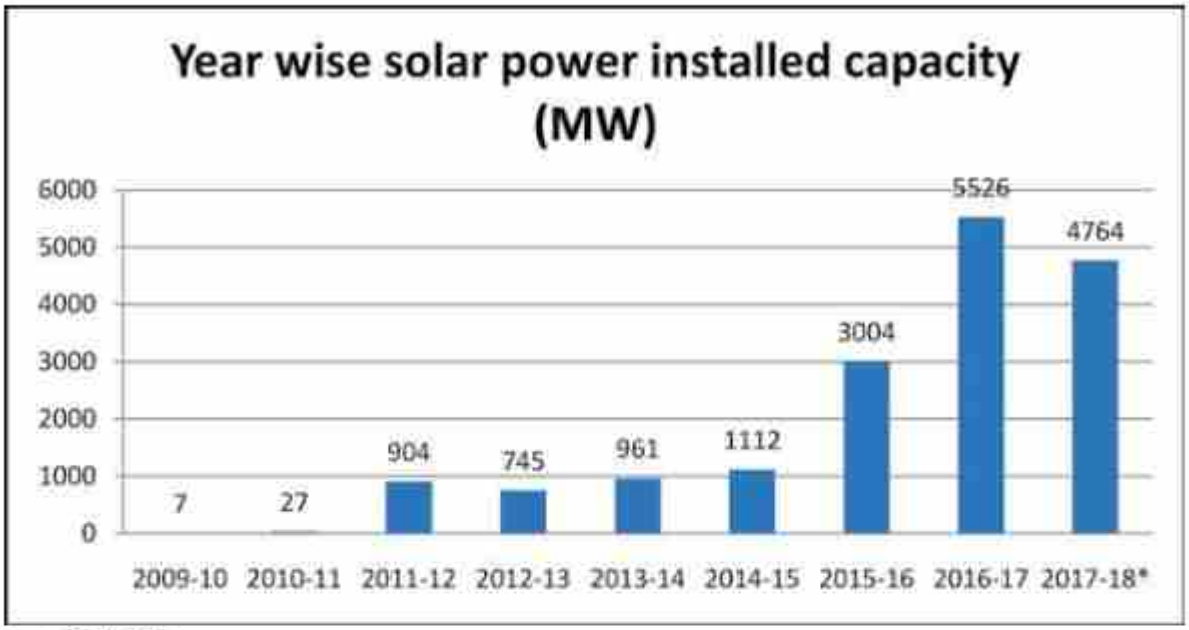

Trends in Budgetary Support
(Revised Estimate)
Rs. in Crore
5000
4000
3000
2000
1000
0
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18


Power Installed Capacity in Country : 333 GW
13%
2%
19%
66%
Hydro
Nuclear
Renewable
Thermal

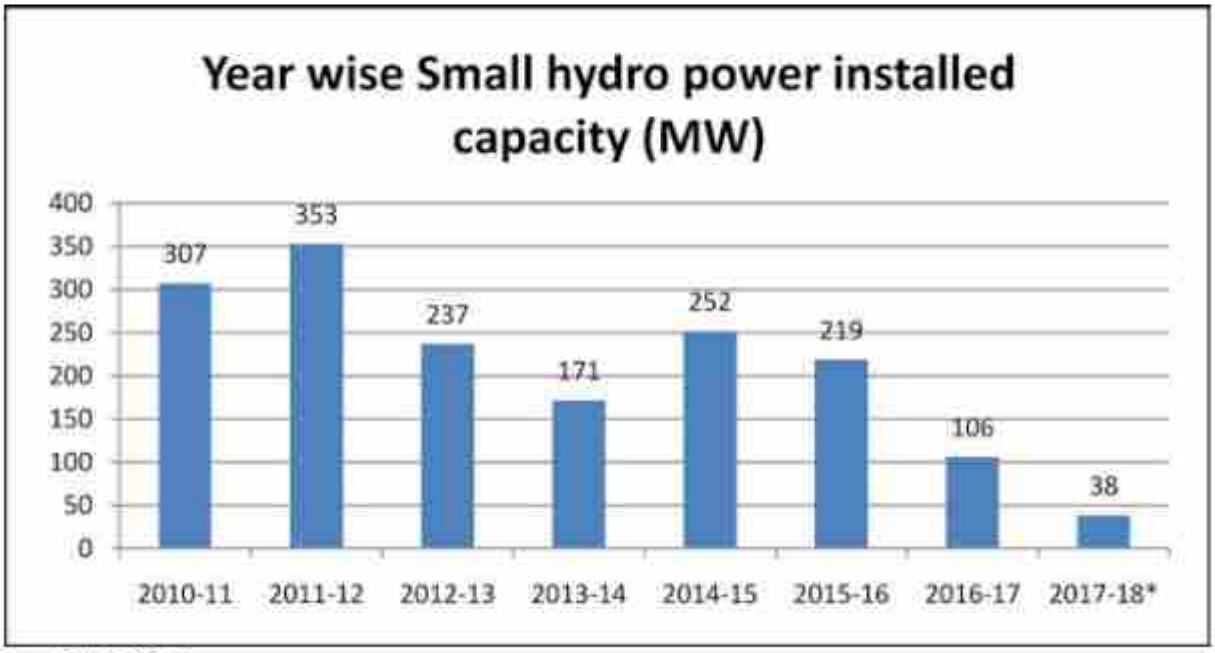




*up to 31.12.2017



*up to 31.12.2017



*up to 31.12.2017

2: INTRODUCTION

Model representation of
'Atal Akshay Urja Bhavan' Ministry's upcoming building

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 MINISTRY OF NEW AND RENEWABLE ENERGY (NAVEEN AUR NAVIKARNIYA OORJA MANTRALAYA)

1. Research and development of bio-gas and programmes related 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.

STRUCTURE OF THE MINISTRY

2.3 Shri Anand Kumar is the Secretary in Ministry of New and Renewable Energy with effect from 23rd June 2017. Various programmes and activities are being implemented by the Ministry through Central Electricity Authority ,State Nodal Agencies (SNAs), Academic Institutions, Research & Development Laboratories, Public Sector Undertakings, and State and Central Government Departments.

INSTITUTIONS UNDER THE MINISTRY

2.4 To support this Ministry, there are five institutions i.e. two Public Sector Undertakings - Indian Renewable Energy Development Agency (IREDA) and Solar Energy Corporation of India (SECI) and three autonomous bodies- National Institute of Solar Energy (NISE), National Institute of Wind Energy (NIWE), and National Institute of Bio Energy (NIBE). NISE is located at GwalPahari in district Gurugram, Haryana and act as an apex national institute in solar energy and co-ordinates research & development and undertakes frontier areas of research. NIWE has been established in Chennai, Tamil Nadu and serve as the technical focal point for wind

power research & development. NIBE is located in district Kapurthala, Punjab and is focusing on research & development in Bio energy. IREDA is a Non-Banking Financial Institution located in New Delhi, under the administrative control of this Ministry, provides term-loans for renewable energy and energy efficiency projects. SECI is a section 3 company under the Companies Act, located in New Delhi, assists the Ministry in implementing and executing National Solar Mission. In addition, Alternate Hydro Energy Centre (AHEC), Indian Institute of Technology, Roorkee provides technical support for small hydro power development

National Institute of Solar Energy (NISE), Gurugram, Haryana

National Institute of Wind Energy (NIWE), Chennai, Tamil Nadu

National Institute of Bio Energy (NIBE), Kapurthala, Punjab

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), other Ministries/ Departments and from the individuals concerned on MNRE's window of CPGRAMS portal of DARPG. A time frame of 60 days has been prescribed for final disposal of petition/grievances. To deliver expedition redressal of grievances, the following measures have been put in place in the MNRE.

i. Grievances/petitions/complaints received are forwarded by Public Grievance Cell, MNRE to the Group 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.

ii. 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. Sh. G.L. Meena, Scientist-'G' has been designated as Liaison Officer for implementation of Scheme of reservation of persons of Scheduled Tribe (ST) category.

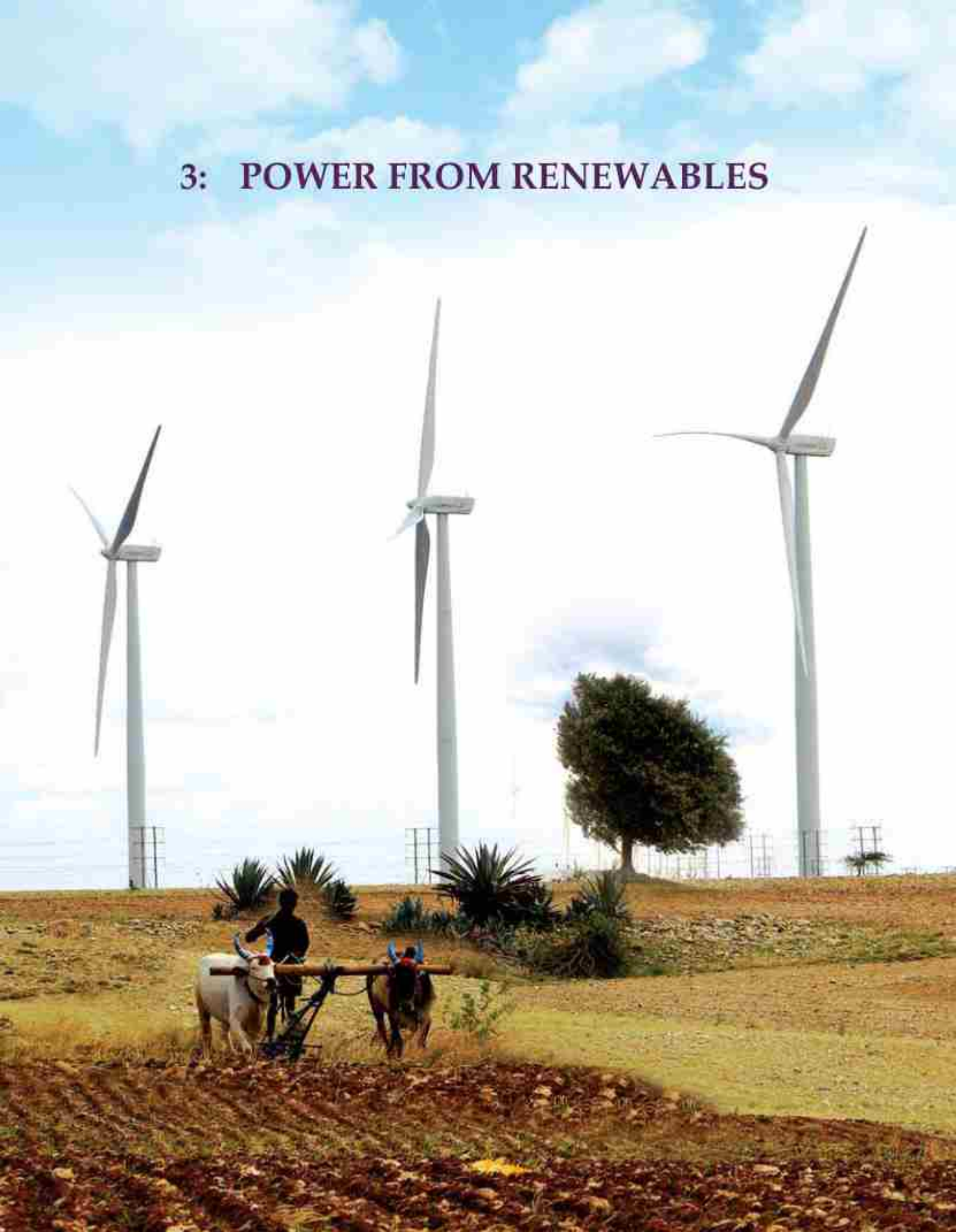
iii. A committee has been constituted to enquire into the complaints of sexual harassment, if any of the women working in this Ministry.

CITIZENS' / CLIENTS' CHARTER OF MNRE

2.6 The Ministry has brought out a Citizens'/Clients' Charter (CCC), incorporating its mission, main Services/Transactions and commitment and the same is available on MNRE's website.

2.7 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.

3: POWER FROM RENEWABLES



POWER FROM RENEWABLES

Grid Interactive and Off-Grid Renewable Power

3.1 India has renewable energy potential such as wind, solar, biomass, small hydro etc. As per NIWE estimates, India has a wind potential of more than 300 GWat a hub height of 100meter, solar potential of ~750 GWassuming 3% wasteland is made available and small hydro potential of ~20 GW. The bio energy potential has been estimated at 25 GW. Further, there exists significant potential from decentralized distributed applications for meeting hot water requirement for residential, commercial and industrial sector through solar energy and also meeting cooking energy needs in the rural areas through biogas. Renewable energy has great capacity to usher in universal energy access. In a decentralized or standalone way renewable energy is quite appropriate, scalable and viable solution for providing power to un-electrified or power deficient villages and hamlets.

3.2 In December 2017, the cumulative renewable power installed capacity was 62.84 GW. Of this 27 GW renewable power installed capacity was added in April 2014 to December 2017.

GRID INTERACTIVE RENEWABLE POWER

WIND ENERGY PROGRAMME

3.3 India is the fourth largest wind power producer in the world, after China, USA and Germany. Ministry's wind power programme covers wind resources assessment, projects through fiscal and promotional policies. A total capacity of 32848.46 MW has been established up to December, 2017.

WIND RESOURCE ASSESSMENT AND POTENTIAL

3.4 The Wind Resource Assessment (WRA) Programme being coordinated by the National Institute of Wind Energy (NIWE), Chennai has so far been covered in 29 states and 3 Union Territories involving establishment of about 836 dedicated wind monitoring stations. Of these, 252 stations have shown potential for commercial wind power installations and 34 stations are in operation as on 31.12.2017.

3.5 Ministry has sanctioned a project entitled "Offshore wind resource assessment at Dhanuskodi, Rameshwaram, Ramanathapuram District in Tamil Nadu" to NIWE, Chennai examining the feasibility for setting up of offshore wind farm project. A 100 m level wind monitoring station, commissioned at Dhanuskodi during 2013-14, is currently collecting data.

3.6 The wind potential at 80m height has been estimated at 102788 MW is given at **Table 3.1**

3.7 In the year 2017-18, NIWE revisited the earlier studies for realistic assessment of wind power potential and has estimated the wind power. potential at 100m height as 302 GW is given in **Figure 3.1**. This potential assessment has been carried out at a spatial resolution of 500m, using

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**

**yet to be validated*

the advanced meso-micro coupled numerical wind flow model, and with the corroboration of almost 1300 actual measurements spread all over India. 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**

3.8 NIWE prepared GIS based wind speed map of India based on meso-micro coupled modelling methodology. NIWE has put on its portal the Wind Speed Map of India at 20 meter above ground level on online Geographic Information System (GIS) platform is given in **Figure 3.2**. This data is expected to facilitate Small Wind Energy and Hydro projects.

Research & Development (Wind Energy)

3.9 Currently there are 19 ongoing R & D projects in wind energy area.

Development of Offshore Wind Energy

3.10 In October 2015, National Wind Energy Policy was notified. Initial studies indicate offshore wind energy potential in the coasts of Gujarat and Tamil Nadu, Geophysical, Geotechnical, Oceanographic & offshore wind resource data collection is expected to be completed by March, 2018. Installation & commissioning of one Light detection and ranging (LiDAR) a remote sensing

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

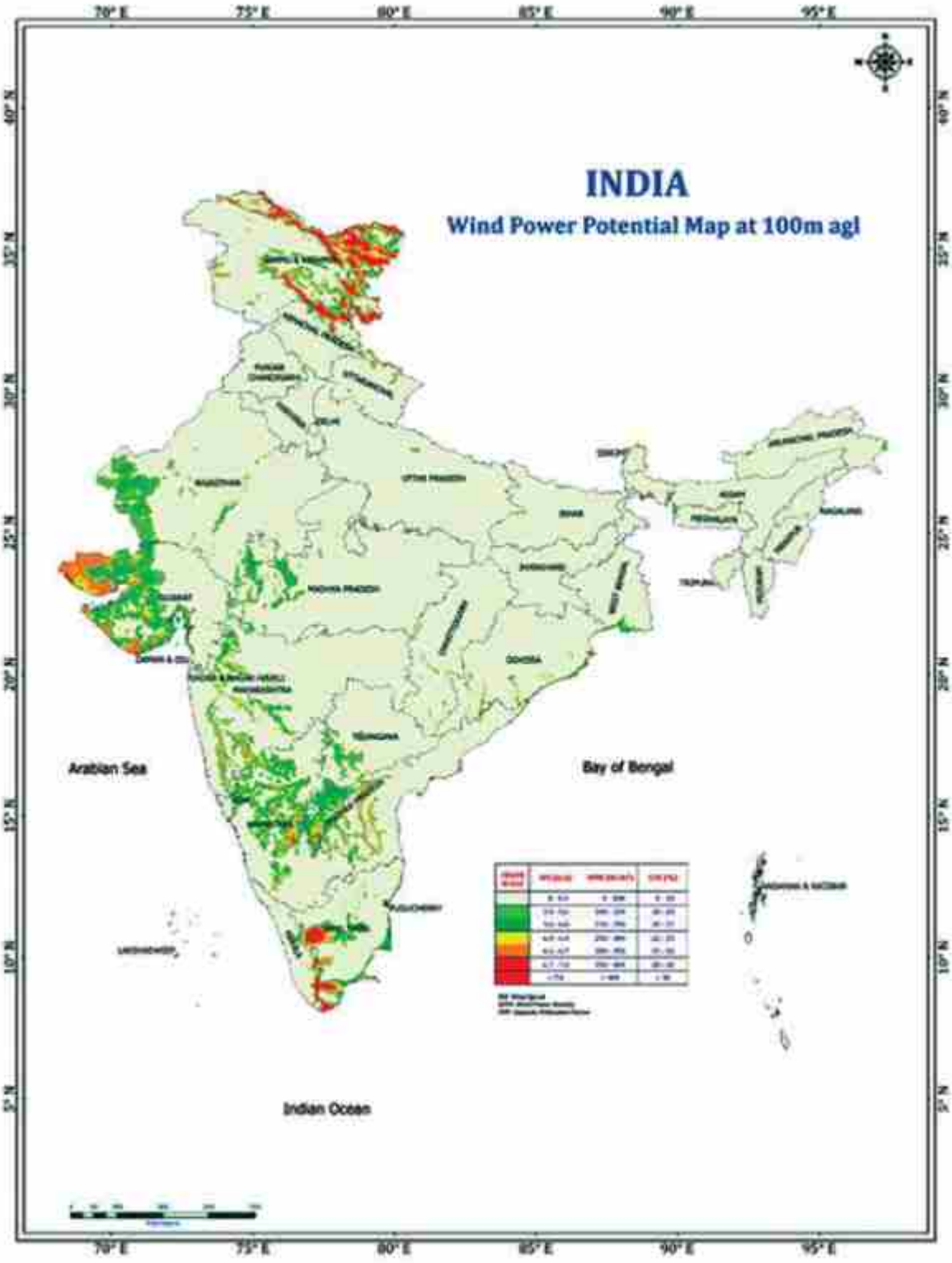
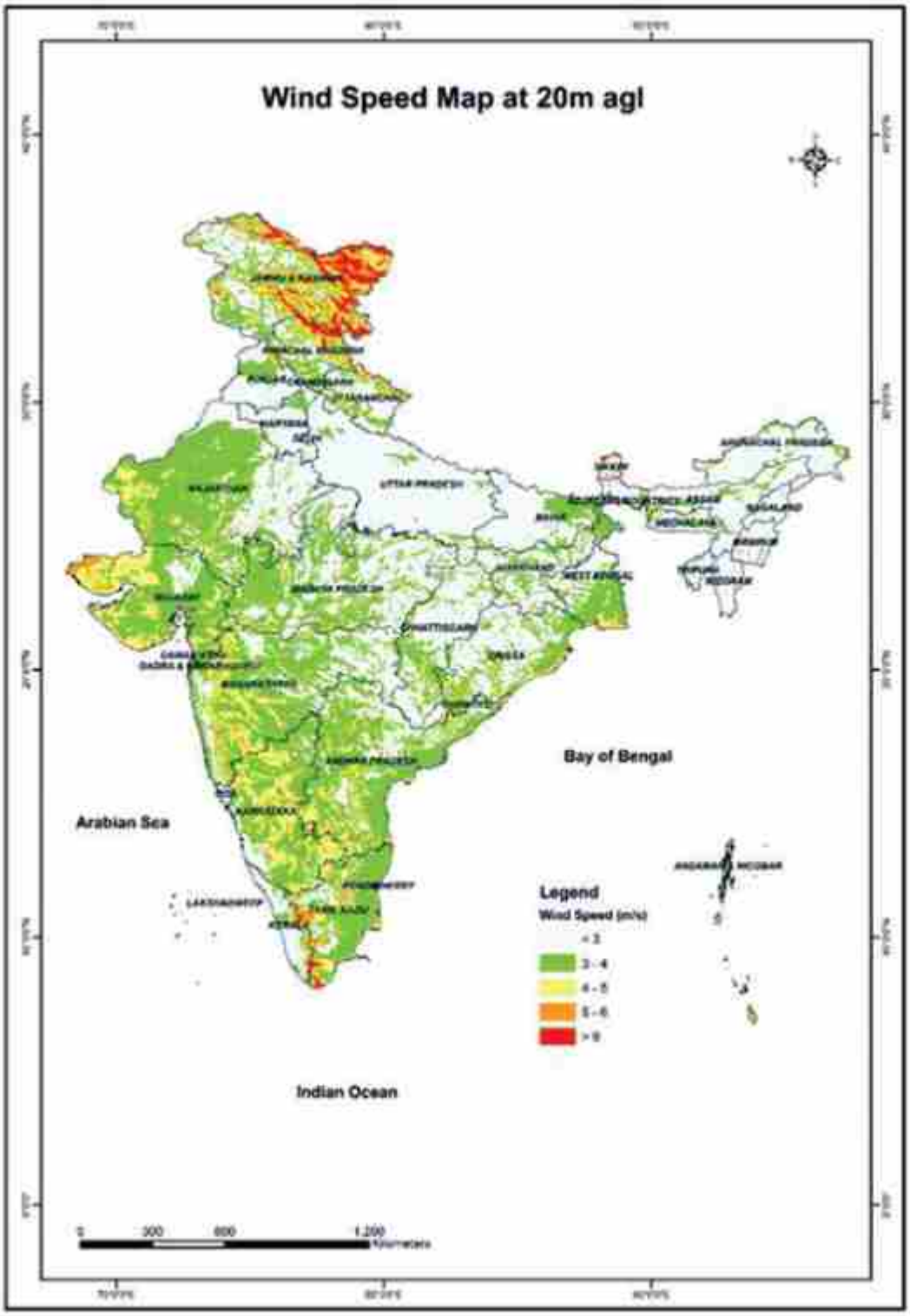
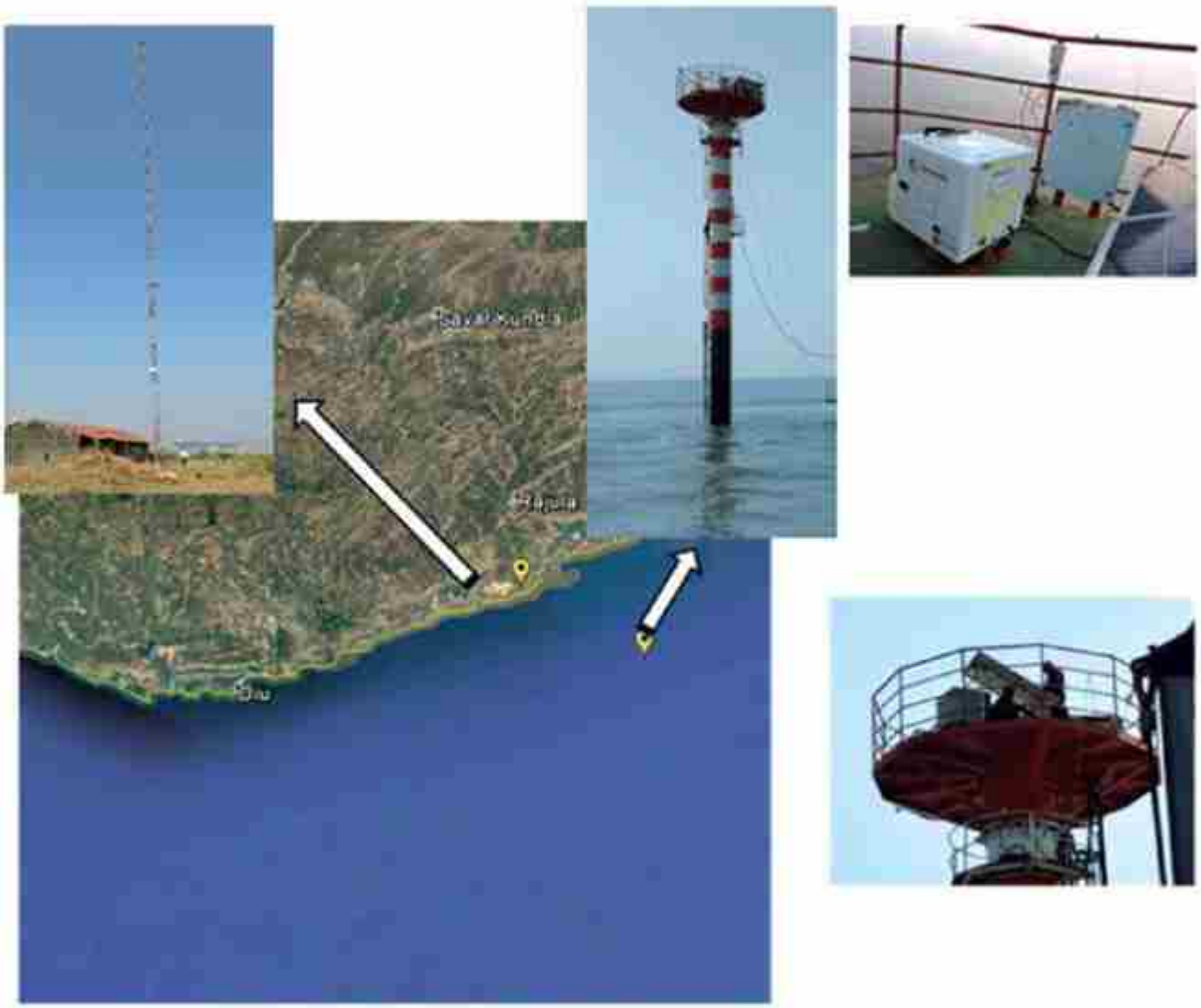


Figure 3.2: Wind Speed Map of India at 20 m above ground level



based wind measurement devise off the coast of Gujarat has been completed in October, 2017 and collection of data is under progress.

3.11 The draft guideline for Offshore Wind Power Assessment Studies and Surveys by Private Players is in advanced stage for finalization. Two committees have been formulated for assessment of grid infrastructure required for offshore wind projects and techno-commercial feasibility of offshore projects in India.



Offshore LiDAR at Gulf of Khambhat

Deployment

3.12 During the year 2017-18, a wind power capacity of 568.71 MW has been added up to December, 2017. The State-wise installed capacity as on 31.12.2017 is given at **Table-3.3.**

Table 3.3 State-wise Wind Power Installed Capacity (MW) (upto 31.12.2017)

S. No.	State	Wind Power Installed Capacity (MW)
1.	Andhra Pradesh	3834.75
2.	Gujarat	5537.37
3.	Karnataka	3793.1
4.	Kerala	51.5
5.	Madhya Pradesh	2497.79
6.	Maharashtra	4777.63
7.	Rajasthan	4281.72
8.	Tamil Nadu	7969.5
9.	Telangana	100.8
10.	Others	4.3
	Total	**32848.46**

Technology Development and Manufacturing Base

3.13 There are 21 manufactures in Wind Energy and models upto a capacity of 3 MW single turbine, are being manufactured. 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 is among lowest in the world.

Promotional Policies

3.14 A package of fiscal incentives 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 provided for promotion of wind power. Those not availing accelerated depreciations are eligible for Generation Based Incentives (GBI). Till December 2017 around 13,600 MW capacity projects have been registered under GBI. An amount of Rs.3020.47 crore has already been disbursed under the Scheme.

Policy initiatives

a. Draft Wind-Solar Hybrid Policy

3.15 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. Accordingly, Ministry

120MW wind farm at Anantpur in Andhra Pradesh

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

b. Wind Bidding Scheme

3.16 A scheme for Setting-up of 1000 MW Inter-State Transmission System (ISTS) connected Wind Power Projects was sanctioned by MNRE on 14 June 2016. The first wind bid (1000 MW) was concluded at a wind tariff of Rs. 3.46 per kWh of wind energy on 23 February 2017. The SECI issued Letter of Award (LoA) to five selected bidders on 5 April 2017 and the projects under the Scheme are likely to be commissioned by October 2018.

3.17 The wind tariff in India touched lowest level of Rs. 2.64 per kWh and Rs. 2.44 per kWh in the second (1000 MW) and third (2000 MW) wind auction respectively conducted by the Solar Energy Corporation of India (SECI) on behalf of Ministry of New & Renewable Energy, Government of India on 4 October, 2017. These wind projects are to be commissioned within 18 months from the date of issue of Letter of Award by SECI to successful bidders.

3.18 Ministry issued another scheme on 22 November 2017 for setting up of 2000 MW wind power projects connected to Inter-State Transmission System (ISTS).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. 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.

3.19 In addition, three States namely Tamil Nadu, Gujarat and Maharashtra have also issued bids of 500 MW each for installation of wind power projects in these States. Gujarat UrjaVikas Nigam Ltd (GUVNL), invited bids for wind power for 500 MW in the month of June 2017 and the competitive auction for wind power for 500 MW was conducted during December 2017 in which the discovered tariff was Rs. 2.43 per unit.

c. Guidelines issued for procurement of wind power through tariff based competitive bidding process

3.20 Government has issued Guidelines under Section 63 of the Electricity Act, 2003 providing a framework for procurement of wind power through a transparent process of bidding including standardisation of the process and defining of roles and responsibilities of various stakeholders. These Guidelines would enable the Distribution Licensees to procure wind power at competitive rates in a cost effective manner. These Guidelines are applicable for procurement of wind power from grid-connected Wind Power Projects ('WPP') having:- (a) Individual size of 5 MW and above at one site with minimum bid capacity of 25 MW for intra-state projects; and (b) Individual size of 50 MW and above at one site with minimum bid capacity of 50 MW for inter-state projects. Key components of the Guidelines include that for compensation for grid unavailability and backing-down, robust payment security mechanism, standardisation of bidding process, risk-sharing framework between various stakeholders through provisions like change in law, force majeure, measures in case of default of procurer as also by generator, etc.

145 MW wind farm in Jath- Maharashtra

BIOMASS POWER AND BAGASSE CO-GENERATION PROGRAMME

3.21 Ministry has been promoting "Biomass Power and Bagasse Co-generation Programme" with the aim to recover energy from biomass including bagasse, agricultural 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 GW. 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 around 7 GW. Thus the total estimated potential for biomass power is about 25 GW.Over 500 biomass power and cogeneration projects with aggregate capacity of 8414 MW have been installed in the country up to December 2017.

8 MW Biomass based Power Plant (Manas Agro Unit-2 / previously known as "Yash Agro") situated at Village – Kolari, Dist- Chandrapur, Maharashtra.

Achievements

3.22 During the year 2017-18, a 253 MW biomass power plants have been set-up. A cumulative capacity of 8414 MW has been commissioned so far. State wise details are given in **Table - 3.4**

Table 3.4 Installed Capacity of Grid Connected Biomass/ Bagasse Power Plants

State	Total Capacity as on 31.12.2017 (in MW)
Andhra Pradesh	378.2
Bihar	113.0
Chhattisgarh	228.0
Gujarat	65.3
Haryana	121.4
Karnataka	1604.6
Madhya Pradesh	93.0
Maharashtra	2065.0
Telangana	158.1
Punjab	194.0
Rajasthan	119.3
Tamil Nadu	893.0
Uttarakhand	73.0
Uttar Pradesh	1957.5
West Bengal	300.0
Odisha	50.4
Total	**8414**

SMALL HYDRO PROGRAMME

3.23 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 is in the process of announcing a new scheme for implementation of Small Hydro Projects for year 2017-18 along with various other sub-schemes.

3.24 As per the prevailing SHP Scheme (2014), the Ministry has been providing 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 / States Govt. dept. & agencies/ local bodies.

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

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 100 kW 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.

3.25 In cumulative terms, 1089 small hydro power projects aggregating to 4418.155 MW have been set up in various parts of the country. In addition, 136 projects of about 754.16 MW are in various stages of implementation. **Table 3.5**- provides state-wise details of projects completed and under execution.

3.26 During the year i.e. 2017-18, against a target of 100 MW, an aggregate capacity of 38.3 MW Small Hydro plants have been set up.

3.27 Private developers are also identifying Potential sites by their own 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 above 21GW of Small Hydro from over 7133 sites.

3.28 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 / 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.

Table 3.5 State Wise Numbers and Aggregate Capacity of SHP Projects (Upto 25 MW) Potential, installed & under implementation (as on 31.12.2017)							
Sl. No.	State	Potential		Projects Installed		Projects under Implementation	
		Nos.	Total Capacity (MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)
1	Andhra Pradesh	359	409.32	44	162.11	0	0
2	Arunachal Pradesh	800	2064.92	152	104.605	16	41.05
3	Assam	106	201.99	6	34.11	1	2
4	Bihar	139	526.98	29	70.7	0	0
5	Chattisgarh	199	1098.2	10	76	0	0
6	Goa	7	4.7	1	0.05	0	0
7	Gujarat	292	201.97	6	16.6	13	92.31
8	Haryana	33	107.4	9	73.5	1	0.1
9	Himachal Pradesh	1049	3460.34	184	842.11	28	272.3
10	J&K	302	1707.45	42	161.03	20	53.2
11	Jharkhand	121	227.96	6	4.05	0	0
12	Karnataka	618	3726.49	167	1230.73	3	29
13	Kerala	238	647.15	33	219.02	9	76
14	Madhya Pradesh	299	820.44	11	86.16	1	9.75
15	Maharashtra	270	786.46	66	349.175	13	40.2
16	Manipur	110	99.95	8	5.45	0	0
17	Meghalaya	97	230.05	4	31.03	2	24
18	Mizoram	72	168.9	18	36.47	4	8.7
19	Nagaland	98	182.18	12	30.67	2	1.15
20	Odisha	220	286.22	10	64.625	5	60.5
21	Punjab	375	578.28	54	170.9	9	7.55
22	Rajasthan	64	51.67	10	23.85	0	0
23	Sikkim	88	266.64	17	52.11	0	0
24	Tamil Nadu	191	604.46	21	123.05	0	0
25	Telengana	94	102.25	30	90.87	0	0
26	Tripura	13	46.86	3	16.01	0	0
27	A&N Islands	7	7.27	1	5.25	0	0
28	Uttar Pradesh	251	460.75	9	25.1	2	25.5
29	Uttarakhand	442	1664.31	102	214.32	7	10.85
30	West Bengal	179	392.06	24	98.5	0	0
Total		**7134**	**21133.62**	**1089**	**4418.155**	**136**	**754.16**

3.29 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. Ministry accorded sanction of Rs. 27.444 crore and released Rs. 3.585 crore for SHP.

3.30 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 initially envisages setting up of 30 small/mini hydel projects with an aggregate capacity of 23.68 MW at a total cost of Rs. 267.00 crore. A committee to assess the status has visited all SHP projects during Sept, 2017. Review of project (SHP) specific duration is under consideration. Success Story is given in the **Box 3.1.**

3 MW canal based SHP project in Gujarat

Box 3.1 Success Story

Commissioning of 1.5 MW Biaras Small Hydro Power Plant in Drass, Kargil (J&K)

As a part of Prime Minister's announced Ladakh Renewable Energy Initiative Project, which is fully funded by Ministry of New & Renewable Energy, Bairass Small Hydro Power (SHP) Project of 1.5 MW capacity has been commissioned on 4th November 2017.

The plant will power the Drass town in Kargil, which is one of the coldest places in India. Power from Bairass SHP would be sufficient to meet normal power requirement of about 1000 families, which would make them comfortable in the extreme winter season. Total cost of the project is Rs.17crore and this is the first project to be commissioned under the Prime Minister announced Ladakh Renewable Energy Initiative (LREI). The project has been developed by Kargil Renewable Energy Development Agency (KREDA) under Ladakh Autonomous Hill Development Council.

Bairass SHP, Drass has performed throughout the winter (-15° C to -39° C) at half rating level (0.750 MW) and provided 24 hour power supply for the first time in Kargil region during winter. This power plant has rested 3 DG power generators of 250 kW each (total 750 kW), saving 44300 litre diesel (approx. Rs 31.00 lakh) so far. At the same rate, this SHP is expected to save 177200 litre diesel per year (Rs. 124.00 lakh/year). Most importantly, the town and Army have got 24 hour power supply instead of 4 hour power supply. This SHP has helped improve local lifestyle. People used heaters for space heating instead of smoky biomass burning (bukhari). This all could happen due to the vision and financial support of MNRE under LREI program.

3.31 Water mill programme of the Ministry involves 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. Ministry has sanctioned funds for setting up of 300 nos. of Water mills out of which 194 nos. have been completed.

Development of laboratory for sediment monitoring and impact analysis studies in Hydro power plant:

3.32 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 ofstudy/ research will be a step ahead in field of erosion problems in hydropower plants especially in Himalayan region. Laboratory is being set up.

2x1.5 MW SHP project at North feeder canal of Somasila Reservoir in Andhra Pradesh

Water Mill Project of MNRE, GOI

3.33 Ministry has sanctioned funds for setting up of 300 nos. of Water mills out of which 194 nos. have been completed.

OFF GRID RENEWABLE POWER

BIOMASS GASIFIER PROGRAMME

3.34 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 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, to provide unmet demand of electricity for villages for lighting, water pumping and micro-enterprises.

3.35 Off-grid power capacity from biomass gasifier in three rice mills and other industries including flour mill for meeting captive demand of electricity and thermal applications have been installed in the state of Uttar Pradesh. The total installed capacity of 1015 kW equivalents during 2017-18 have been installed in industries.

Small Wind Energy and Hybrid Systems (SWES)

3.36 During the year 2017-18 (upto December 2017) 20 water heaters, pumping wind mills and 144KW Aero-generator/hydro system were installed. The state-wise installations of Water Pumping Mills and Aero-generators / Wind Solar Hybrid Systems are given in **Table-3.6.**

Table-3.6 Installation of cumulative Water Pumping Mills and Aero-generators/ Wind-Solar Hybrid Systems (up to 31.12.2017)

S.No	State/ UT	Water Pumping Mills (Nos.)	Aero-generators & Hybrid Systems (kW)
1	Andaman & Nicobar	2	0
2	Andhra Pradesh	6	271
2	Arunachal Pradesh	0	7
3	Assam	3	6
4	Bihar	46	0
5	Goa	0	194
6	Gujarat	1046	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	1775
13	Manipur	0	140
14	Meghalaya	0	201
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	**1516**	**3287**

Biogas Power (Off-grid) Programme (BPP)

3.37 Ministry is promoting biogas power for decentralized power generation applications in the capacity range, 3kW to 250kW under the Biogas based Power Generation (Off-grid) Programme based on the sufficient quantity of bio-degradable waste comprising of a variety of feed stock such as cattle dung wastes, kitchen/food wastes, sago, tapioca, starch and agro-processing wastes etc. at the project sites. The scheme aims for generation of biogas and use of biogas for generation of power for off-grid/decentralized applications and also for thermal usage.

Achievements

3.38 During the 2017-18, a total of 15 nos. of new projects with a total cumulative power generation capacity of 178 kW corresponding to biogas generation capacity of 1595 m^3 with an estimated CFA of Rs.78.32 lakh have been given as administrative approval for setting up projects, by various implementing agencies in the country. A total 19 nos. of biogas projects with cumulative power generation capacity of 773 kW with corresponding to biogas generation capacity of 7205 m3/day have been completed during the year up to 31.12.2017. A total of 409 biogas based power generation(Off-grid) projects with power generation capacity of about 7.04 MW have been set up in the country under this programme up to 31.12.2017.

85 m^3 Biogas Power Generation (Off-grid) Plant at Vill.-Yellemla, Teh. Jangaon, Distt.- Warangal (Telangana).

150 m^3 Biogas Power Generation (Off-grid) Plant at Ramchandrapur Math, Yeswantpur, Taluk-Malur, Dist-Kolar, Karnataka and Biogas slurry being used for making vermi-compost

4: NATIONAL SOLAR MISSION

NATIONAL SOLAR MISSION

Introduction

4.1 National Solar Mission (NSM), launched on 11th January, 2010, had set a target for development and deployment of 20 GW solar power by the year 2022. The Cabinet in its meeting held on 17/6/2015 had approved revision of target under NSM from 20 GW to 100 GW.

Focus area under Phase-II of NSM

A) Grid connected Projects

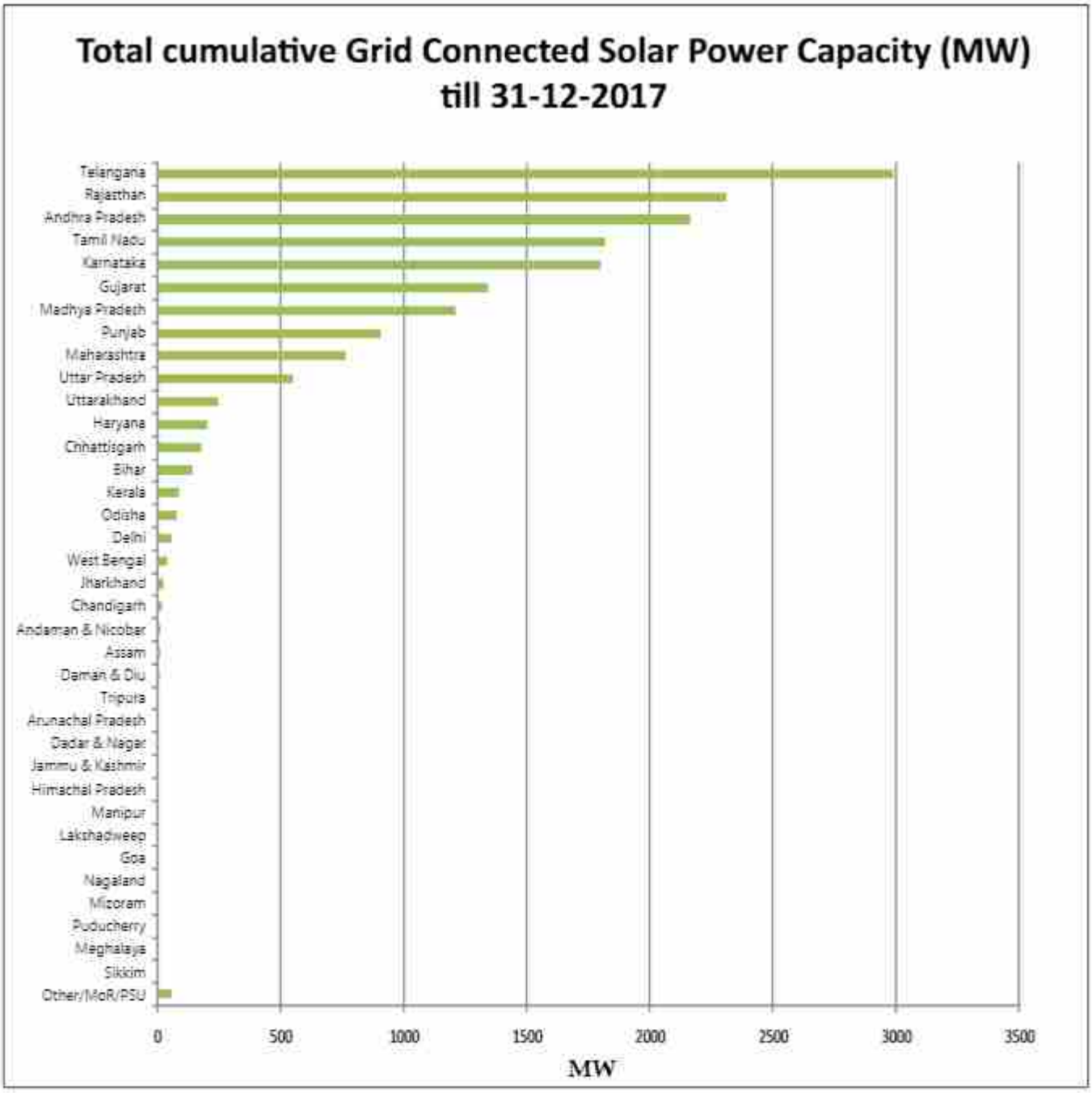
4.2 As on 31st December 2017, the total solar power capacity installed is 17052.37 MW. Based upon availability of land and solar radiation, the potential of solar power in the country has been assessed to be around 750 GWp. State-wise details of estimated solar energy potential in the country and the cumulative installed capacity are given in **Table –4.1** and **Table – 4.2** respectively:

50 MW commissioned under 200 MW capacity solar park at Kasargod, Kerala

Table – 4.1 State-wise estimated Solar Energy Potential in the Country		
Sr. No.	**State/UT**	**Solar Potential (GWp)#**
1.	Andhra Pradesh	38.44
2.	Arunachal Pradesh	8.65
3.	Assam	13.76
4.	Bihar	11.20
5.	Chhattisgarh	18.27
6.	Delhi	2.05
7.	Goa	0.88
8.	Gujarat	35.77
9.	Haryana	4.56
10.	Himachal Pradesh	33.84
11.	Jammu & Kashmir	111.05
12.	Jharkhand	18. 18
13.	Karnataka	24.70
14.	Kerala	6.11
15.	Madhya Pradesh	61.66
16.	Maharashtra	64.32
17.	Manipur	10.63
18.	Meghalaya	5.86
19.	Mizoram	9.09
20.	Nagaland	7.29
21.	Odisha	25.78
22.	Punjab	2.81
23.	Rajasthan	142.31
24.	Sikkim	4.94
25.	Tamil Nadu	17.67
26.	Telangana	20.41
27.	Tripura	2.08
28.	Uttar Pradesh	22.83
29.	Uttarakhand	16.80
30.	West Bengal	6.26
31.	UTs	0.79
Total		**748.98**

Assessed by National Institute of Solar Energy

Table-4.2 Commissioning Status of Grid Connected Solar Projects				
Sr. No.	State/UT	Total cumulative capacity (MW) as on 31-03-2017	Capacity commissioned in 2017-18 (MW)	Total cumulative capacity (MW) as on 31-12-2017
1	Andaman & Nicobar	6.56	6.05	12.61
2	Andhra Pradesh	1867.23	297.99	2165.21
3	Arunachal Pradesh	0.27	4.12	4.39
4	Assam	11.78	0.00	11.78
5	Bihar	108.52	33.00	141.52
6	Chandigarh	17.32	1.57	18.89
7	Chhattisgarh	128.86	50.52	179.38
8	Dadar & Nagar	2.97	0.00	2.97
9	Daman & Diu	10.46	0.00	10.46
10	Delhi	40.27	17.75	58.02
11	Goa	0.71	0.00	0.71
12	Gujarat	1249.37	95.32	1344.69
13	Haryana	81.40	122.45	203.85
14	Himachal Pradesh	0.73	0.75	1.48
15	Jammu & Kashmir	1.36	1.00	2.36
16	Jharkhand	23.27	0.00	23.27
17	Karnataka	1027.84	773.01	1800.85
18	Kerala	74.20	14.00	88.20
19	Lakshadweep	0.75	0.00	0.75
20	Madhya Pradesh	857.04	353.07	1210.11
21	Maharashtra	452.37	310.71	763.08
22	Manipur	0.03	1.30	1.33
23	Meghlya	0.01	0.05	0.06
24	Mizoram	0.10	0.10	0.20
25	Nagaland	0.50	0.00	0.50
26	Odisha	79.42	0.09	79.51
27	Puducherry	0.08	0.03	0.11
28	Punjab	793.95	111.69	905.64
29	Rajasthan	1812.93	497.53	2310.46
30	Sikkim	0.00	0.01	0.01
31	Tamil Nadu	1691.83	127.59	1819.42
32	Telangana	1286.98	1703.09	2990.07
33	Tripura	5.09	0.00	5.09
34	Uttar Pradesh	336.73	213.65	550.38
35	Uttarakhand	233.49	13.40	246.89
36	West Bengal	26.14	13.70	39.84
37	Other/MoR/PSU	58.31	0.00	58.31
TOTAL		**12288.83**	**4763.54**	**17052.37**



4.3 The Government has finalized tendering trajectory in order to achieve the Mission target of 100 GW by 2022 with the details as under:-

Year	Tendering target (MW)
2017-18	20,000
2018-19	30,000
2019-20	30,000

Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects:-

4.4 The scheme for development of Solar Parks and Ultra Mega Solar Power Projects was rolled out by Ministry of New & Renewable Energy in December, 2014. The Scheme 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.

4.5 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 facilitates and speeds 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.

Salient Features

i. It was planned 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.(revised in 2017 with the approval of Cabinet to setup at least 50 solar parks with aggregate capacity of 40,000 MW)

ii. The capacity of the Solar Parks is normally 500 MW and above. However, smaller parks 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 are 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 is sanctioned a grant of upto Rs.25 Lakh/Park for preparing Detailed Project Report (DPR) of the Solar Park.

v. Thereafter, application is sent 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 is released by SECI as per milestones prescribed in the scheme.

vi. In-principle approval has been accorded to 35 Solar Parks of aggregate capacity of 20,514 MW planned to be set up in 21 States/UTs. Details given in the attached **Table 4.3**.

Table-4.3 Details of Solar Parks Sanctioned

Sl. No.	State	Name of the Solar Park	Capacity (MW)	Name of the Solar Power Parks Developer (SPPD)	Land identified at
1.	Andhra Pradesh	Ananthapuramu-I solar park	1500	AP Solar Power Corporation Pvt. Ltd., JVC of SECI, APGENCO and NREDCAP	NP Kunta of antpuramu & Galiveedu of Kadapa Districts
2.	Andhra Pradesh	Kurnool solar park	1000		Gani and Sakunala Village of Kurnool District

3.	Andhra Pradesh	Kadapa solar park	1000	AP Solar Power Corporation Pvt. Ltd., JVC of SECI, APGENCO and NREDCAP	Vaddirala, Thalamanchi, Pannampalli, Ramachandrayapalli, KonnaAnanthapuram and Dhidium villages in MylavaramMadal, Kadapa district
4.	Andhra Pradesh	Ananthapuramu-II solar park	500		Talaricheruvu&Aluru Villages, TadipathriMandal, Anathapuramu District of Andhra Pradesh
5.	Arunachal Pradesh	Lohit solar park	30	Arunachal Pradesh Energy Development Agency (APEDA)	Tezu township in Lohit district
6.	Assam	Solar park in Assam	80	APGCL	Amguri in Sibsagar district
7.	Chhattisgarh	Rajnandgaon solar park	250	Chhattisgarh Renewable Energy Development Agency	Dhaba, Rengakathera, Amlidih, Dundera and Kohka villages of (100 MW) and Tolagaon, Odarband, Gatatola, Girgaon, Gugwa, Salhe villages of Dongargadh Tehsil, RajnandgaonDist
8.	Gujarat	Radhnesada solar park	700	Gujarat Power Corporation Limited	Radhnesada, Vav, Distt. Banaskantha
9.	Gujarat	Harsad solar park	500	Gujarat Power Corporation Limited	Villages-Harsad and Navapara, Taluka-Suigam, District-Banaskatha
10.	Haryana	Solar park in Haryana	500	Saur Urja Nigam Haryana Ltd (SUN Haryana)	Bugan in Hisar district, Baralu and Singhani in Bhiwani district and Daukhera in Mahindergarh district
11.	Himachal Pradesh	Solar park in Himachal Pradesh	1000	HP State Electricity Board Ltd.	Spiti Valley of Lahaul&Spiti District
12.	Jammu & Kashmir	Solar park in J&K	100	Jammu and Kashmir Energy Development Agency	Mohagarh and BadlaBrahmana, District-Samba

13.	Karnataka	Pavagada solar park	2000	Karnataka Solar Power Development Corporation Pvt. Ltd.	Villages- Valluru, Ravacharlu, Balasamudra, Kyathaganacharlu, Thirumani of PavagadaTaluk, Tumkur dist.
14.	Kerala	Kasargod solar park	200	Renewable Power Corporation of Kerala Limited	Paivalike, Meenja, Kinanoor, Kraindalam and Ambalathara villages of Kasargode district
15.	Madhya Pradesh	Rewa solar park	750	Rewa Ultra Mega Solar Limited	Gurh tehsil, District Rewa, MP
16.	Madhya Pradesh	Neemuch-Mandsaur solar park	700	Rewa Ultra Mega Solar Limited	Neemuch site: Under identification; and Mandsaur site: Runija and Gujjarkhedi villages in Suwasra Tehsil, Mandsaur district
17.	Madhya Pradesh	Agar-Shajapur-Rajgarh solar park	1050	Rewa Ultra Mega Solar Limited	Agar, Shajapur and Rajgarh district
18.	Madhya Pradesh	Morena (Chambal) solar park	250	Rewa Ultra Mega Solar Limited	Morena, (Chambal)
19.	Maharashtra	Sai Guru solar park	500	M/s Sai Guru Mega Solar Park Pvt. Ltd. (formerly M/s Pragat Akshay Urja Ltd.)	Bhamer Village, Taluka-Sakri, Dhule District
20.	Maharashtra	Dondaicha solar park	500	Maharashtra State Electricity Generating Company Ltd. (MAHAGENCO)	Villages-Vikhran&Methi, Taluka-Dondaicha, district Dhule, Maharashtra
21.	Maharashtra	Patoda solar park	500	M/s Paramount Solar Power Pvt. Ltd. (formerly M/s K. P. Power Pvt. Ltd.)	Villages Tambarajuri, and Wadzari, TalukaPatoda, Dist. Beed.
22.	Meghalaya	Solar park in Meghalaya	20	Meghalaya Power Generation Corporation Ltd (MePGCL)	Thamar, West Jaintia Hills &Suchen, East Jaintia Hills districts

23.	Mizoram	Vankal solar park	20	Zoram Energy Development Agency (ZEDA)	Vankal, Mizoram
24.	Nagaland	Solar park in Nagaland	23	Directorate of New & Renewable Energy, Nagaland	Ganeshnagar (12 MW) of Dimapur and Jalukie (11 MW) of Peren districts
25.	Odisha	Solar park in Odisha	1000	Green Energy Development Corporation of Odisha Limited	Balasore, Keonjhar, Deogarh, Boudh, Kalahandi and Angul
26.	Rajasthan	Bhadla-II solar park	680	Rajasthan Solar Park Development Company Ltd.	Village-Bhadla, Jodhpur Dist, Rajasthan
27.	Rajasthan	Bhadla-III solar park	1000	Surya Urja Company of Rajasthan Ltd	Village-Bhadla, Jodhpur Dist, Rajasthan
28.	Rajasthan	Phalodi-Pokaran solar park	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, distJaisalmer (300 MW)
29.	Rajasthan	Bhadla-IV solar park	500	M/s Adani Renewable Energy Park Rajasthan Limited	Village-Bhadla, Jodhpur Dist, Rajasthan
30.	Rajasthan (421 MW through support of GoI out of 1500 MW)	Fatehgarh Phase-1B solar park	421	M/s Adani Renewable Energy Park Rajasthan Limited	Fatehgarh&Pokaran, Jaisalmer, Rajasthan
31.	Rajasthan	Nokh solar park	1000	Rajasthan Solar Park Development Company Ltd.	Village-Nokh, Pokaran, Jaisalmer, Rajasthan
32.	Tamil Nadu	Solar park in Tamil Nadu	500	To be finalized	Initially proposed in Ramanathapuram district. Site under revision.
33.	Uttar Pradesh	Solar park in UP	440	Lucknow Solar Power Development Corporation Ltd.	Orai&kalpi Tehsils of Jalaun, Meja tehsil of Allahabad, Chaanbe tehsil of Mirzapur and Akbarpur tehsil in Kanpur Dehat districts

34.	Uttarakhand	Solar park in Uttarakhand	50	State Industrial Development Corporation Uttarakhand Limited (SIDCUL)	Sitarganj and Khurpia farm in US Nagar district
35.	West Bengal	Solar park in West Bengal	500	West Bengal State Electricity Distribution Company Ltd.	East Mednipur, West Mednipur, Bankura
Total			**20514**		

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:

4.6 Potential of Solar Energy in cantonment and Military Stations are approximately 5000 MW and in Ordnance Factory Boards (OFB) are around 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 Ministry has issued Administrative Approval of a scheme for Defence establishments on 07th January, 2015.

Bhadla-II solar park in Rajasthan of capacity 680 MW commissioned

4.7 The broad guidelines of the scheme are as under:

i. A capacity of 300 MW is to 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 also to be covered under this scheme.

ii. Minimum size of the project to be 1 MW.

iii. The projects under this Scheme are to mandatorily use solar cells & modules which are made in India.

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

v. Project Implementation Schedule is 5 years period i.e. from 2014-19

vi. 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.

vii. The Defence Organisations/Establishments are 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.

viii. The solar project developers are provided VGF based on the bid. The bidders are 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.

Amendment in Scheme:

4.8 An amendment of the scheme was issued vide OM dated 17.02.2017. Major changes under scheme were as;

a) The VGF limit is revised from upto Rs 2.5 Cr/MW to Rs 1.1 Cr/MW irrespective of sizes for all projects for which tenders have not yet been brought out.

b) The tariff of solar power is reduced from Rs 5.50 per unit to Rs 4.50 per unit.

c) The projects under developer mode will be free to procure solar cells/modules under open category (indigenous or imported).

d) The projects for which tenders have already been brought out before 17th February, 2017, will have provisions as per administrative approval dated 07.01.2015.

4.9 **Physical Achievement :** In-principle approval of 357.5 MW has been given to different Defence Organisations (**Table 4.4**). Out of this, 22 MW has been commissioned so far.

3000 MW Grid connected solar PV power projects under NSM Phase-II, Batch-II, Tranche-I – 'state specific bundling scheme'

4.10 Under this Scheme, which is part of Tranche-I of Batch-II of Phase-II of National Solar Mission, 3 GWcapacity of solar PV power plants are being set up based on the mechanism of bundling of solar power (3 GW) with unallocated thermal power (1500 MW) in the ratio of 2:1 (in MW terms), for which the required 1500 MW unallocated thermal power has been made available by the Ministry of Power.

Mechanism for implementation

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

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

b. The bidding is State specific and conducted through e-bidding.

c. It is based on fixed levellised tariffs. The developers have submitted bids quoting a fixed levellised tariff for the entire project duration of 25 years.

d. The selection of bids has been done based on the tariff quoted by the bidders. Selection has been 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 are free to avail fiscal incentives like Accelerated Depreciation, Concessional Customs and Excise Duties, Tax Holidays, etc. as available for such projects. The same does 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.

Table-4.4 Present status of 357.50 MW solar PV power projects under different Defence Organisations							
Ministry	Organisations	Capacity Allocated (MW)	Date of in principle approval	Tender Issued (MW)	Order placed (MW)	Constr-uction started (MW)	Commi-ssioned (MW)
Department of Defence Production (207.5 MW)	OFB, Bhandara	2	17.03.2015	2	2	2	2
	OFB, Ambajhari	5	17.03.2015	5	5	5	5
	Bharat Electronics Limited (BEL)						
	OF, Medak, Telangana	16	11.08.2015/ 25.04.2016	16	16	16	15
	OF, Itarsi, MP	10		10	10	10	
	OF, Bolangir, Odisha	7.5		7.5	7.5	7.5	
	HMV, Avadi, TN	16		16		16	
	Gun Carriage Factory, Jabalpur, MP	10		10	10	10	
	Vehicle Factory, Jabalpur, MP	10		10	10	10	
	OF, Khadi	3					
	OF, Muradnagar	2					
	OF, Nalanda	1					
	Other Locations	74.5					
	Bharat Dynamics Limited (BDL)	25	26.11.2015	5	5	5	
	HAL, Nasik	15	21.04.2016	15	15	15	
	Ordnance Factory, Kanpur	5	25.07.2016	5	-	-	
	MIDHANI	4	30.08.2016	4	4	4	
	OF, Ambajhari	1.5	06.01.2017				
Department of Defence (150 MW)	Department of Defence		16.02.2016/ 06.04.2016				
	Army Locations	94		50.6	31	17.5	
	Navy Locations	19					
	Air Force Locations	32.7		11.5	6	4	
	Others	4.3					
	Total	**357.5**		**162.6**	**121.5**	**122**	**22**

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 30.11.2017):

Allocation:

4.12 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, State-wise allocations have been given in **Table 4.5**.

Table - 4.5 State-wise allocations of 3000 MW State Specific Bundling Scheme under NSM Phase-II, Batch-II

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**

Implementation (as on 30.11.2017):

4.13 Notice Inviting Tender Published for full Tranche-I of 3,000 MW.

- Reverse auction completed: 3000 MW.
- Power Sale Agreement (PSA) Signed with State Discoms: 2750 MW
- Letter of Intent issued to successful bidders: 2750 MW
- Power Purchase Agreements (PPAs) signed: 2750 MW.
- Project Commissioned : 2050 MW as on 30.11.2017; Break-up is as follows in **Table 4.6**

Pilot-cum-demonstration project for development of grid connected solar PV power plants on canal banks and canal tops.

4.14 Under National Solar Mission (NSM), "Pilot-cum-Demonstration Project for Development of Grid Connected Solar PV Power Plants on Canal Banks and Canal Tops" is under implementations.

Table-4.6 Break-up of 2050 MW Project Commissioned as on 30.11.2017		
State	Solar PV Projects Allotted (MW)	Solar PV Projects Commissioned (MW)
Andhra Pradesh	1250	1000
Rajasthan	650	650
Uttar Pradesh	100	100
Karnataka	600	0
Telangana	400	300
Total	**3000**	**2050**

4.15 Based on the requests received from various States for allocation of canal-top/canal-bank solar power projects in-principle approval given for setting up full targeted capacity of 50 MW canal-top and 50 MW canal-bank solar PV power projects, as follows in **Table 4.7** and **Table 4.8** respectively.

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

Table-4.7 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 31.12.2017
1	Andhra Pradesh	New and Renewable Energy Development Corporation of Andhra Pradesh (NREDCAP)	1 MW canal-top	1 MW
2	Gujarat	SardarSarovar Narmada Nigam Limited (SSNNL)	10 MW canal-top	10 MW
3	Karnataka	Krishna BhagyaJala Nigam Limited (KBJNL)	10 MW canal-top	-
4	Kerala	Kerala State Electricity Board Limited (KSEB)	2 MW canal-top	2 MW
5	Punjab	Punjab Energy Development Agency (PEDA)	20 MW canal-top	5 MW
6	**Uttarakhand**	**UttarakhandJalVidyut Nigam Limited**	**1 MW canal-top**	**-**
7	**Uttar Pradesh**	**Uttar Pradesh Irrigation Department**	**6 MW canal-top**	**-**
	Total		**50 MW canal-top**	**18 MW**

Table-4.8 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 31.12.2017
1	Andhra Pradesh	Andhra Pradesh Power Generation Corporation Limited (APGENCO)	5 MW canal-bank	5 MW
2	Gujarat	SardarSarovar Narmada Nigam Limited (SSNNL)	15 MW canal-bank	15 MW
3	Kerala	Kerala State Electricity Board Limited (KSEB)	1 MW canal-bank	1 MW
4	Uttarakhand	UttarakhandJalVidyut Nigam Limited	19 MW canal-bank	-
5	West Bengal	West Bengal State Electricity Distribution Company Limited (WBSEDCL)	10 MW canal-bank	10 MW
	Total		**50 MW canal-bank**	**31 MW**

1000 MW solar park, Kurnool, Andhra Pradesh

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.

4.17 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. Under the Scheme, MNRE, as on 15.12.2017, has allocated about 963 MW capacity to 12 different CPSUs/ Govt. Organisations within the sanctioned funds of Rs.1000 Crore for this scheme.

4.18 The details of physical and financial progress under this Scheme is as follows in **Table 4.9**

1000 MW Capacity Grid-Connected Solar Power Projects implemented through NVVN under National Solar Mission (NSM) Phase-I

4.19 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

4.20 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 (54MW SPV and 30MW ST) were approved under this scheme for long-term procurement of power by NVVN at CERC notified tariff for 2010-11 viz. Rs.17.91/unit for SPV and Rs.15.39/unit for ST. 11nos. SPV projects of 48 MW capacity have been commissioned under this scheme.

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

4.21 Under NSM Batch-I and Batch-II of NSM, 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.

4.22 In Batch-I the eligible project capacities were 5 MW for SPV and upto 100 MW for ST. 28 nos. SPV Projects with an aggregate capacity of 140 MW and 7 nos. of ST Projects with an aggregate capacity of 470 MW were allotted. The bid tariffs for SPV projects were in the range of Rs.10.95-12.76/ unit, with average of Rs.12.12/unit and for ST projects in the range of Rs.10.49-12.24/unit, with 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.

4.23 In Batch-II for SPV, the project capacity fixed was 5-20 MW. 27 nos. SPV projects with an aggregate capacity of 340 MW were allotted at tariff ranging between Rs.7.49-9.44/unit, with average of Rs.8.77/ unit. 26 nos. SPV projects of aggregate 330 MW capacity have been commissioned under NSM Phase-I, Batch-II.

Table - 4.9 Status of Projects under 1000 MW CPSU Scheme (as on 15.12.2017)						
Sl. No.	Name of Agency	Capacity sanctioned (MW)	Year of sanction	Capacity Commi-ssioned (MW)	VGF required (Cr. Rs.)	VGF released (by MNRE)
1	NTPC Limited	250 MW (Ananthapur, A.P.)	2014-15	250	250	250
2	NTPC Limited	180 MW (Bhadla, Rajasthan)	2015-16	180	180	180
3	NTPC Limited	229.5 MW (Mandsaur, M.P.)	165 MW in 2015-16; 64.5 MW in 2016-17	229.5	229.5	114.75
4	NTPC Limited	20.5 MW (Pavagada, Karnataka)	2015-16	0	20.5	0
5	BHEL	1.5 MW (Trichy, TN)	2015-16	1.5	1.5	1.5
6	BHEL	5 MW (RC Puram, Hyd. TG)	2015-16	5	5	5
7	BHEL	7.5 MW (Trichy, T.N.)	2017-18	0	7.50	3.75
8	BHEL	2.5 MW (Jhansi, U.P.)	2017-18	0	2.50	1.25
9	BHEL	5 MW (Haridwar, U.P.)	2017-18	0	5	0
10	Rashtriyaİspat Nigam Ltd.	5 (Visakhapatnam, A.P)	2015-16	5	5	5
11	NHPC Limited	50 (Tamil Nadu)	2015-16	0	25	12.5
12	ONGC	6	2016-17	0	3	0
13	GAIL	5.76	2015-16	0	2.88	1.44
14	Scooters India Ltd.	1 (Lucknow, UP)	2015-16	1	0.5	0.5
15	Sambhar Salts	1 (Sambhar, Rajasthan)	2015-16	0	1	0
16	Dadra & Nagar Haveli PDCL	3 Dadra Nagar haveli (UT)	2015-16	3	3	1.5
17	Paradip Port Trust	10 (Paradip Port, Odisha)	2015-16	0	10	5
18	THDC	50 (Kerala)	2016-17	0	25	0
19	NLC India Ltd.	130 (Neyveli, Tamil Nadu)	2017-18	90	97.50	0
	TOTAL	**963**		**765**	**874**	**582**

4.24 A 5 MW SPV project by Delhi Mumbai Industrial Corridor Development Corporation Limited (DMICDC) and a 10 MW SPV project by Solar Energy Corporation of India (SECI) has also been set up under the MNRE bundling scheme of NSM Phase-I.

4.25 Thus, under NSM Phase-I, 533 MW solar PV projects and 200 MW solar thermal power projects have been commissioned under the bundling scheme.

4.26 Power generated from the commissioned plants is being purchased by the 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 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.

VIABILITY GAP FUNDING (VGF) SCHEME

4.27 Under VGF Scheme, 750 MW, 2000 MW and 5000 MW of Grid connected Solar Power Projects have been taken up. Solar Energy Corporation of India (SECI) has been designated as an implementing agency for these schemes. Details of each of three scheme are given below:

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

4.28 Solar Energy Corporation of India (SECI) is implementing the first VGF scheme of 750 MW, under NSM 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. Other salient points are as follow.

- Power is purchased by SECI @ Rs. 5.45/kWh and sold @ Rs. 5.50/kWh.
- DCR (375 MW) & Open (375 MW).
- VGF support of Rs. 2.5 Crore per MW (30% of Project cost, whichever is lower).
- Total VGF Disbursement :Rs 704.69 crore.
- Rs. 500 crore for Payment Security Mechanism (PSM) to SECI for 750 MW, 2000 MW and 5000 MW VGF Scheme initially.
- Total 680 MW capacity of SPV plants have been commissioned in 7 States (Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Karnataka, Tamil Nadu & Odisha).
- Total VGF Disbursement, as on 31.12.2017 is Rs. 704.69 crore
- No further capacity likely to be added under the scheme.

4.29 State-wise details of commissioned projects are given in **Table 4.10**

Table-4.10 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

4.30 Scheme for Setting up of over 2000 MW Grid connected solar PV Projects with VGF under NSM Phase-II, Batch-III

- Guidelines issued on dated 04th August 2015. Power purchased by SECI @ Rs. 4.43/kWh (PPA) and sold to buying utilities @ Rs. 4.50/kWh (PSA).
- Bidding have been carried out amounting to Rs. 1515 Crore out of the total approved scheme allocation of Rs. 2100 Crore.
- 2 categories: DCR (250 MW) & Open (1750 MW). Project Size is Minimum 10 MW up-to 50 MW (in multiples of 10 MW).
- State-specific tenders based on the demand from State. Projects could be set up either in the Solar Parks and or outside the solar park.
- VGF up-to Rs. 1.31 Crore per MW (DCR) and Rs. 1 Crore per MW (Open) is being provided. Average bided VGF under the open category is 63.27 lakh/MW and DCR category is 1.11 Crore/MW.
- Rf5 have been issued for 2410 MW capacity in 7 States/UTs (Maharashtra, Uttar Pradesh, Andhra Pradesh, Chhattisgarh, Karnataka, Puducherry and Himachal Pradesh), LoI placed: 2295 MW, PPA signed: 2295 MW & PSA signed: 2425 MW (As on 31.12.2017).
- Total 300 MW Capacity reported as commissioned in Maharashtra, at non-solar park locations.

5000 MW VGF Scheme Batch IV Phase II

4.31 Scheme for Setting up of over 5000 MW Grid Connected Solar PV Projects with VGF under NSM Phase–II, batch-IV

- The Scheme was Launched in 2015-16, to be implemented in 4 years (at least 1250 MW in each year). Project Size is Minimum 10 MW up-to 50 MW (in multiples of 10 MW).

- Initial provision was that power will be purchased by SECI @ Rs. 4.43/kWh and sold @ Rs. 4.50/kWh. Now onwards the bidding under the scheme will be carried out at discounted tariff below from bench mark tariff Rs. 4.43/kWh with zero VGF option.
- Project Size is Minimum 10 MW upto 50 MW (in multiples of 10 MW).
- VGF support of Rs. 1.25 Crore per MW (DCR) &Rs. 1.00 Crore per MW (Open)
- Projects could be set up either in the Solar Parks or out-side locations. The tenders will be state-specific based on the demand from particular state. Inter-state solar power transmission is permissible under the scheme.
- For 2015-16 and 2016-17, RfS has been issued for 2620 MW capacity in 6 States (Gujarat, Odisha, Andhra Pradesh, Maharashtra, Karnataka and Rajasthan), LoI placed: 1720 MW, PPA signed: 970 MW, PSA signed: 1720 MW (As on 31.12.2017).
- **Ever lowest discovered tariff of Rs. 2.44/kWh arrived in Solar discounted tariff bidding.**
- Discovery of solar power tariff of Rs. 2.47-2.48 per kWh (in Dec, 2017, post introduction of GST)
- Total 250 MW Capacity has been commissioned in the State of Gujarat, in Charanka solar park locations (As on 31.12.2017).

4.32 State-wise tendering/projects status for the FY 2016-17 & 2017-18 (upto 31.12.2017) is given in **Table 4.11.**

Table- 4.11 State-wise status of tendering under 5000 MW VGF Scheme

Sl. No.	State	NIT issued	LoI issued & PPA signed
1	Gujarat	400 MW	250 MW
2	Odisha	270 MW	270 MW
3	Maharashtra	450 MW	450 MW
4	Rajasthan	1500 MW	750 MW
5	Uttar Pradesh	275 MW	-
6	Karnataka	200 MW	-
7	Andhra Pradesh	750 MW	-
8	Pan-India	2000 MW	-
	Total	**5845 MW**	**1720 MW**

4.33 In the FY 2017-18 (up to 31.12.2017), NIT has been issued for 3975 MW capacity. LoI have been issued for 750 MW and PPAs have been signed for the same capacity. Financial Closures have been achieved for 445 MW capacity and 250 MW has been commissioned.

Demonstration Programme on Grid Interactive Solar PV Power Generation

4.34 Demo Solar GBI

- MNRE had announced the Demonstration Programme on Grid Interactive Solar PV Power Generation (Demo Solar GBI) in the FY 2008-09 before the starting of NSM. Salient features are as under:
- Initially the scheme was formulated for 25 MW for Demonstration of MW capacity solar PV plants. Projects of capacity from 1 MW to 5 MW and commissioned.
- MNRE provides Generation Based Incentive (GBI) to these projects. The GBI is bieng disbursed directly to the project developer through IREDA.
- Total 07 numbers of Projects were commissioned from FY 2009-10 to 2011-12
- Against the target capacity of 25MW, a total of 19 MW for seven project developers could be commissioned by in 6 states **(Punjab, Maharashtra, Rajasthan, Tamil Nadu, Andhra Pradesh, West Bengal)** with a capacity ranging from 1MWp to 5MWp each.
- Ministry releases GBI to Developers through IREDA maximum upto Rs.12/kWh for period of 10 years.
- GBI was fixed based on the difference of the State PPA rate and notational tariff of Rs. 15/ kWh maximum up-to Rs.12/kWh. Total GBI released so far is Rs. 150 cr.

Generation Based Incentives (GBI) Programme for Small PV Solar Power Plants

4.35 Rooftop PV and Small Solar Power Generation Programme (RPSSGP)

- After successful demonstration of MW projects in Demo Scheme, Ministry launched a Generation Based Incentives (GBI) programme on 16th June 2010 to give a thrust to rooftop PV and other small solar power plants connected to grid under Phase I NSM. Implementing Agency is IREDA.
- 100 MW Solar capacity was allocated and 91.8 MW of 72 projects in 12 States was commissioned. GBI is applicable for 25 years from the commissioning date and payable to the distribution utility.
- Ministry provides fixed GBI from Rs. 8.69 to 12.24 /Kwh 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 base rate of Rs. 5.50 per kWh.
- Annual budget requirement by Ministry under RPSSGP scheme is approx. Rs.180.00 crore for 91.8 MW.
- Although initially Solar tariff was Rs. 17.91/Unit, however after adopting different mechanism to lower the tariff, now solar tariff arrived at Rs.2.44/Unit.

Grid Connected Rooftop and Small Power Plants Programme

4.36 The Ministry is implementing "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

Grid connected solar rooftop plants of 300 kWp installed by SECI at SS College of Engineering, Udaipur, Rajasthan

including Sikkim, Uttarakhand, Himachal Pradesh, Jammu & Kashmir and Lakshadweep, Andaman & Nicobar Islands for installation of grid connected rooftop solar power plants in building of residential, institutional and social sector. For Government sector achievement linked incentives upto 25% of the benchmark cost in general category States/UTs and 60 % of the benchmark cost for special category States/UTs are being provided. About 4200 MW is being targeted under this scheme (2100 MW with subsidy and 2100 MW without subsidy) by year 2019-20.

4.37 So far, 1810 MWp solar rooftop systems have been sanctioned/ approved under the scheme. Aggregate 982.30 MWp have been reported as installed in the country. 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..

4.38 Model Power Purchase Agreement (PPA), Memorandum of Understanding and Capex Agreement for government sector projects have been developed which were duly vetted by Department of Expenditure (Ministry of Finance) and Department of Legal Affairs, Ministry of Law & Justice.

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

4.40 Commitment Certificate of about 3890 MWp has been received from different Ministries/ Departments. In addition, the following reference documents have been developed :-

- Compendium of policies and regulations of GOI, State/UTs
- Best Practice Guide on Solar Rooftop

Grid connected solar rooftop plants of 387 kWp installed at Mukundpur Metro Station of Delhi Metro Rail Corporation Ltd.

- Working paper on international solar alliance: nurturing possibilities
- Solar Rooftop Calculator has also been developed for financial calculations of grid connected solar rooftop projects on PAN India basis.

4.41 An online platform namely SPIN has been developed for submission of online proposal, project completion reports, 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 programme. 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. SPIN is also inbuilt with the utilities like email and SMS for communicating to various stake holders. The SPIN is designed and developed by National Informatics Centre (NIC).

Mobile App ARUN has also been developed for Solar Rooftop Project

4.42 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, Government departments 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 are being provided by MNRE.

4.43 Rs.1118.06 Crore has been released as Central Financial Assistance to different implementing agencies for installation of grid connected rooftop projects of which Rs. 144.77 crore has been released in FY 2017-18.

Initiatives by States/UTs

4.44 Electricity Regulatory Commissions of all States/UTs have notified net metering regulations / tariff orders .

4.45 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.

4.46 Govt. of Haryana, Chhattisgarh, Uttar Pradesh and Chandigarh has issued mandatory notification for installation of solar rooftop plants for certain categories of buildings.

4.47 Chief Electrical Inspector to Government (CEIG) inspection has been made optional by States of Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Madhya Pradesh, Odisha, Haryana, Delhi, Maharashtra and Rajasthan for solar rooftop plants upto certain capacity.

Grid connected solar rooftop plants of 650 kWp installed by SECI at BAPS Swaminarayan Sanstha, Pandav Nagar, New Delhi

Initiatives for loans and International funding

4.48 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 systems. For individual households, the loan limit is Rs. 10 lakh per borrower.

4.49 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.

4.50 Department of Expenditure has reduced the Guarantee fee from 1.2 % to 0.5 % for multilateral loan of USD 1370 million including World Bank loan of USD 620 million through State Bank of India , Asian Development Bank loan of USD 500 million through Punjab National Bank and New Development Bank loan USD 250 million through Canara Bank . SBI has sanctioned concessional loans of aggregate Rs.2021.85 Crore for aggregate capacity of 517.6 MW capacities and PNB has sanctioned concessional loan of aggregate Rs. 113.89 crore for aggregate capacity of 32.39 MW under this multilateral loan programme.

4.51 Multilateral grant of USD 5 million by ADB, USD 1.8 million from USAID and USD 28.8 million from World Bank has been approved for solar rooftop programme.

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

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

OFF GRID SOLAR PHOTOVOLTAICS

4.54 Under the Off-Grid and Decentralized Solar PV Programme for 2017-18, Ministry is providing Central Financial Assistance (CFA) to implementing agencies for deployment of SPV home lighting systems, Solar street lights, Solar pumps, power packs and other solar applications to meet out the electricity and lighting needs of the individual in the rural areas. State Nodal Agencies (SNAs) are the primary implementing agency through which CFA of 30% was being provided. NABARD was one of the implementing agencies for pumps and lighting systems through which CFA of 40% of the benchmark cost was being provided.

4.55 More than 96,000 pumps have been sanctioned during 2017-18 under Off-grid solar pumps. Overall, about 2.4 lakh pumps have been sanctioned and 1.47 lakh solar pumps installed under the programme till 31.12.2017. A total of 182 MWp capacity solar PV off-grid systems / power plants have been installed till 31st December 2017 as shown in **Table 4.12** State-wise system installation during 2017-18 (up to 31.12.2017) is shown in **Table 4.13**. Some major Off Grid Solar PV projects sanctioned during 2017-18 are as follows:

- 70,00,000 Solar Urja Lamps (SoUL) for school going children have been distributed in selected states by Indian Institute of Technology, Bombay.
- State Wise details of the pumps sanctioned during the year 2017-18 are given in **Table 4.14**

4.56 During the year, the solar systems having total capacity of 104.41 MWp which includes solar study lamps, solar home lights, solar street lights, solar pumps, Mini/micro grids and power

Table-4.12 State wise cumulative installation of SPV systems as on 31.12.2017						
S. No.	State/UT	Lanterns & Lamps Nos.	Home Lights Nos.	Street Lights Nos.	Pumps Nos.	Stand Alone Power Plants (KWp)
1	Andhra Pradesh	51360	22972	7812	19526	3785.595
2	Arunachal Pradesh	14433	18945	1671	22	650.1
3	Assam	13379	6926	318	45	1605
4	Bihar	210391	12303	955	1882	4168.6
5	Chhattisgarh	3311	7754	2042	26673	28660.04
6	Delhi	4807	0	301	90	1269
7	Goa	1093	393	707	15	32.72
8	Gujarat	31603	9253	2004	8010	13576.6
9	Haryana	93853	56727	22018	1243	2321.25
10	Himachal Pradesh	33909	29342	58718	6	1905.5
11	Jammu & Kashmir	51224	65319	5806	39	7719.85
12	Jharkhand	138723	9450	787	3598	3639.9
13	Karnataka	7334	52638	2694	4118	7754.01
14	Kerala	54367	41912	1735	818	15825.39
15	Madhya Pradesh	529101	4016	9378	5584	3654
16	Maharashtra	239297	3497	10420	3315	3857.7
17	Manipur	4787	3900	1888	40	1241
18	Meghalaya	24875	7844	4900	19	1084.5
19	Mizoram	9589	6801	5056	37	2019
20	Nagaland	6766	1045	6235	3	1506
21	Odisha	99843	5274	5834	8570	567.515
22	Punjab	17495	8626	42758	1857	2066
23	Rajasthan	225851	166978	6852	41377	10850
24	Sikkim	23300	15059	504	0	850
25	Tamil Nadu	16818	273015	39235	4459	12752.6
26	Telangana	0	0	351	424	6643
27	Tripura	64282	32723	1199	151	667
28	Uttar Pradesh	104791	235909	185091	10877	10041.46
29	Uttarakhand	93927	91595	21905	26	2365.03
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	600	2465	0	2190
34	Puducherry	1637	25	417	21	121
35	Others	125797	24047	9150	0	23885
36	NABARD	0	116226	0	4012	0
	Total	**2328865**	**1477189**	**471220**	**147527**	**181901.36**

Table-4.13 State wise SPV system installation during 2017-18 as on 31.12.2017						
S. No.	State/UT	Lanterns & Lamps Nos.	Home Lights Nos.	Street Lights Nos.	Pumps Nos.	Stand Alone Power Plants (KWp)
1	Andhra Pradesh	0	0	0	8907	0
2	Arunachal Pradesh	0	0	0	0	50
3	Assam	12258	0	0	0	0
4	Bihar	160274	0	0	0	200
5	Chhattisgarh	0	0	0	15203	216
6	Delhi	0	0	0	0	0
7	Goa	0	0	0	0	0
8	Gujarat	0	0	0	0	0
9	Haryana	0	0	0	700	0
10	Himachal Pradesh	0	0	6860	0	52
11	Jammu & Kashmir	0	0	0	0	0
12	Jharkhand	115349	0	0	452	0
13	Karnataka	0	0	0	641	0
14	Kerala	0	0	0	8	1931
15	Madhya Pradesh	519657	0	0	1771	0
16	Maharashtra	170614	0	0	1287	0
17	Manipur	0	0	0	0	0
18	Meghalaya	0	0	3627	0	200
19	Mizoram	0	0	0	0	300
20	Nagaland	0	0	0	0	0
21	Odisha	89961	0	0	1491	0
22	Punjab	0	0	0	0	0
23	Rajasthan	221135	11709	0	187	0
24	Sikkim	0	0	0	0	0
25	Tamil Nadu	0	42695	2433	0	0
26	Telangana	0	0	107	0	1269
27	Tripura	0	0	0	0	10
28	Uttar Pradesh	42776	0	0	17	0
29	Uttarakhand	0	0	0	0	826
30	West Bengal	0	0	0	0	0
31	Andaman & Nicobar	0	0	0	0	0
32	Chandigarh	0	0	0	0	0
33	Lakshadweep	0	600	740	0	0
34	Puducherry	0	0	0	0	0
35	Others	0	0	0	0	0
36	NABARD	0	8226	0	1985	0
	Total	**1332024**	**63230**	**13867**	**32649**	**5054**

Table-4.14 State wise pumps sanctioned during the year 2017-18

Sr No	State	Number of Solar Pumps Sanctioned
1	Andaman and Nicobar	20
2	Andhra Pradesh	15,000
3	Bihar	3,300
4	Chhattisgarh	15,000
5	Gujarat	5,000
6	Jharkhand	2,000
7	Karnataka	1,500
8	Madhya Pradesh	14,000
9	Maharashtra (for Drinking water)	1,000
10	Maharashtra (for Irrigation)	7,000
11	Odisha	1,500
12	Punjab	2,556
13	Rajasthan	7,500
14	Tamil Nadu	1,000
15	Uttar Pradesh	20,000

plants were installed in various states. Some of the highlights of the completed projects during the financial current year are given below:

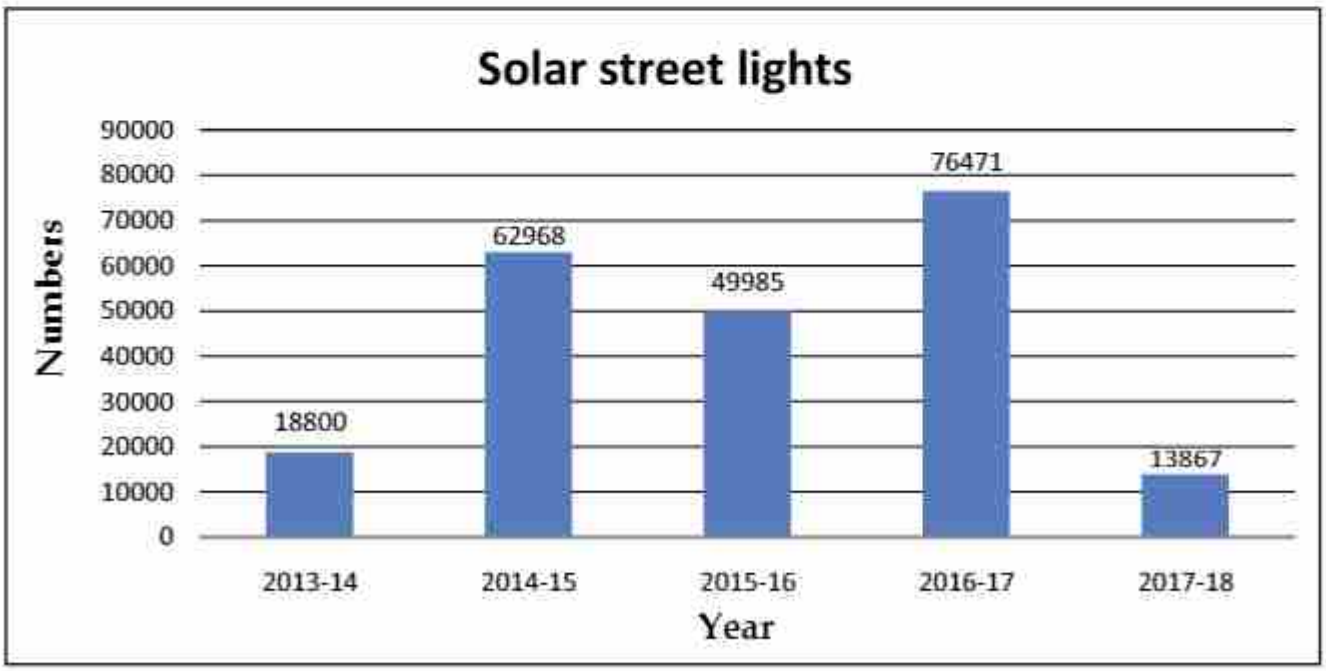
- 150 kWp of SPV power plants has been installed at various hospitals and Primary Health Centres in Arunachal Pradesh.
- A total of 7,920 solar home lighting systems and 8,793 number of solar street lights hs been installed in the state of Madhya Pradesh.
- SPV power plants having aggregated capacity of 153 kWp has been installed at police stations in Andhra Pradesh
- 2,000 number of Solar pumps for the purpose of drinking water has been installed in Odisha

Solar PV street lights installed in Himachal Pradesh

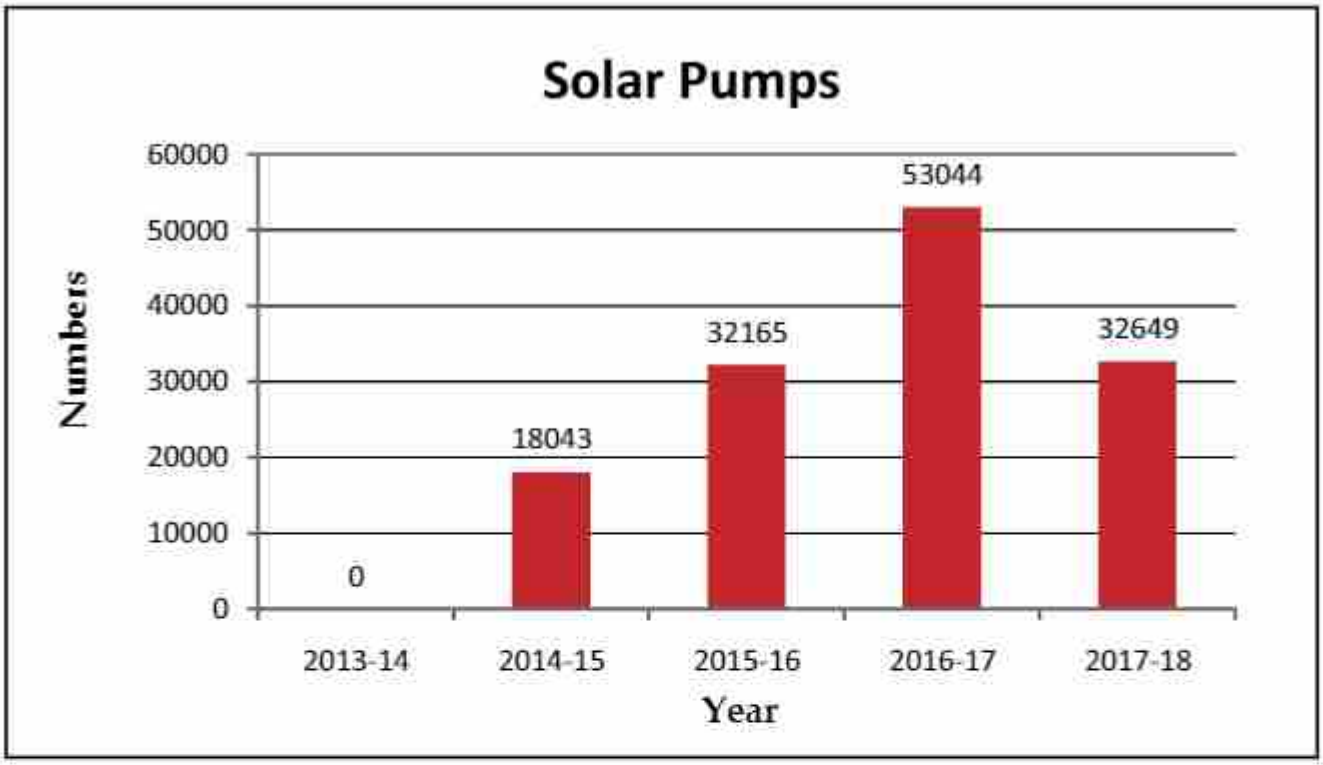
- SPV power plants of capacity 500 kWp has been installed in Chhattisgarh
- 9 Mini grids having capacity of 210.4 kWP has been installed in nine villages of Gumla districts in Jharkhand.
- Along the road side from Deogarh to Basukinath Temple, in Jharkhand, the electrification has been done with SPV power plant of 500 kWp.
- 12,890 number of solar pumps has been installed in Chhattisgarh
- SPV power plants of capacity 134 kWP have been installed in Rajasthan.
- SPV power plant of capacity 25 kWp and 700 number of Solar street lights have been installed in Manipur.

Cumulative Systems Installed	
SPV Systems	**Cumulative up to 31.12.2017**
Lanterns and Study lamps (No)	23,28,865
Home Lights (No)	14,77,189
Street Lights (No)	4,71,220
Solar Pumps (No)	1,47,527
SPV Plants (MW)	182

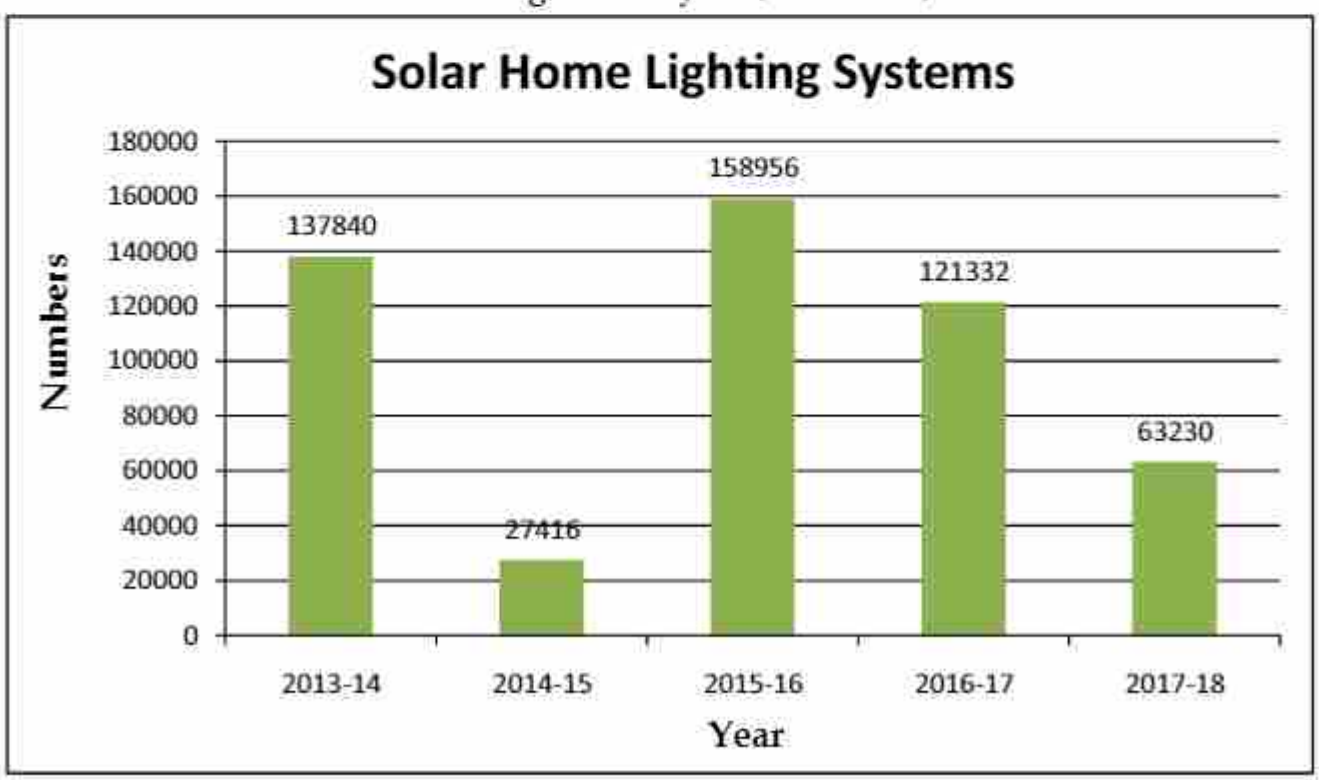
Solar street lights installed during last five years including current year (31.12.2017)



Solar pumps installed during last five years including current year (31.12.2017)



Solar home lighting systems installed during last five years including current year (31.12.2017)



Atal Jyoti Yojana

4.57 Under the Atal Jyoti Yojna (AJAY) programme Solar Street Lights are to be installed in rural, semi-urban and urban areas which don't enjoy adequate coverage of power grid in the states of Uttar Pradesh, Assam, Bihar, Jharkhand and Odisha.

Installation of 60kWp Floating Pond Top Solar Power Plant at Hon'ble Governor House in Bihar

4.58 The total cost of the scheme is Rs 499.30 crore. MNRE is providing provide 75% of the cost of street lights and remaining 25% comes through from Member of Parliament Local Area Development Scheme (MPLADS) funds, Panchayat funds or Municipalities and other Urban Local Bodies (ULBs) Funds.

4.59 As on 31st December 2017, the consent from 109 nos. of Hon'ble MP has been obtained out of total 169 Lok Sabha Constituencies.

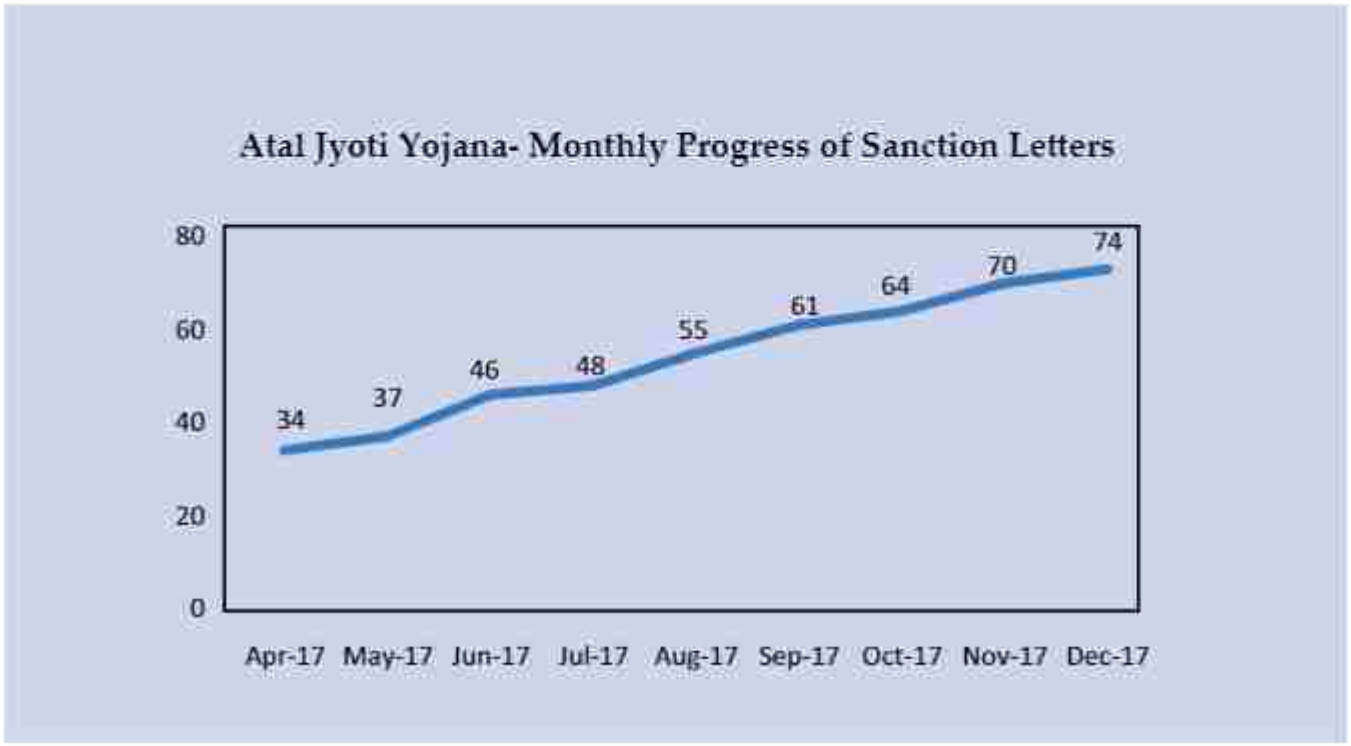
Decentralised distrubuted solar mini-grid in Himachal Pradesh

4.60 As on 31st December 2017, the implementing agency (EESL) has received sanctions letters from DMs from 74 constituencies which includes 1,05,217 nos. quantity to be installed in all 5 states out of which 47 are from Uttar Pradesh, 11 are from Bihar, 5 are from Odisha, 7 are from Jharkhand and 4 are from Assam.

4.61 Physical Progress (as on 31.12.2017)

- Total nos. of lights installed is 68,628
- Current rate of installation by EESL is 1000 lights/day.
- Work is in progress in all 5 States.
- Out of 74 sanctions received from District Authorities, work is in progress in 71 locations.
- Work at 13 nos. of constituencies is completed.

State-wise Division of total Sanction Letters received		
States	Sanctioned letters (No)	Progress as on 31.12.2017
Uttar Pradesh	67417	47414
Bihar	14638	10828
Assam	6165	2317
Jharkhand	9267	3946
Odisha	7730	4123



2 HP Solar Water Pumping Systems installation under irrigation scheme in Bihar

MNRE's Scheme of 70 Lakh Solar Study Lamps

4.62 Ministry of New and Renewable Energy (MNRE), Government of India has sanctioned a scheme proposed by IIT Bombay (IITB), which aims to provide 70 Lakh students in rural India with high quality, affordable clean light through solar study lamp in cheapest and fastest possible way. The scheme covers 5 states of Assam, Bihar, Jharkhand, Odisha& Uttar Pradesh, which have more than 50% un-electrified households (Census 2011). This scheme is being implemented in the mission mode over a span of two years, from January 2017 to December 2018. The objectives of the scheme are:

- Supporting education of school students in un-electrified rural households by providing them solar study lamp
- Employment/livelihood generation through localization of solar energy empowers local communities through imparting skill & knowledge about solar technology
- Reaching out marginalized communities is achieved through targeting most remote and backward regions of the country
- Providing adequate light Intensity for Studying Purpose by providing the recommended level of light for casual reading.
- Awareness & Confidence on Solar Technology is built through a first-hand experience of solar products to rural communities

4.63 The blocks have been selected for implementation on the basis of criteria given by MNRE, which are 1) Blocks having more than 50% kerosene consumption at house hold level as main source of lighting and 2)Percentage of marginalized population. A total of 1495 blocks got qualified the criteria across the intervention states, out of which around 325 blocks are selected for the operations under the project covering around 70 lakh lamp targets. The target beneficiaries in block are considered as 60% of the school going students enrolled.

Community Solar Pump Systems installed at Kulhadighat Distt. Gariyabandh, Chhattisgarh

Implementing Agency

4.64 EESL being chief procurement agency handles the procurement of the lamp kit as well as tool kits along with monitoring of vendors, Zonal Execution Agencies (ZEAs) & Block Execution Agencies (BEAs) and coordination with IITB, Vendors, Zonal & Block level execution agencies with regards to supply as per timeline & schedule . IITB being Chief Implementation Agency is handling overall execution. It's main responsibilities include overall planning, process standardization, training, quality check of process & product, documentation, Technical assistance, developing IT system etc. It coordinates with ZEAs, BEAs & EESL on regular basis towards timely completion of the project activities. The State Rural Livelihood Missions (SRLM) as Zonal Execution Agencies (ZEAs) in intervention states are empanelled. These ZEAs establishes Block level Execution Agencies (BEAs) for grassroots level implementation. The BEAs are mainly SRLM promoted Cluster level Federation/Block level Federations/Village Organizations of women self-help groups. BEAs have further set up Assembly & Distribution Centres (ADCs) at block level. These ADCs employ local rural people for the purpose of assembly, distribution & after sales services.

Training

4.65 The project puts emphasis on local skill development by introducing appropriate capacity building activities under 3 sets of training viz. (1) Technical Skills (2) Soft Skills (3) Business Skills. At a Block Execution Centre these training are designed to be completed in 20 days across project duration at a BEA (14 months).

GLIMPSE OF THE SOLAR STUDY LAMPS PROJECT

Women at the **Assembly & Distribution Centre** *in Gurua, Bihar*

***A lamp assembly line** at an Assembly and Distribution centre in Sisai, Jharkhand*

Training *of women self trainees at Latehar, Jharkhand*

Assembly & Distribution Centre, *BillimarKundi, Uttar Pradesh*

Solar Study Lamps distribution *in schools of Dhudhi, Sonabhadra, Uttar Pradesh*

Students Studying *under Clean Light of Solar Study Lamp at Khajuri, Uttar*

OFF-GRID SOLAR THERMAL PROGRAMME

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

4.66 National Programme on Solar Thermal is being implemented by Ministry of New and Renewable Energy aimed to promote the use of Renewable Energy sources to meet the thermal energy requirements in industrial, institutional and commercial sectors. Even with huge improvements in industrial sector, most of the thermal energy requirements are met using fossil fuels. Not only in industries, even for community cooking, space cooling etc. where there is requirement for huge thermal energy are still based on fossil fuels.

4.67 Concentrated Solar Technologies (CSTs) is one of such technology which can be used as sustainable source of thermal energy. CST works like a concave mirror, which focuses the Incoming Solar Radiation (INSOLATION) onto a receiver. The receiver gets heated up and the heat will be transfer to the working fluid, which can be used for various processes. Using this technology, a temperature of 90-350 OC can be reached, which is the temperature range required for most industrial and commercial applications. Industries having good potential for implementation of CST 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 modifications/tinkering to the existing setup which can help in reduce conventional fuels which in turn will help in reducing Green House Gases (GHGs) emissions. Some of the emerging concentrated solar technologies are Scheffler Dish, Fresnel Reflector based dish, Paraboloid dishes, Parabolic Troughs, Linear Fresnel, and Non-Imaging Concentrator (NIC/CPC).

4.68 During the financial year 2017 – 18, **11 Nos. of CST systems with 3130.2 m2 collector/ reflector area** were installed and commissioned and **48 Nos. of CST projects with 16555 m2 collector/ reflector area isunder installation** for process heating, air conditioning and steam cooking requirements in industrial, institutional and commercial establishment against the physical target of 20,000 m2 collector/reflector area.

4.69 BIS National Standards for various CSTs & Test methods were developed and Parts 1 to 3 & Part 5 were already published and Part 4 is in process of publication:-

IS 16648 Part 1: Dish Technology- Requirements and Specifications.

IS 16648 Part 2: Scheffler Technology – Requirements and Specifications.

IS 16648 Part 3: Parabolic Trough Concentrator – Requirements and Specifications.

IS 16648 Part 4: Non Imaging Concentrator – Requirements and Specifications.

IS 16648 Part 5: CSTs-Test Methods.

Some success stories of the F.Y 2016-17:

4.70 Shree Krishnayan Ganga Desi Gowraksha Gaushala, Haridwar is having 2500 cows with 80 staffs. In order to run the Goushala, they generated revenue by selling processed cow urine.

Electric heaters were used to heat the urine to 70 OC and are allowed to cool for removing Urea and then it is again heated to 160 OC converting it to steam. It is then condensed to the final product, Cow urine arak. To make this process more cost effective and to promote Renewable Energy, Pababolic Dish based Concentrated Solar Thermal (CST) System of 700 m² was installed by M/s. Green life Solutions Pvt. Ltd (**Fig. 1**). On an average the system delivers 160/kg/ day steam with a saving of about 128kWh of electricity benefiting a saving of approximately ₹ 5000/- per day.

Fig. 1.Paraboloid dishes

4.71 M/s Uttarakhand Cooperative Resham Federation Premnagar, C/o Directorate of Sericulture, Premnagar, Dehradunhas three numbers of Silk reeling units which requires 8000 LPD hot water for degumming of silk cocoon and silk yarn reeling process (**Fig. 2**). They are initially operated by using steam generated using 875 kg of firewood per day. In order to reduce the use of fire wood 295.5 m² of Non-Imaging Concentrator (NIC/CPC) were installed. The installed system is providing 8000 LPD hot water at the temperature of 85-90 OC. After installation of this system, use of firewood is reduced by 417 kg per day and approximately ₹ 2500 is being saved perday.

Fig. 2.Silk Reeling process

4.72 Gujarat State Electricity Corporation Limited (GSECL) has initiated its activities in the field of Generation of Power and has constructed solar and wind power projects including World's 1st Canal Top Solar PV project near Sanand. Similarly, the CST based air conditioning system is installed at Gandhinagar Thermal Power Station (GTPS) is one of the largest in India. Gujarat Energy Research & Management Institute (GERMI) developed and supervised this installations carried out by M/s. VSM Solar Pvt. Ltd. In this project, 1575 m² of NIC were installed for providing hot water at 90° C to the Vapour Absorption Machine (VAM) having 150 TR full load capacity (Fig. 3). Chilled water from VAM is circulated through three Air Handling Unit (AHU) providing conditioned air to all blocks. This VAM can reduce the

water temperature up-to 7° C in the summer. There are two coils namely (1) Heating coil and (2) Cooling coil arranged inside the AHUs for winter air conditioning and summer air conditioning respectively. System is designed to provide space heating, space cooling and dehumidification and hence, year round utilization of solar thermal energy. Also buffer tanks help storing water during the non-working days to further enhance comfort next day. Back-up electrical heaters ensures smooth operation of the system during non-sunny periods. The solar thermal AC plant of GTPS is the largest operational project of India. System is expected to deliver annual savings of INR 34 lakhs towards savings on electricity consumption and a payback of less than 6 years.

Fig. 3.CPC Collectors at GTPS, Gujarat and HUL, Amli

4.73 Hindustan Unilever Limited, Amli factory was using diesel (HSD) hot water generators (HWGs) to meet its daily demand (~50 kL/ day) of hot water for its process & cleaning needs. After considering the location of factory, having an average solar irradiation of 5.1 kWh/ hr/ m^2 and unused shadow free RCC roof top of 2300 sq. m, compound parabolic collectors (CPC/NIC) were selected and were installed in two phases by M/s. Thermax Ltd. (Phase – I: 136 m^2 & Phase – II: 816 m^2). The CST system (Phase – I and Phase – II combined) delivers hot water at the rate of 8 kl per hour at saving about 200 litres of Diesel (HSD) with a savings of approximately ₹ 12,000 per day. Installation of 163 m^2 is planned under the third phase.

Externally Funded projects

4.74 UNDP-GEF-CSH project 'Market development of concentrated solar technologies for industrial process heat applications was started in 2012 with a GEF support of USD 4.40 Million (Approx. ₹ 28.60 Cr.). Major objective of the project was to develop market of Concentrated Solar Heat (CSH) systems through public awareness, removing barriers and developing knowledge documents for various types of stakeholders.

4.75 During the current year following activities were undertaken in the project

- 2 issues of 'SUNFOCUS', quarterly magazine were published and dispatched to 1000 stakeholders.

- Around 50 field projects were completed and commissioned with accounts settled by releasing the sanctioned UNDP support to beneficiaries
- 4 video films (One of community cooking, 2nd on industrial process heat, 3rd on space cooling and 4th on all applications were prepared for use to various stakeholder)
- A Compendium pending 5 SUNFOCUS magazine was prepared and kept for use. Earlier a Compendium of 10 previous magazines was prepared.
- A booklet of 19 Case studies appeared in all the 15 SUNFOCUS magazine was prepared for use.
- 24 video clipping each of about 40-60 seconds on various field projects were prepared and are in process of uploading on CSH website.
- Two documents as per following were prepared on media activities as per the details given below:
    - o Development and implementation of a Communication Strategy aimed at public relation activities about CSTs in Mainline Dailies and Regional Papers – Anchor Stories on various Applications
    - o Development and implementation of a Communication Strategy aimed at public relation activities about CSTs in Regional Papers – Regional Stories on various Applications
    - o A booklet on 50 field systems visited by APITCO, Hyderabad with 2 page write up on each was prepared. Detailed report on GHG emission for 40 systems in the field was also prepared.

4.76 The project has ended on 31.12.2017. Major achievement were as follows:-

Field projects & Awareness

4.77 Level of awareness & interest on CSTs increased significantly through awareness workshops/ business meets & publicity campaign through newspapers and industrial/ commercial magazines (over 70 workshops/ business meets & 7 advertisement each in 3 Newspapers and 12 magazines done)

4.78 Number of installations & CST area almost doubled (50,000 sq. m. as compared to 25,000 sq. m. before start of project). Installations have spread to Industrial & Commercial establishments for various applications (Increased to around 50% as compared to 20% in 2012). Applications include milk pasteurization, medicine preparation, metal phosphating, flavoring of tobacco leaves, heat storage for use on non-sunshine hours etc.

4.79 Newer & better technologies have been introduced

4.80 First time the project proposals have started coming for implementation in ESCo. mode. 4 projects supported under CSHP.

4.81 800 state wise & sector wise potential assessment reports for various establishments in 20 States for generation of proposals.

4.82 A total of 130 projects with 35,000 sq. m. area were sanctioned with additional direct support of 10-20% from the project towards performance monitoring, O & M etc. including installation besides MNRE subsidy. All the projects have been commissioned with accounts settled.

Test Set Ups, Standards & Capacity Development

4.83 1st time in country, National & Regional Test Centers (Mobile & Immobile) has been established at NISE & UoP.

4.84 Booklets on component & material specifications of 6 CSTs are in place for quality guidance to suppliers & beneficiaries

4.85 On line performance monitoring made mandatory for all field projects supported under CSHP. Data started coming from 40 installations.

4.86 Training-cum-Awareness center established with WRST, Mount Abu. A total of around 20 training programmes organized with over 500 entrepreneurs/ ITI students trained.

Knowledge Documents

4.87 Over 25 knowledge documents have been developed in the project which include National Toll Free Helpline on Solar Energy, dedicated CSH website (www.cshindia.com) , monthly newsletter (electronic), booklets on component & material specifications, magazines, Case studies on different projects, Technology assessment report etc.

4.88 United Nations Industrial Development Organization (UNIDO), in association with the Ministry of New and Renewable Energy (MNRE), Government of India, is implementing a project entitled "Promoting Business Models for Increasing Penetration and Scaling up of Solar Energy" in India to promote deployment of CST technologies and support its commercialization by removing the barriers associated with them such as awareness, capacity building, as well as market barriers. The initiative also aims at standardization of CST performance measurement and spreading technology related information and knowledge.

Achievements

4.89 Financial support in the form of soft loan is being offered in partnership with IREDA:

- Loan for up to 75% of the project cost is available.
- Bridge loan against subsidy and at normal interest rate would be available
- Soft loan with an interest subvention of 5% is available for about 45% of the project cost. The funds under the UNIDO project would be used for subvention of the interest rate.

4.90 A nation-wide awareness generation initiative by the UNIDO project in form of focused workshops in twelve states, engaging the respective State Nadal Agencies and the local industry associations attracted participation by over 1300 representatives from the industry. As a part of this campaign, 18 visits to various CST sites were conducted to impart better understanding on the utility of the solar systems for various applications.

4.91 Partnership with National Institute of Solar Energy (NISE) has been formalized; as well as with International Expert/ Organization to ensure that the skill development trainings provided would be of international standards.

GREEN ENERGY CORRIDOR

4.92 In order to facilitate integration of large scale renewable generation capacity addition, the Cabinet Committee of Economic Affairs (CCEA) in Financial Year 2015-16 approved creation of Intra-state Transmission System in the states of Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu, rich in renewable resource potential and where large capacity renewable power projects are planned, at an estimated cost of Rs.10,141.68 crore with Government of India contribution from National Clean Energy Fund (NCEF) of Rs. 4056.67 crore. The activities envisaged under the project includes establishment of Grid sub-stations of different voltage levels with aggregate transformation capacity of approx. 19000 MVA (Mega Volt Ampere) and installation of over 8500 ckt-kms (Circuit kilometres) of transmission lines in these eight states. The creation of the Intra-State Transmission System will facilitate the evacuation of renewable power from generation stations to load centres.

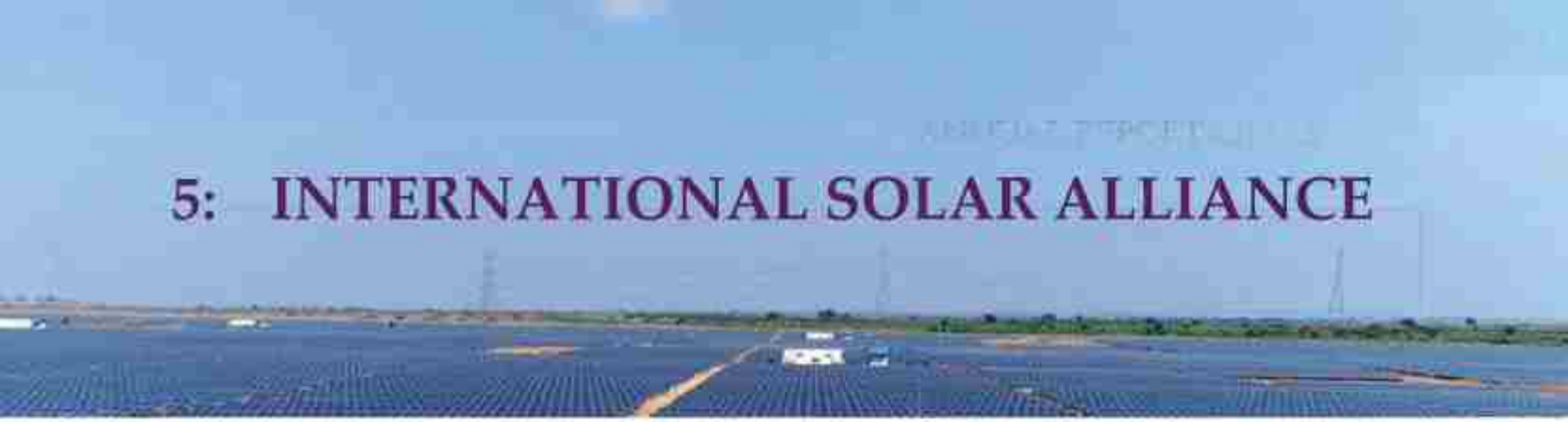
4.93 The project is scheduled to be completed by Financial Year 2019-20 with funding mechanism consisting of 40% NCEF Grant, 40% KfW loan (EUR 500 Million) and the remaining 20 percent as State contribution. As on 31.12.2017, a total of approx. Rs. 1389 crores has been disbursed to the States from the Government of India contribution, and works related to installation of transmission towers and its stringing for aggregate 1100 ckt-kms have been completed:

a) Andhra Pradesh: 400kV Quad Moose DC line from 400 kV Uravakonda Substation to 400 kV Hindupur Substation.

b) Tamil Nadu: (i) Rasipalayam - Palavadi 400 kV transmission line and (ii) 230 KV Transmission lines: Kayathar 400 kV Substation – Tuticorin Auto D/C line, Veeranam-Tirunelveli (PGCIL) Substation S/C line, Veeranam- Kodikurichi S/C line, Ingur- Arasur 400 kV Substation (PGCIL) S/C line, Arasur 400 kV Substation (PGCIL) – Gobi Substation S/C line and Cuddalore- SP Koil (Veerapuram) D/C line.

c) Karnataka: 400kV LILO line with twin Moose ACSR conductor from 400 kV Guttur-Guddadahalli S/C line to 400/220 kV Substation at Gadag (Doni).

d) Gujarat: (i) LILO of both circuits of 220 KV D/C Jamanvada – Varsana line at 220 KV Bhachunda M/C line and (ii) 220 KV D/C Radhanpur – Sankhari line.



5: INTERNATIONAL SOLAR ALLIANCE

INTERNATIONAL SOLAR ALLIANCE

5.1 On 6 December 2017, the International Solar Alliance (ISA) achieved yet another milestone.In conformity with ISA Framework Agreement, with ratification by Guinea as the 15th country on 6 November 2017, one month after the date on 6 December 2017 ISA has become full-fledged treaty based International intergovernmental organization headquartered in India. ISA Secretariat is located in the National Institute of Solar Energy campus, Gwalpahari, Gurugram, Haryana, India. As of 6 February 2018, 50 countries have signed and of these 22 countries have ratified the Framework Agreement of ISA.The ISA Founding Conference has been scheduled for 11 March 2018. The General Assembly of the ISA is planned for 20 April 2018 during RE-INVEST 2018 that is scheduled from 19-21 April 2018.

5.2 The ISA is an Indian initiative jointly launched by the Prime Minister of India and the President of France on 30 November 2015 in Paris, France on the sidelines of COP-21, the UN Climate Conference. It aims at addressing obstacles to deployment of solar energy at scale through better harmonization and aggregation of demand from solar rich countries lying fully or partially between the Tropic of Cancer and Tropic of Capricorn.

Shri Ananad Kumar, Secretary, MNRE, speaking in an event on ISA during CoP-23 at Bonn, Germany

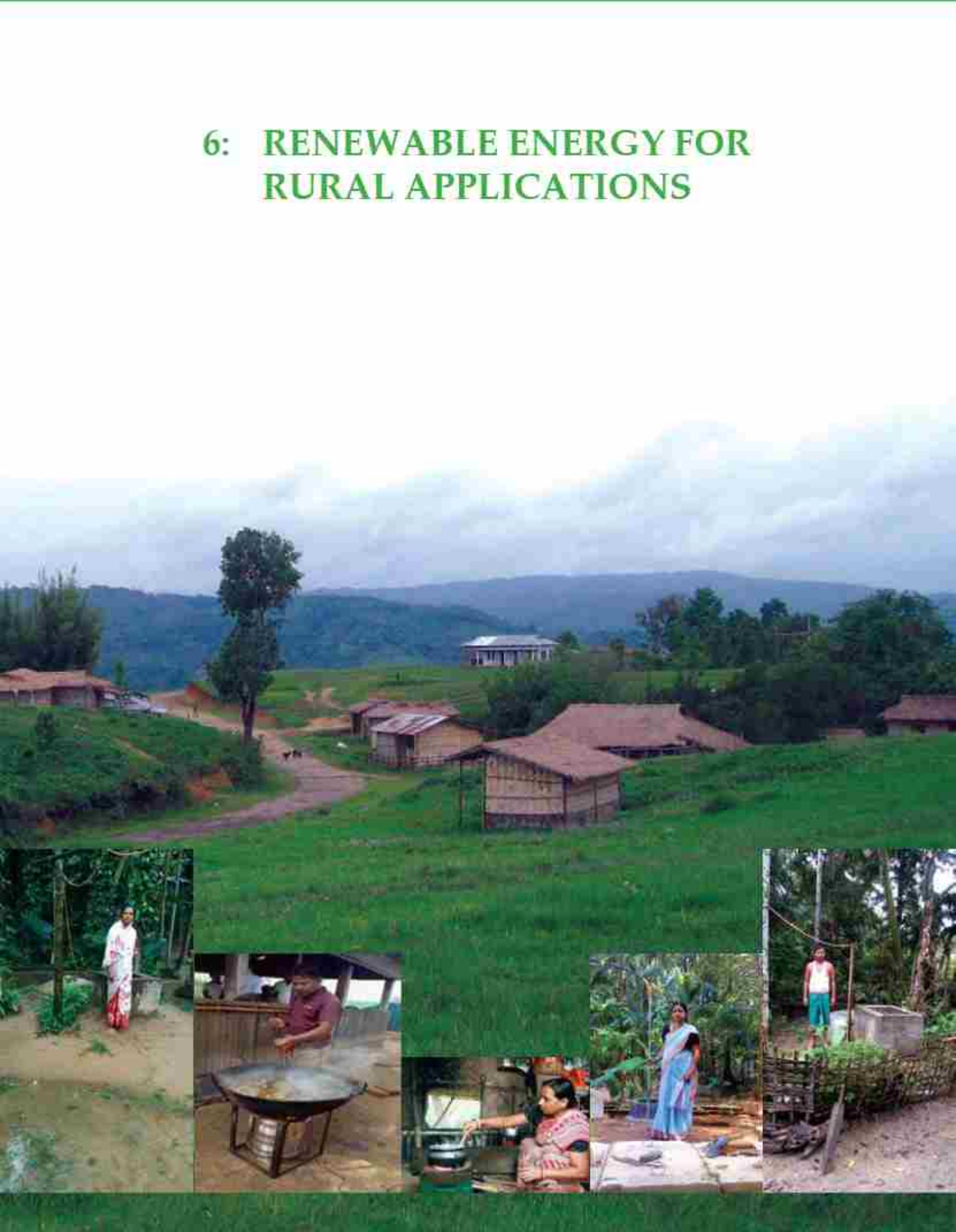
5.3 ISA Interim Secretariat has been operational as a de-facto organization on 25th January, 2016. Three programmes Scaling Solar Applications for Agriculture Use, Affordable Finance at Scale and Scaling Solar Mini-grids have been launched. These programmes will help in achieving the overall goal of increased solar energy deployment in the ISA member countries for achieving universal energy access and speeding up economic development. In addition to the existing 3 programmes, ISA has initiated plans to launch two more programmes: Scaling Solar Rooftops and Scaling Solar E-mobility and Storage.

5.4 ISA is in the process of developing a "Common Risk Mitigating Mechanism (CRMM)" for de-risking and reducing the financial cost of solar projects in the ISA member countries. The instrument will help diversify and pool risks on mutual public resources and unlock significant investments. An international expert group has been working on the blue print of the mechanism and it will be rolled out by December 2018. Another major initiative is establishment of DIGITAL INFOPEDIA which will serve as a platform to enable policy makers, Ministers and corporate leaders from ISA countries to interact, connect, communicate and collaborate with one another. The digital Infopedia will have three heads: (a) Member countries counter for investment opportunities; (b) at least 1000 best practices on solar energy (audio/visual), and (c) Member countries of ISA and the ISA Secretariat audio and visual interaction. The interactive platform was operationalized on 18 May, 2017.

5.5 The Paris Declaration establishing ISA 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 solar generation assets. This will help pave the way for future solar generation, storage and good technologies for each prospective member countries' individual needs by effectively mobilizing more than US$ 1000 billion dollars in investments that will be required by 2030.

5.6 India has offered to meet ISA Secretariat expenses for initial five years. In addition, the Ministry of External Affairs, Government of India has set aside US$ 2 Billion for solar projects in Africa out of Government of India's US$ 10 Billion concessional Line of Credit (LOC) for Africa. Government of France has also earmarked Euro 300 million soft loan for solar related projects in ISA member countries.

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.

NATIONAL BIOGAS AND MANURE MANAGEMENT PROGRAMME (NBMMP)

6.2 The NBMMP is a central sector scheme which aims to provide biogas plants as an asset for households, communities of households for meeting their clean cooking fuel needs in particular to rural/semi-urban households and organic manure for raising farm yield and productivity and maintaining the soil health. Biogas plants are, thus potential source of helping farmers in adopting organic farming. A biogas plant is a small farm infrastructure asset for farmers and household amenity for others.

6.3 The NBMMP is being implemented during the year 2017-18 as per the demand and physical targets received from the States through their designated State Nodal Agencies/Departments, KVIC and BDTCs. Under the NBMMP, a target for setting up 65180 family type biogas plants during the year 2017-18 have been allocated to all State Nodal Departments/ State Nodal Agencies and Khadi and Village Industries Commission (KVIC) and Biogas Development and Training Centers (BDTCs). Eight Biogas Development and Training Centers (BDTCs) were continued for providing training and technical and innovative support to the Programme Implementing Departments/Agencies during the year 2017-18. Against the annual physical targets of 65180 biogas plants allocated in first phase for 2017-18, about 20,000 family type biogas plants are reported to have been set up upto December, 2017. The State/ UT-wise details of the cumulative achievements upto 2016-17 and progress of current year 2017-18, (upto 31.12.2017) are given in **Table-6.1**.

2 m³ capacity. Dheenabandu modal biogas plant at Theyyangad, Ponnani, Kerala

Components of Central Finance Assistance

6.4 The MNRE provides subsidy and other supports as Central Financial Assistance (CFA) which have been effective since 08.05.2014 vide the Administrative Approval No. 5-5/2014-BE (NBMP) dated 30.06.2014 and continued during the year 2017 18 (upto 31.12.2017).

Progress and Achievements

6.5 Upto December, 2017 about 20000 biogas plants have been set up during the current year 2017-18. The cumulative potential and achievement under the scheme since inception till March, 2017 and targets and achievements during the year 2017-18 under the National Biogas and Manure Management Programme are given **Table-6.1**.

Table-6.1 State-wise estimated potential and cumulative achievements of family type biogas plants till 31st March, 2017 and Targets and Achievements during 2017-18				
State/Union Territories	Estimated potential (Plants in Nos.)	Cumulative physical achievements as on 31-03-2017 (Plants in Nos.)	Targets and achievements during 2017-18 (Plants in nos.)	
			Target	Achievements (upto 31.12.2017)
1	2	3	4	5
Andhra Pradesh	1065000	549235	6030	2250
Arunachal Pradesh	7500	3555	100	0
Assam	307000	130375	9000	4200
Bihar	733000	129844	-	NA
Chhattisgarh	400000	54825	2000	565
Delhi	12900	681	0	NA
Goa	8000	4230	0	NA
Gujarat	554000	433317	1600	641
Haryana	300000	62085	0	NA
Himachal Pradesh	125000	47650	100	25
Jammu & Kashmir	128000	3163	0	NA
Jharkhand	100000	7579	350	43
Karnataka	680000	491764	8000	1987
Kerala	150000	149568	2300	962
Madhya Pradesh	1491000	365689	8500	1910
Maharashtra	897000	899472	9200	3414
Manipur	38000	2128	0	NA
Meghalaya	24000	10196	800	0
Mizoram	5000	5412	300	146
Nagaland	6700	7953	400	0
Odisha	605000	270880	2400	542
Punjab	411000	177445	3650	1310
Puducherry	4300	578	0	0
Rajasthan	915000	71231	800	41
Sikkim	7300	9044	400	0
Tamilnadu	615000	222870	250	0
Telangana	-	22591	4100	0
Tripura	28000	3620	200	33
Uttar Pradesh	1938000	440713	700	0
Uttarakhand	83000	21558	1000	789
West Bengal	695000	366974	-	NA
A&N Islands	2200	137	0	NA
Chandigarh	1400	97	0	NA
Dadra & Nagar Haveli	2000	169	0	NA
KVIC	-	-	3000	1267
TOTAL :	**1,23,39,300**	**49,66,628**	**65,180**	**20,125**

Monitoring and Evaluation of NBMMP

6.6 The designated State Renewable Agencies/ State Nodal Departments, Khadi and Village Industries Commissions (KVIC) are implementing the NBMMP maintaining all data in hard and soft copies. The completion certificate by inspection of plants are issued by the concerned officials of the Programme Implementing Agencies on 100% basis. Further inspections are done by the SNA/SND, KVIC officials on regular basis. Uploading of beneficiaries year-wise, village-wise and district-wise lists is mandatory on the official websites of all the Programme Implementing Agencies. Physical inspections of biogas plants are also carried out by selecting from the list of beneficiaries on random basis inspecting at least 1000 biogas plant by each of the Biogas Development and Traning Centres (BDTCs) annually which are functioning under the NBMMP.

Evaluation study of NBMMP implemented during the 12th Five Year Plan period (2012-13 to 2016-17)

6.7 Ministry entrusted an evaluation study of the NBMMP implemented during the 12the Five Year Plan period (2012-13 to 2016-17) to an independent third party in December 2016. The study covered 10 States representing 6 major regions of the country. The study brought out in June 2017 its first draft report and final draft report in October, 2017 and overall functionality rate of 96.5% for the inspected plants sample surveyed.

3 m³ capacity Deenabandhu modal biogas plant at Village Dholbari, P.O-Dholbari, Dist-Lakhimpur, Assam.

2m³ capacity biogas plant at Shyampura, Piprali, Sikar, Rajasthan

UNNAT CHULHA ABHIYAN PROGRAMME (UCAP)

6.8 The Ministry is implementing Programme on Improved Biomass Cookstoves known as Unnat Chulha Abhiyan (UCA) Programme. The UCA Programme was launched on 27th August, 2014 and continued in 2017-18 with the objective to provide a clean cooking energy solution to household and community kitchen in rural areas where people are still dependent on solid biomass for meeting there cooking energy demand. In this Programme Improved Biomass Cookstoves are developed and disseminated to the beneficiaries. It is a central sector scheme.

Biomass Cookstove Test Centers

6.9 Improved Biomass Cookstoves are designed and developed by various manufactures in the country for better energy efficiency and lesser emission as compared to traditional cookstoves. The Ministry has developed unique test centres for performance testing of the Improved Biomass Cookstoves as per revised BIS (IS 13152:2013) specifications for its quality. The Test Centres of Improved Biomass Cookstove are established by MNRE at:

- Indian Instsiute of Technology (IIT) Delhi.
- Maharana Pratap University of Agriculture and Technology (MPUAT), Udaipur.
- Institute of Minerals and Materials Technology, Council of Scientific & Industrial Research (CSIR-IMMT) Bhubaneswar.
- Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE), Kapurthala.

6.10 Biomass Cookstove Test Centres (BCTC) also conduct training on operation and maintenance for State Nodal Agencies (SNAs), NGOs, project developers, industries, etc. engaged in implementation and promotion of cookstoves, in consultation with the Ministry.

BCTC, MPUAT, Udaipur

BCTC, IIT, Delhi

BCTC, IMMT, Bhubneshwar

BCTC SSS-NIBE, Kapurthala

The Target Beneficiaries

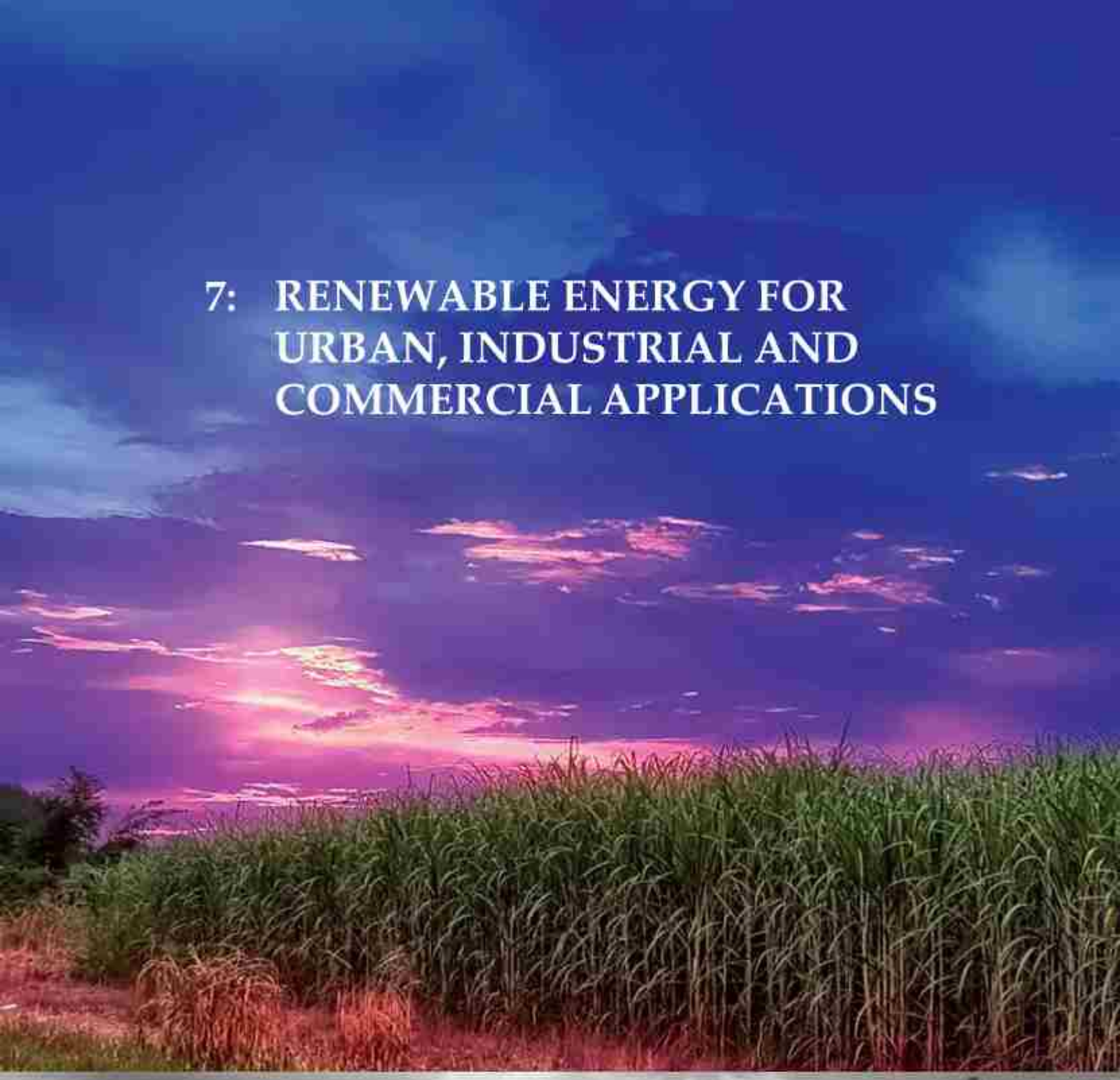
6.11 The target beneficiaries under Unnat Chulha Abhiyan (UCA) Programme are individual households in rural, semi-urban areas who still use solid biomass as fuel with traditional chulha for cooking purposes and community kitchens of Mid-day-Meal (MDM) scheme, Aangwadis, Forest Rest Houses, Tribal Hostels and small business establishments (road side dhabas, small hotels and restaurants and a variety of cottage industries like textile dyeing, drying of spices etc.)

Forced Draft Community Type Cookstove

Natural Draft Family Type Cookstove

6.12 During 2017-18, the Ministry continued the UCA Programme as it is a scheme for rural population. The target set at the launch of UCA Programme is yet to be achieved. During this year targets were given to Chhattisgarh State Renewable Energy Development Agency (CREDA), Odisha Renewable Energy Development Agency (OREDA) Kargil Renewable Energy Development Agency (KREDA) and Mizoram Energy Development Agency (ZEDA).

7: RENEWABLE ENERGY FOR URBAN, INDUSTRIAL AND COMMERCIAL APPLICATIONS



RENEWABLE ENERGY FOR URBAN, INDUSTRIAL AND COMMERCIAL APPLICATIONS

7.1 The programmes being implemented during the year include: i) Energy Efficient Solar /Green Building Programme; ii) Energy from Urban, Industrial and Agricultural Wastes/Residues; and iii) Energy from Urban, Industrial and Agricultural Waste/Residues including Biomass Co-generation (non-bagasse) in Industry.

ENERGY EFFICIENT SOLAR/GREEN BUILDINGS PROGRAMME

7.2 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.

- 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.
- 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. So far, '11' buildings have been awarded GRIHA Ratings.
- Capacity building programme including trainings, seminar, conferences, and 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.

7.3 Under this programme, so far, in the FY 2017-18, Rs. 0.36 Crore has been released towards reimbursement of different capacity building programmes.

DEVELOPMENT OF SOLAR CITIES PROGRAMME

7.4 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.

7.5 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 along with 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). So far, under the programme, '60' cities have been approved/ sanctioned, of which master plan of 49 cities has been prepared.

7.6 Presently five cities namely Bhubaneswar, Chandigarh, Gandhinagar, Mysore and Nagpur are being developed as 'Model Solar Cities' for which the financial support upto Rs.9.50 crore per Model Solar Ciry has been sanctioned.

7.7 Also '13' cities namely Agartala, Coimbatore, Rajkot, Shimla, Faridabad, Thane, Raipur, Shirdi, Leh, Aizawl, Puducherry, Vijayawada and Amritsar are being developed as 'Pilot Solar City' for which the financial support upto Rs.2.50 crore per Pilot Solar City has been sanctioned.

7.8 So far, cumulative Rs101.60 crore has been sanctioned and Rs 25.95 crore has been released under this programme.

GREEN CAMPUS

7.9 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. Upto March, 2017, Ministry has sanctioned financial assistance of Rs.2.60 crore @ Rs.5.00 lakh to '52' institutions (mainly technical/ educational institution) for preparation of Master Plan/ DPR for developing their campuses as green campus and an amount of Rs.1.02 crore is released to them till 31st December, 2017. However, only '13' institutions have prepared Master Plans, so far.

ENERGY FROM URBAN, INDUSTRIAL AND AGRICULTURAL WASTES/RESIDUES

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

7.10 During the year 2017-18, the Ministry has continued the implementation of the "Programme on Energy from Urban, Industrial and Agricultural Waste/Residues" aimed at generation of biogas, Bio CNG and Power from different wastes, such as municipal solid wastes, vegetable and other market wastes, slaughterhouse waste, agricultural residues and industrial wastes &effluents. About 100 tons/day of municipal solid waste have capacity to generate 1MW of power and 100 tons/day of cow dung can generate about 1600 kgs of Bio CNG per day. In addition to Bio CNG/Biogas, biogas plants generate organic fertilizer as a by-product which is valuable for agricultural fields.

New Initiatives taken by the Government of India

Swachh Urja Se Swachchata

7.11 During "Swachchata Hi Sewa" campaign, a Workshop on "Uses of Waste for Energy" was organized on 26th September, 2017 in New Delhi with a message of "Swachh Urja Se Swachchata" to utilize Waste for generation of energy through various proven technologies and established business models. The workshop deliberates upon how to utilize Waste for generation of energy through various proven technologies and established business models and how to scale up programme in close association with all stakeholders including corporate houses.

Ministry of Road Transport and Highways Notification

7.12 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).

Indian Standard on Biogas (Bio-methane)

7.13 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	90.0	IS 15130 (Part 3)
ii)	Moisture, mg/m^3 Max	16.0	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)	10.0	IS 15130 (Part 3)
iv)	CO_2 percent, Max (v/v) (when intended for filling in cylinders)	4.0	IS 15130 (Part 3)
v)	O_2 percent, Max (v/v)	0.5	IS 15130 (Part 3)

Progress during the year 2017-18

7.14 During the year 2017-18 following 11 projects were commissioned/supported as on December,2017.

Commissioned/Supported Projects

i) A grid connected power plant of capacity 16MW based on Municipal Solid Waste was setup by M/s. Timarpur Okhla Waste Management Company Ltd. (TOWMCL) at Old NDMC Compost Plant, Okhla, New Delhi.

ii) 4 Biogas generation projects of installed capacity of 56,500 cubic meter per day for thermal application from industrial effluents/urban waste were set up in Andhra Pradesh and Uttar Pradesh.

iii) 5 projects of cumulative production of 14,710 kg/day of Bio-CNG, were commissioned in Gujarat, Haryana, Madhya Pradesh and Uttarakhand. A brief on these projects is as under:-

- A plant for production of 6000 kg/day of Bio-CNG from 14,000m³/day of biogas generated from Urban waste was set up by M/s. Greenearth Biogas Pvt Ltd. in Surendranagar District, Gujarat;
- A plant for production of 600kg/day from 1500 m³/day biogas from poultry litter was set up by M/s Sarovar Agro Farms & Biogas Pvt. Ltd. in Ambala District, Haryana;
- A plant for production of 1450 kg/day of Bio-CNG from 4000 m³/day from poultry litter was setup by M/s Punchkula Farms Pvt. Ltd in Punchkula District, Haryana;
- A plant for production of 1200 kg/day of Bio-CNG from 3000 m³/day from cattle dung was setup by M/s Shri Dayoday Urja Evam Jaivik Khaad in Bhopal district, Madhya Pradesh.
- A plant for production of 5460 kg/day of Bio-CNG from 12000 m3/day from paper industry effluent was setup by M/s Century Pulp & Paper in Nainital District, Uttarakhand.

iv) A 40 kW off-grid Power plant based on biogas for captive use from dairy industry effluent was setupby M/s Vadilal Industries in District Gandhinagar, Gujarat.

7.15 In addition to above, 3 projects of biogas production with cumulative capacity of 48,500 cubic meter per day, 2 projects of cumulative 4000 kg/day Bio CNG generation and one project of 0.5 MW off-grid power generation project in different states were sanctioned and are expected to be commissioned by July2018.

7.16 So far, 24 Grid interactive projects of about 138 MW installed capacity, 70 off-grid power projects of 111.4 MW capacity, 74 biogas generation plants of 5,97,120 cubic meter per day generation capacity and 12 Bio CNG generation plants of 46,628 kg per day generation capacity have been set up in the country.

Shri R.K. Singh Hon'ble Minister of State (IC) for Power and New & Renewable Energy addressing during Workshop on Swachh Urja Se Swachchata

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

7.17 The Ministry has been promoting "Programme on Energy from Urban, Industrial and Agricultural Wastes/Residues" including Biomass Co-generation (non-bagasse) in industries for exploiting the potential of biomass power in the form of thermal energy and power for captive use in industry.

1.5 MW biomass co-generation project installed at Sansarpur Terrace, Kangra, Himachal Pradesh

Progress

7.18 A cumulative capacity of 662 MW has been commissioned upto 31.12.2017 mainly in the states of Tamil Nadu, Uttar Pradesh, Haryana, Karnataka, Andhra Pradesh, Uttarakhand, Punjab and Rajasthan. State wise details are given in below table.

State-Wise List of commissioned Biomass (Non-Bagasse) Projects:

S. No.	State	Installed Capacity (in MW)
1	Andhra Pradesh	98.98
2	Chhattisgarh 8	2.50
3	Haryana	78.26
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	128.10
12	Bihar	8.20
13	Rajasthan	2.00
14	Jharkhand	4.30
15	Uttar Pradesh	170.41
16	Uttarakhand	47.50
17	West Bengal	19.92
18	Tamilnadu	28.55
	Total	**662.61**

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

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

8.1 Technology development, validation and standardization are the core requirements for the growth of New & Renewable Energy. In this endeavor, the Ministry New & Renewable Energy (MNRE) 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 systems and devices including integration for large scale use of new and renewable energy in the country. 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.

8.2 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, storage, small hydro power, biogas, hydrogen and fuel cells, geothermal, etc. Thrust areas are identified for RD&D. Other activities taken up during the current year include adoption of satellite based tools for wind and solar resource assessment and power forcasting, scheme for awards for innovative ideas and support for entrepreneur development for widespread deployment of New and Renewable Energy for various applications in the country.

Policy and Guidelines

8.3 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 in association with industry to facilitate commercialization. Ministry provides upto 100% financial support to Government/non-profit research organizations/NGOs and 50% to industry.

8.4 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. The projects are monitored by Monitoring Committees. Projects on completion are reviewed in Project Appraisal Committee Meetings for their achievements.

RD&D Focus

8.5 The RD&D efforts are continued with emphasis on cost reduction and efficiency improvement. The thrust areas identified in solar thermal, SPV, biogas, wind, wind-hybrid, storage, small Hydro Power, hydrogen and fuel cells, geothermal, etc. are supported for RD&D Activity. In solar, the focus has been developing high efficiency solar cells, new solar cells,storage and power electronic systems. Projects in solar thermal power generation utilizing solar concentrating technologies have been taken up for technology demonstration and validation for scaling up deployment for power generation and industrial process heat applications including storage.

One such project, 1MWe (3.5MW)Solar Thermal Power Plant with 16 hours thermal storage has been set up for continuous operation at Mount Abu by World Renewal Spiritual Trust (WRST), Mumbai. The project is based on solar concentrating dish technology and storage system. In SPV, a major R&D project "National Centre for Photovoltaic Research and Education (NCPRE), which was taken up in 11th Plan Period at IIT, Bombay was continued in March 2017 for further five years for improving efficiency of crystalline Silicon Solar Cell from 18% to 22% at Lab Scale, apart from R&D in other solar cell materials. In hydrogen and fuel cells, the focus is on technology development and demonstration for hydrogen production and storage for stationary and transport applications.Start-ups for entrepreneur development in renewable energy sector have been supported under an on-going project sanctioned to Centre for Innovation, Incubation and Entrepreneurship (CIIE), IIM, Ahmedabad.In addition to ongoing projects, RD&D projects in the areas of solar thermal, SPV, battery storage and related components, Biogas, hydrogen and fuel cell, small hydro were sanctioned to various R&D/academic institutions, industries for implementation during the current year.

Institutional Mechanism

8.6 The Ministry is supporting creation of enabling conditions for institutional mechanism for collaboration for faster development and demonstration of technology for commercialization. The Ministry has taken initiatives strengthening its 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, testing, standardization and certification in solar, bioenergy and wind energy systems, respectively. The objective is to transform them to world class R&D institutions in the respective areas. Centres of Excellences have also been supported at R&D/academic institutions for pursuing research in advanced areas for technology development and training for promotion of R&D in the respective areas.

8.7 In addition, the MNRE is also partnering with MHRD for implementation of research projects in NRE under IMPRINT and UAY initiatives. These initiatives envisage supporting projects in consortia including industry for technology development on cost sharing basis by partner ministries/departments/industries. The MNRE has agreed to support one project on thermal storage with 50% cost of the project under IMPRINT.

Review of RD&D Programme

8.8 Secretary, MNRE reviewed the progress of RD&D projects funded by MNRE in 12th Plan Period in Jan/Feb 2017 to take stock of achievements and for taking steps to support RD&D in focused manner with emphasis on applications oriented R&D associating industry. The review focused on supporting research and innovation which leads to indigenous development and manufacture of new and renewable energy systems/devices for widespread promotion of new and renewable energy for various applications in the country. It was considered that the RD&D policy and guidelines may be revised orienting the policy framework for supporting projects aiming at applications and scalability.

8.9 In pursuance to the Ministry constituted "Panel of Experts" for evaluation of RD&D Programme implemented in 12th Plan Period. The subject-wise "Panel of Experts" appraised projects in respective areas during 14-17th September, 2017 and submitted the evaluation report to MNRE.

The Panel of Experts made recommendation for strengthening RD&D Programme with suggestions for action on support and monitoring of projects.

New Interventions

8.10 Keeping in view the fast development in technology due to sustained technology innovation across the globe, the R&D infrastructure created in the country and also "Mission Innovation" that was launched in Paris on 30.11.2015 on the sidelines of the UNFCCC's COP21, an initiative was taken to prepare a policy which encompasses technology development, demonstration, validation, innovation and start-up with a robust framework and ecosystem aiming at promoting indigenous technology development and manufacture, improving quality and reliability of energy supply. The Ministry has prepared a comprehensive programme for RD&D for Technology Development, Demonstration, Innovation, Validation, Testing and Standardization for RE Sector for the period 2017-18 to 2019-20.

Lab Policy for Testing, Standardization and Certification

8.11 The MNRE has initiated the process of making standards mandatory for the entire renewable energy sector. In this regard, the MNRE has brought out a "National Lab Policy on Testing, Standardisation and Certification for Renewable Energy Sector" for quality control. The said policy has brought out clarity about the need of testing and standardization, making the testing and standardization mandatory for entire renewable energy sector with comprehensive plan for strengthening/expanding test labs for the purpose. The policy is an endeavour to ensure reliability and consistency in manufacturing of renewable energy systems/devices. The Lab Policy has been launched on 7th December 2017 and uploaded on MNRE web for implementation.

Notification for Quality Control of SPV Systems/Components

8.12 In view of the enhanced target of 100 GW solar power, the MNRE in September 2017 brought out a Quality Control Order for SPV Systems/Components under BIS Act for quality control in SPV power projects. The said Quality Control Order has been notified in government official gazette on 5th September 2017. As per the said order all solar photovoltaics products listed in the same shall follow Indian Standards with effect from expiry of one year from the date of publication in official gazette. Any manufacturer, who manufactures, stores for sale, sells or distributes Goods, shall make an application to the Bureau of Indian Standards for obtaining registration for use of the "Standard Mark" in respect of the Indian Standards given in the same. This is a major step taken by the Ministry for quality assurance in view of major import of solar panels.

8.13 The MNRE initiated action for implementation of the Quality Assurance Order. In this regard, the Ministry has decided to reduce the period for enforcement of the said order making it effective with effect from 1/4/2018 so as to ensure quality of the products in the target of solar power projects in the year 2018-19. Secretary, MNRE has taken series of meetings with test labs, industries, project developers, experts, representatives from BIS and Department of Commerce, to review the preparedness of test labs for testing the products listed in the schedules of the order such as SPV Module, Inverters, and Battery Storage.All test labs have been directed to

expedite. NABL accreditation followed by recognition by BIS. New test labs are also planned to be set up in private and government institutions.

Scheme for Awards for Innovative Ideas in New & Renewable Energy

8.14 In July 2017, the Ministry launched a scheme for "Award for Innovative ideas in New & Renewable Energy- Abhinav Soch-Nayee Sambhawanayen" to encourage innovation in the sector. The scheme envisages to organize a national level competition at National Institute of Solar Energy Gurgaon for deciding the wards. The awardees will be given cash prizes for their innovation, who will be supported further for scaling up their innovation. The activity has been integrated with TDIP with a provision for support to innovative ideas recognized till commercialization of products.

Space Technology based tools for renewable energy resource assessment

8.15 The Ministry has 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) were initiated. As follow up to interaction, activities on validation of satellite based wind and solar data against the ground measured data is being pursued by NIWE. NIWE and SAC are also working for wind and solar power forecasting for Tamil Nadu State.

Start-Ups

8.16 The MNRE in February 2011 sanctioned a project "Centre of Excellence to help in scouting and mapping, designing, development and piloting of new and innovative ideas in solar and other renewable energy sector" with total project cost of Rs. 48,00,00,000/- (Rs. Forty Eight Crore), to CIIE, Ahmedabad with a grant-in-aid of Rs. 24,00,00,000/- (Rs. Twenty four crore only) by the Ministry of New and Renewable Energy. The balance cost was to be mobilized by CIIE, IIM Ahmedabad through private investors. Under this project 40 prototyping/piloting and 18 scale-ups have been supported in renewable energy sector. Out of Rs.24 crore sanctioned for the project, a total of Rs.19.4 crore has been released to CIIE for the project till March 2017. CIIE, Ahmedabad has also mobilised Rs.84 Crore from the INFUSE Funds. The project envisages to support a few scale-ups during the current year.

SOLAR R&D

8.17 The details of activities being carried under Solar R&D are given below:-

Solar Photovoltaic

8.18 For the project entitled "Facilitating the target of 100 GW solar by 2022: An inclusive analysis towards achievement" being implemented by the National Institute for Advanced Studies (NIAS), Bangalore, an introductory white paper was written and two workshops, one at NIAS (**Fig.1**) and the other in New Delhi, conducted. The two objectives, namely i) Report on

100 GW by 2022 and beyond and ii) Dissemination workshop with stakeholders in New Delhi (planned for end of February 2018), are slated for completion by March 2018.

Fig. 1 Participants from government, industry, academia at Workshop 1 held at NIAS, Bangalore

8.19 The Ministry's flagship project in solar photovoltaics being implemented at IIT Bombay and christened National Centre for Photovoltaic Research and Education (NCPRE) Phase II, had several major areas. The progress made in each of these areas is briefly described below.

(a) **Education and Training :** Seven short-term courses Organized on different aspects of Solar PV for academia and industry. Published book on anti-reflection and light trapping in c-Si solar cells (**Fig. 2**).

(b) **Crystalline Si Solar Cells:** Achieved cell efficiency of 18.5 % on 6 inch pseudo square, Al:BSF solar cells. For other cell structures, i.e. PERC and IBC, plans are afoot to use Cu metallization, screen-printed junctions and solution processed passivation layers. An indigenous Ag paste developed jointly with a cell manufacturer that is presently undergoing trials in the manufacturer's production line. Also, developed texturing process for mc-Si wafers sawn using diamond wire saw (DWS).

(c) **Thin Film Materials and Devices:** Organic solar cells (OSCs) and OLEDs have been developed and studied for their performance. Also, perovskite based OLEDs have been prepared (**Fig.3**).

(d) **Energy Storage:** Developed Li-ion cells that can store 2.5 times energy in volume compared to the current technology. Also, 12 V LED glowing with the LiB cells have been developed (**Fig. 4**). While the batteries developed compare favourably with the commercial ones, these are particularly suitable for grid applications.

(e) **Power Electronics :**

- A transformer less, inverter system developed for rooftop PV system working in both on-grid and off-grid modes, with or without battery storage and with over 96 % efficiency (**Fig. 5**).
- A universal control for multifunctional operation of inverters in a micro-grid environment has been developed for controlling the line voltage.
- A high efficiency, permanent magnet, BLDC motor has been developed (**Fig. 6**) that incorporates MPPT and features a position estimating system for the rotor. It can be used in PV based rural, submersible water pumping applications.

(f) **Module Reliability:** Conducted all-India survey of PV modules together with NISE team. Won best poster award at the PV Reliability Workshop held at Lakewood, Colorado, USA (**Fig.7**).

Devised a quick method to identify with thermography hot-spots and other temperature inhomogeneity in PV modules.

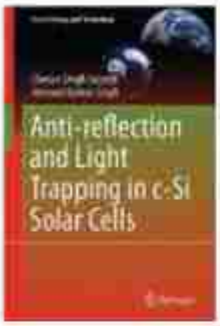


Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

8.20 In the other MNRE sponsored projects with a large outlay being implemented at Indian Institute of Engineering Science and Technology (IIEST), Shibpur, the areas of development included thin film solar cells and BOS components and systems.

8.21 The development in thin film solar cells featured development of single junction, a-Si solar cell (9.7% efficient with 17% light induced degradation), microcrystalline solar cells (efficiency of 8.5%), double tandem cells (12 % efficient) and HIT solar cells (16.5 % efficient).

8.22 The development in BOS components and systems comprised i) a set of pre-commercial, high efficiency (>= 80% with 20% partial load), robust and cost-effective Central Charging System developed for Solar Lanterns with LED lamps with built-in Overcharge Charge Protection (OCP) and with performance monitoring units like charging current and voltage of each lantern (**Fig. 8**), ii) a 96V/4kVA grid interactive solar PV inverter (**Fig. 9**) with an efficiency of 90% , iii) a Grid-tied single-phase, string type 1kW inverter having a transformer-less design and a compact structure (**Fig. 10**) and with a Total Harmonic Distorsion (THD) of the injected current < 5%, unity power factor and an overall efficiency of 90% at full load condition, and iv) an efficient MPPT based solar PV battery charge controller (**Fig. 11**) with a power conversion efficiency and tracking efficiency of above 90% and 95% respectively.

8.23 An efficient solar PV turbo charger for super capacitor has been developed. Each super capacitor bank having 2.7 Volts and they are connected in series to have fully charged voltage of 13.5 Volts.

Fig. 8

Fig. 9

Fig. 10

Fig. 11

8.24 Thin film solar cells based on perovskite has generated a lot of interest in the scientific world due its potential of delivering high efficiency solar cells. In this direction, the MNRE sponsored project being implemented at IIT Bombay has made good progress. The latest report includes claim of 20 % efficient, small area perovskite solar cells (**Fig. 12**) and a degradation of around 10 % over 3500 hrs (**Fig. 13**). A cross-sectional SEM picture of a typical perovskite solar cell being developed has been shown in **Fig. 14**.

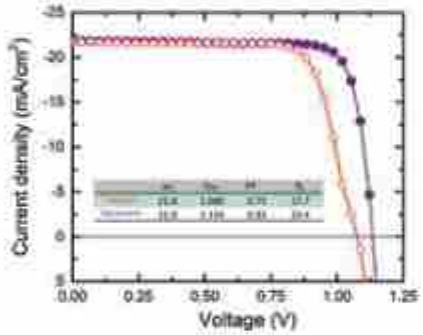


Fig. 12

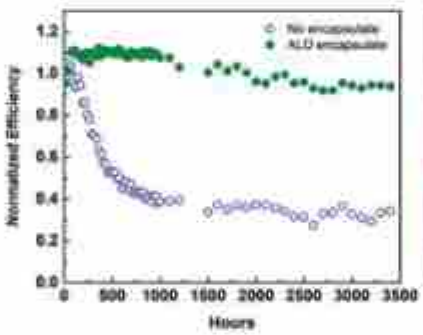


Fig. 13

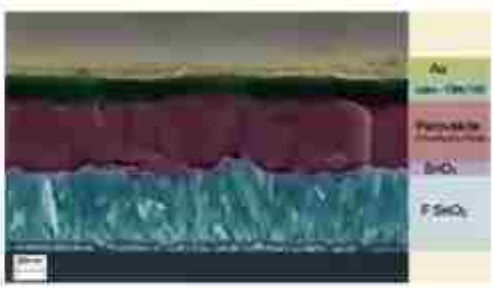


Fig. 14

8.25 The high efficiency and good stability have been developed with a low temperature process (~100 ° C) and use of atomic layer deposited oxides over the active layer for encapsulation.

8.26 MNRE has also sponsored research in the area of growth of silicon material (ingots and wafers) in the country. In a project being implemented at the SSN College of Engineering in Tamil Nadu, a facility has been created with indigenous efforts for growing multi-crystalline silicon ingots through directional solidification (DS) process. The equipment has been fully commissioned (**Fig. 15**) and is being employed to routinely grow multicrystalline silicon ingots (**Fig. 16**). The ingots have been diced into bricks and sliced to produce multicrystalline silicon wafers having minority carrier lifetimes of 0.47 micro second (target: 6 micro second).

8.27 As against the routine p-type silicon wafers that is used for solar cells, the ones with n-type Si wafers have shown the potential for higher solar cell efficiencies. In an effort to make solar cells using n-type Si wafers, the Meghnad Saha Institute of Technology (MSIT) in Kolkata has set up the facility and started making these solar cells with an improved process. It entails surface texturing, impurity diffusion from BBr3 source, use of different combination of thin films for the

Fig. 15

Fig. 16

anti-reflection coating and rear passivation etc. Preliminary efforts have resulted in solar cells with 15 % efficiency on 54 sq. cm areas.

8.28 In a project aimed at providing drinking water to the masses, NISE has combined with Surya Enertec, a Gurugram-based private company in developing Solar-powered Clean Drinking Water Systems suitable for various locations in the country. The first system (500 LPH, AC pump) installed at the NISE campus (**Fig. 17**) has been functioning satisfactorily for the past 9 months and has provided 1.5 lakh litres of pure drinking water for the employees of NISE and ISA. The design of future systems based on DC pumps and smaller capacity (100 LPH) is ready and would soon be taken up.

Fig. 17

8.29 Apart from this, MNRE sponsored R&D projects also include National Primary Standard facility for cell calibration, being implemented at the National Physical Laboratories (NPL), Delhi, inverter other BOS development projects at Vignan Institute of Technology and Science (VITS), Hyderabad, at ERDA, Ahmedabad, at BITS, Pilani etc.

Solar Thermal

8.30 In one of the completed projects entitled "Development of Modular Central Receiver Concentrated Solar Power Plant for Decentralized Power Generation", design and fabrication of prototype receiver have been completed and currently being tested for its performance at NISE.

8.31 Another major completed project is on solar thermal power entitled "Development of a Megawatt Scale National Solar Thermal Power Testing Simulation and Research Facility", which has been installed and tested for its functionality at NISE by IIT, Bombay. The plant is ready after servicing.

8.32 A Calibration Laboratory for calibrating the instruments installed in the field under Solar Radiation Resource Assessment Project sanctioned by the Ministry. The laboratory follows all the International standard procedures for calibration of sensors as specified by World Metrological Organisation (WMO) and also by Regional Radiation Center eg; IMD Pune. This project has been implemented by Solar Energy Corporation of India (SECI) in collaboration with NISE, funded by MNRE. Several Pyranometers and Pyreheliometers received from various field stations have been tested.

8.33 Setting up of 1 MW el (3.5 MW) solar thermal power plant with 16 hours thermal storage for continuous operation based on parabolic dish solar concentrators designed and fabricated indigenously, at an estimated solar to electricity efficiency of about 12%. The configuration of power plant will include 750 solar dishes having a provision of thermal storage and each having 60 square meter aperture area. The estimated output of the power plant will be i) electrical power of 1 MW el. x 8 hours; ii) electrical power of 800 kW x 16 hours; iii) cogeneration of 1 million liters of hot water and iv) 8 tons of steam for 24 hours. This project has been successfully completed and now under further investigation.

8.34 Centre for Excellence in Solar Passive Architecture and Green Building Technologies at CEPT University, Ahmedabad established during 2011 and 2016 under grant from Ministry of New and Renewable Energy, Government of India. Centre was established to enhance the energy efficiency of the building by adopting enhanced construction materials and technologies, create advanced knowledge about thermal comfort and integration of renewable energy in buildings. Centre has met its objectives by providing technical inputs in policy making, providing solutions to achieve energy efficiency to architects and engineers and by developing teaching tools for students. Laboratory infrastructure established under MNRE grant has become one of the best laboratories in south-east Asia.

8.35 At MIT, Pune, Desiccant & Ejector concept based system is being developed on Proto basis for application in Air conditioning. It is intended to substitute commercially used Compressor based air conditioning systems by utilizing solar energy harnessed using solar concentrator. The scope includes designing, testing and performance evaluation of both type concepts. Currently, Proto type for Ejector system is getting ready for Performance evaluation while the conceptual design of Desiccant system is in final stages.

8.36 Several laboratories/facilities are setup on solar thermal research and education at IIT Jodhpur viz. (a) Solar Resource Assessment, (b) Material Characterization, (c) Solar Thermal, (d) Optics, and (e) Instrumentation and Smart Grid. Both research and teaching activities are actively undertaken in these laboratories leading to development of (a) a tool for resource estimation, (b) high temperature coatings and storage materials, (c) an open volumetric air receiver, (d) a solar air tower simulator facility, (e) the novel concept of solar convective furnace, (f) a radiation calorimeter, (g) a glass-to-metal seal (h) the capability of field design, (i) a PV based 20kW dc micro-grid for integration with other renewable sources.

8.37 Indian Institute of Science (IISc), Bangalore, has developed its first prototype of pressurized air solar receiver, as part of the project titled "Development of High Efficiency Receiver for Supercritical CO2 Integrated with Static Focus Parabolic Dish". This hybrid volumetric and cavity type receiver design consists of open-end dome-end cylindrical cavity surrounded by concentric annular porous medium, as shown in the figure below. Receiver design provides flexibility of testing different materials – steel mesh, ceramic honeycomb and foams. The receiver is to be field tested with a Scheffler dish concentrator having a fixed focus.

Green building testing laboratory

8.38. Central Tasar Research & Training Institute (C.T.R & T.I) Ranchi, Jharkhand has taken a lead in "Utilization of solar energy in Trasar post cocoon technology operations" Tasar Silk industry in India is Cottage Industry with an agriculture base and of labour intensive in all its stages i.e. cocoon stifling / drying, cooking reeling, spinning and the post-yarn stage processes like degumming, bleaching, dyeing, printing and mechanical finishing etc. Solar energy can prove to be a cheap, localized source of energy for Tasar silk industry of India. At C.T.R & T.I, Ranchi one 10KWp roof top hybrid solar power plant has been installed and one Hot air dryer for stifling & drying of tasar cocoon is being operated by solar power on trial basis.

Solar receiver fabricated at IISc, Bangalore

Completed projects:-

8.39 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.**

8.40 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. A similar floating solar power plant is now being proposed by Kerala Govt. in line with this R&D project's achievements and a new scheme is under process.

Solar Radiation Resource Assessment (SRRA) Stations

8.41 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 4 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.**

SMALL HYDRO POWER

8.42 Two R&D Projects supported by Ministry are ongoing in IIT Roorkee in the area of Hydro power focused on "Development of Efficient Cross Flow Turbine for Hilly Region" and Development of laboratory for sediment monitoring and impact analysis studies in Hydro Power plant. The R&D project for establishing a Small Hydro Hydraulic Turbine Laboratory at AHEC,IIT Roorkee was supported by this Ministry. The project aims at setting up of Small Hydro Turbine testing Laboratory, Model Testing of hydraulic turbines, human Resource Development, Design and R&D in the area of hydro turbines including hydro-mechanical equipment, control and instrumentation of small hydroelectric power plants.

BIOGAS RESEARCH, DESIGN AND DEVELOPMENT

8.43 Biogas Technology Development Division promotes research and innovation and persuaded projects for Research, Design, Development and Demonstration in Biogas Technology area. Ministry funded three R&D projects are ongoing for "Development & Performance Evaluation of a 3 kW biogas based power generation system utilizing Lignocellular Biomass", "Development of Hybrid-High rate Bio-methanation Reactor using locally available media for treating waste water and solid waste"; and "Development of Suitable Pre-treatment System for Paddy Straw Disintegration for Biogas Generation Leading Towards Commercialization of Technology "at IIT-Guwahati, Tamil Nadu Agricultural University, Coimbatore, and Centre for Rural Development and Technology, IIT Delhi, respectively. The R&D project entitled "Design and Development of Mobile Unit for Biogas Enrichment funded to IIT, Delhi was completed in 2017-18".

Experimental set-up for Bio-methanation reactor at TN&U Laboratory

Laboratory scale hydrothermal reactor at IIT, Delhi

A view of hydrothermally pretreated paddy straw at IIT, Delhi

Biogas production studies in 100 L continuous feed digester at IIT, Delhi

HYDROGEN ENERGY AND FUEL CELLS

8.44 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 31.12.2017, a total of 22 RD&D projects on different aspects of hydrogen energy and fuel cells are under implementation.

8.45 On-going projects include development of electrolyser based hydrogen dispensing station at Indian Oil Corporation, Faridabad; Hydrogen fuelled vehicles developed by IIT Delhi and Mahindra & Mahindra (3-wheelers, mini-bus); Hydrogen Production facilities through biological routes at IIT Kharagpur and through biomass gasification at IISc Bangalore; and development of Hydrogen Storage materials (solid hydrides) at Banaras Hindu University.

8.46 RD&D Projects on "Development and Demonstration of Diesel Hydrogen Dual Fuel SUV" by Mahindra & Mahindra, "Mission Mode Project on Hydrogen Storage in Carbon Materials" by IIT Madras, "Development and Demonstration of Hydrogen Fuelled Multi Cylinder SI Engine Generator Set for Stationary Power Generation" by IIT Delhi, "Mission Mode Project on Hydrogen Production through Biological Routes" by IIT Kharagpur and IICT Hyderabad, and "Demonstration and performance evaluation of various technologies of hydrogen energy" by National Institute of Solar Energy, completed during this year.

8.47 In August 2017, Ministry constituted a Panel of Experts for evaluation of RD&D project proposals and re-constituted the four Project Monitoring Committees for independent monitoring and evaluation of RD&D projects being implemented with Ministry's support in the Hydrogen Energy and Fuel Cells domain.

Fuel Cell bus developed by Tata Motors demonstrated at the event in IIT Bombay

8.48 National Consortium Advancing Hydrogen and Fuel Cell Technology was organized by the Ministry in collaboration with Tata Group on 15 December 2017 at IIT Bombay. The event saw participation from subject area experts from industry, academia, and consulting groups. Hydrogen and Fuel Cells Technologies and prototypes developed in the country, including with MNRE support, were exhibited during the event.

9 : SPECIALIZED INSTITUTIONS

SPECIALIZED INSTITUTIONS

NATIONAL INSTITUTE OF SOLAR ENERGY (NISE)

9.1 National Institute of Solar Energy (NISE), an autonomous institution of Ministry of New and Renewable (MNRE), is the apex National R&D institution in the field of Solar Energy. The Government of India converted the 25 year old Solar Energy Centre (SEC) under MNRE to an autonomous institution in September 2013 to assist the Ministry in implementing the National Solar Mission and to coordinate research, technology and other related work.

9.2 NISE has assumed all technical activities of SEC and has also re-organized itself to undertake roles and responsibilities assigned to it by the Ministry. The institute is involved in demonstration, standardization, interactive research, training and testing of solar technologies and systems, serving as an effective interface between the Government and institutions, industry & user organizations for development, promotion and widespread utilization of solar energy in the country.

9.3 NISE is maintaining an NABL accredited Solar Photovoltaic module testing laboratory, lighting system test laboratory, battery testing facility and a water pumping system test rig and outdoor test facilities. The Institute has fully developed testing facility for small and large size solar thermal systems and Solar Resource Assessment.

9.4 A new building named "Surya Bhavan" and 30 room international guest house with solar passive concept is fully functional. It is proposed to meet the entire electricity requirement of the campus through solar energy and make it a "net zero electricity consuming campus".

Major Facilities at NISE and Activities Undertaken during 2017-18

9.5 The NISE has undertaken the following activities during 2017-18:

SOLAR RADIATION RESOURCE ASSESSMENT

9.6 Solar Radiation Calibration Laboratory (SRCL) at NISE has commenced calibration program of Phase-II Solar Radiation Resource Assessment (SRRA) stations. Phase -II of SRRA has all the Hukseflux make sensors in operation for which all necessary equipment were procured by NISE for performing their calibration at its facility. As an extension of calibration services to any organization in the country, commercial mode was also initiated. During the year SRCL has calibrated a total of 18 sensors from 6 SRRA Phase-II stations and 8 sensors from various private companies under commercial calibration mode. The calibrated sensors stations details are given in following table:

S. No.	Details of the stations		No. of sensors calibrated at SRCL		Total
			Pyranometer	Pyrheliometer	
1	Phase-II SRRA stations	Chandigarh	2	1	3
2		Kapurthala	2	1	3
3		Murthal	2	1	3
4		Solan	2	1	3
5		Ranchi	2	1	3
6		Jamshedpur	2	1	3
7	Private Organization		8	0	8
Total			**20**	**6**	**26**

SOLAR PHOTOVOLTAIC SYSTEMS AND DEVICES DIVISION 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 initiated 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 2017-18. Performance data collected from different locations is being analyzed to understand the reliability and process of degradation of PV modules under Indian field conditions. The report is under preparation. The study of performance of PV power plants will be initiated in March 2018 under this joint activity.

Net metering of NISE

9.8 NISE has more than 800 kWp SPV power plant capacity installed in the campus and new power plants are going to be added. NISE is moving towards the NET Positive Energy campus by next year. NISE is feeding power to the grid through net-metering from PV power plant during the day time.

Secondary Reference Cell Calibration for Large Area Solar Cells

9.9 NISE along with IIT Bombay, Mumbai; National Physical Laboratory (NPL), New Delhi; and Fraunhofer-Institut für Solare Energiesysteme (ISE) Germany has been working to develop a secondary reference cell calibration facility in the country for commercial solar cells of 6 inch x 6 inch size. Under this project, Round Robin testing of large area (5 inch and 6 inch square) mono and multi-crystalline silicon solar cells was taken up at NISE, IIT Bombay and NPL, New Delhi, in India and Fraunhofer Institute for Solar Energy (ISE), in Germany. Comparison of I-V measurements made at these four centres on several large area solar cells, with the measurements made at ISE taken as the benchmark revealed the extent of deviation in measurements made at different laboratories. The study also brought out the specific improvements that have to be made on the respective setups.

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

9.10 NISE and NREL, USA have embarked on a project to compare the performance of sister thin-film modules deployed in India and in Colorado, USA. NISE purchased a set of modules and shipped 6 of these modules to NREL. The thin-film modules were deployed in outdoors in December 2013. First joint technical report with NREL is already published. The result has been presented in the conference on Reliability of PV module organized by NREL. The long term measurement of performance of the modules is still going on.

SERIIUS Project

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

i. Identification of climatic zones and environment conditions.

ii. Modelling of the performance studies of various technology modules under different climatic zones.

iii. Preparation of general specifications of PV modules and components.

iv. Development of models using time dependent performance reliability indicators.

v. Dust effect and mitigation in different climatic zones of India.

9.12 NISE is working on the quantification of reliability index of PV module based on the field data measured for different climatic zones. Designing of testing conditions for Indian climate for PID of PV modules is going on. Currently the project is extended up to March 2018.

TESTING AND PERFORMANCE EVALUATION

Solar Cell Characterization Laboratory

9.13 The Solar cell characterization laboratory at NISE that features a Class AAA solar simulator has recently been upgraded with incorporation of an indigenously designed and fabricated four-probe contacting system and an accurate temperature-controlled water bath. Currently, the system has been designed for contacting solar cells having up to 4 bus bars. However, plans are afoot to extend it within this financial year to solar cells with five bus bars. The system is being used for validation of cell efficiency claims made by R & D Institutions, Universities and industries implementing MNRE sponsored projects on development of high efficiency solar cells, as well as other cell manufacturers. The versatile system has the ability of making I-V measurements on small as well as large area solar cells under STC as also under different conditions of temperature and insolation. Solar cells from IIEST, Shibpur, IIT, Bombay and BEL, Bangalore have recently been measured using the I-V tester at NISE. The facility would soon be further equipped with the addition of a spectro-radiometer and a spectral response measurement system for solar cells.

Outdoor PV Module Testing Facility

9.14 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 conditions 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 environmental conditions. A new set up of Electroluminescence camera has been designed for solar PV module with the help of NCPRE, IITB. Outdoor PID testing of PV module is being added to the lab. This lab has published more than 25 papers this year.

Mobile Testing lab for inspection of PV power plant

9.15 A Mobile test facility has been created at NISE for testing/evaluation of PV power plant performance in actual working/field conditions in India. A bus has been designed for this activity. The procurement of instruments for the Mobile test lab is going on.

POWER ELECTRONICS LAB

Advanced SPV Systems and Lighting Laboratory

9.16 This laboratory, with well-equipped testing facilities, is engaged in testing of performance and reliability of solar based lighting systems as well as validation of field performance. The laboratory is involved in R&D in the field of application of Solar Photovoltaic systems & Illumination Engineering. This is the first Solar Lighting laboratory deployed by MNRE to promote Solar PV Lighting program in rural India. The major Solar PV lighting systems promoted by MNRE include portable Solar Lanterns, Solar Home Lighting and Solar Street lighting systems, etc. It is necessary that products and devices have the desired quality, efficiency, reliability, ruggedness and ease of operation.

9.17 NISE offers advice to manufacturers for improving the quality and helps in preparing the performance guideline through its testing activity. MNRE has developed its own technical specifications for Solar Lanterns, Solar Home Lighting Systems, Solar Street Lighting Systems etc. Recently, MNRE revised the technical specification (i.e. Off-grid Solar Applications Scheme 2016-2017), and a few changes have been done in the system design in solar lantern, home lighting system, and street lighting systems with motion sensor. A Solar Power Pack for DC & AC models and home lighting systems with batten type luminary was introduced. W-LED lamps which include the solar Inverter of 24V/300VA, Pure Sine wave, PV integrated Micro solar dome and LED based solar home lighting system with batten type luminary are also introduced in the new technical specifications of MNRE.

9.18 The Laboratory has tested lighting systems and generated revenue of more than Rs. 60 lakh in the financial year of 2016-17 which is twice the revenue generated in the financial year 2015-16.

Virtual Visit to the Advanced SPV System & Lighting Laboratory

Solar Water Pump Testing Facility

9.19 NISE has a testing facility for certification of SPV water pump systems as per MNRE specifications and user requirements, 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 During the year, NISE tested 56 different types of SPV water pumping systems. A fully automatic in-door and outdoor SPV water pump testing facility was commissioned in July 2016 at NISE which is capable of testing eight SPV water pump samples at a time. Ittakes 7 days for outdoor testing and 2 days for indoor testing with the use of array simulator for different dayprofiles 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.
- Development of a Standard of SPV Water Pump testing.

500 kW Photovoltaic Power Plant

9.21 The 500 kW SPV Power Plant with five different technologies, i.e Copper Indium Gallium Selenide (CIGS), Cadmium Telluride (CdTe), Hetero-junction Intrinsic Thin film (HIT), IBC (Sunpower), and Crystalline Silicon has been commissioned in the campus of NISE. Out of 500 kW, 200 kW is connected with battery storage and hybrid invertor. The balance 300 kW is connected to the grid. The power plant would be used for research and field reliability testing of different technologies in the same climatic condition and for establishing a mini-grid. Grid stability would also be maintained or analyzed.

Solar Design Simulation Lab

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

9.23 The Solar Design Simulation Lab has been providing consultancy on different SPV projects and training the people of different backgrounds from industries, educational institutions, etc. This lab has trained more than 220 senior engineers and managers from SJVN, BHEL, NTPC, REC, THDC, PCRA; teaching faculty of different universities, new solar entrepreneurs, businessmen and international trainees through ITEC and sixteen system design programs at NISE during the year.

SOLAR THERMAL TECHNOLOGIES

9.24 NISE has undertaken various research projects on solar thermal energy for cooking, heating, cooling, power generation, process heat applications, desalination, thermal storage, bulk milk chilling system using thermal storage, cold storage facility with thermal storage and in-house research and development etc. The following facilities have been set up 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, 15 kW Absorption Prototype System with Air Cooling, 5 kW Adsorption Prototype System, 3x3 kWp Solar Stirling Engine, Distillation system, PV based bulk milk chilling system with thermal storage, PV based cold storage with thermal storage for continuous operation, Solar Air-Dryer and PV based heat storage for cooking.

1 MWe Solar Thermal Power Plant

9.26 A 1 MW Solar Thermal Power Plant based on parabolic trough collector and Linear Fresnel Reflector technologies was 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. The unique feature of this plant is the integration of two different solar fields (parabolic trough collectors and linear Fresnel reflectors) without a fossil fuel backup. The plant intends to combine the advantages of synthetic oil based Parabolic Trough Collector (PTC) field for high efficiency and direct steam generation (DSG) of linear Fresnel reflector (LFR) field to lower down cost of generation. The plant was non-functional since August 2015. Operation and maintenance of the plant was undertaken by NISE during the year. The plant is expected to become fully operational by March 2018.

Solar Thermal Test facilities for CST

9.27 NISE has created a facility for characterization and testing of all types of concentrator technologies. This includes Hot water/ Steam based Test Set Ups, Thermic fluid based Test Set Up, FPC and ETC, Cooker Test Facility as per BIS standard and MNRE Specifications. 3 nos. of CST technologies, 1 no. of Flat Plate Collector and 1 no. of Evacuated Tubular Collector. All of these have been tested and certified through 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. 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 applications across India.

CO-ORDINATION OF NATIONAL RESEARCH ACTIVITIES IN SOLAR ENERGY

9.29 NISE has been entrusted with the coordination work of National Research Activities in Solar Energy by MNRE, including 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 2017, around 35 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 17 project proposals in PV are being prepared for submission to the Ministry. These would be further evaluated at the meetings of RDPAC and RDSPAC. The results of evaluation of the remaining 18 proposals would be sent to the Ministry before the end of the financial year 2017-18.

9.31 NISE has also been regularly carrying out monitoring of the on-going MNRE sponsored projects in solar photovoltaics by conducting biannual meetings of the Project Review Committee at NISE wherein the PIs of the on-going R&D projects make brief presentations and describe the progress made in the respective project. The Minutes of Meeting entailing specific recommendations in respect of each project is then sent to the Ministry for further action.

Solar Thermal R&D Projects

9.32 Since April 2017, around 30 project proposals have been received in solar thermal energy for evaluation and further processing. These projects were mainly on small scale power generation, solar refrigeration and air-conditioning, solar cookers, solar distillation and solar industrial process heating. All these projects have been evaluated by experts and RDPAC and RDSPAC meetings were organized. The expert panel has also been updated and a meeting of experts for evaluation and midterm correction was organized for all the ongoing projects.

9.33 As a part of NISE's outreach programme, under the institute serial publication series (multi-volume), one new volume (Volume-4) of the book entitled "Advances in Solar Energy Science and Engineering" dealing with Policies for Renewable Energy and Energy efficiency was 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

Skill Development Division

9.34 NISE has been assigned with the responsibility to execute the various skill development programmes throughout the country in the field of solar energy technology. At present various

programmes are being conducted at NISE and its partner institutes across India. The focus of the programme is on technology development, system design, installation, commissioning, operation & maintenance and repair, etc. The capacity building activities under the skill development programme of NISE are as follows:

Suryamitra Skill Development Program

9.35 NISE is implementing "Suryamitra" training program to train the ITI/diploma holders as field technicians to provide a skilled work force for installation, commissioning, operation and maintenance in the field of solar technology to execute National Solar Mission (NSM) programme across the country. NISE has identified a network of institutions through State Nodal Agencies (SNAs) to conduct training programmes. It provides funds to these agencies and also monitors the skill development programmes implemented by them. Separately, NISE is also organizing Suryamitra programme in its own campus. Under Suryamitra programme a total of 72 programs with 2208 Suryamitras, have been organised in FY 2017-18 till 31.12.2017. Since inception, a cumulative number of 542 programmes have been conducted by NISE and other implementing agencies approved by it and a total of 16,161 Suryamitras have been imparted trainings under this programme up to 31.12.2017, including 5,148 during 2017-18.

NISE Skill Development Programs

9.36 NISE has been conducting Solar and Renewable Energy trainings for the past two decades for national and international participants. NISE regularly invites people from solar and renewable energy industry and interacts with them to identify the skill gaps in the new recruits of the renewable energy industry. A dedicated training programme on Renewable Energy Technologies for senior defence officers is also being conducted on a yearly basis. Besides, NISE is also organizing a number of other training programmes for start-ups, solar PV roof top projects, SPV pumps, solar thermal technologies and hydrogen energy and fuel cells. NISE has also planned to start a long term programme for solar professionals for six months duration from February 2018. A total number of 17 training programs on various aspects of Solar Energy by imparting training to over 900 participants have been organized in 2017-18 till 31.12.2017.

International Training Programmes

9.37 Ministry of External Affairs, Govt. of India has identified NISE as a premier institute to conduct Indian Technical and Economic Cooperation Programme (ITEC) every year for international participants along with other international programmes like Indo African Forum Summit (IAFS) and Programme for SAARC countries. NISE has conducted 3 International Programmes in FY 2017-18 till 31.12.2017 and 3 more are scheduled by 31st March 2018. These programmes are for a duration of three-weeks, focused on latest Solar and Renewable Energy Technologies. Apart from ITEC, IAFS and SAARC programme, NISE has also conducted 2 programs for International Solar Alliance (ISA) member countries in FY 2017-18 till 31.12.2017. A total of 101 participants from 66 countries have participated in these International Training Programmes.

COORDINATION ACTIVITIES

9.38 NISE has been maintaining a good coordination with various national and international organisations to augment its strength and use their capabilities and expertise. Three International MoUs developed and finalized with National Solar Energy Institute (CEA-INES), France, National Electronics and Computer Technology Centre (NESTEC), Thailand, and United Nations International Development Organization (UNIDO) have been submitted to MNRE for approval.

9.39 MoUs have been signed with the following national organizations:

1. National Power Training Institute (NPTI)
2. The Energy and Resources Institute (TERI)
3. AFC India Limited
4. Solar Energy Corporation of India (SECI)
5. Central Board of Irrigation and Power (CBIP)

CONSULTANCY SERVICES

9.40 Consultancy is one of the key competencies of the institute. With an excellent pool of scientific manpower and management experts, NISE is extending various consultancy services like site survey, preparation of Detailed Project Report, Solar System Design and vetting of tender documents and specifications, Project management & EPC advisory, Solar Feasibility Report / DPR on solar photovoltaic & solar thermal technologies, solar power plant performance evaluation & monitoring in the field, and testing & performance of the solar systems with the help of Mobile Lab facilities etc. Institute has active collaborations and MoUs with prominent national & international organizations in the area of solar energy technologies for consultancy work. During 2017-18 NISE has extended following consultancy services:-

Sl. No.	Projects undertaken/Evaluated during the last few years
1.	Preparation of feasibility Report for 750 kWp Solar Power Plant at Sheetala Mata Mandir Gurgaon.
2.	Preparation of feasibility Report for 3.0 MW Solar Power Plant at Indian Naval Academy Ezhimala, Kannur, Kerala
3.	Preparation of feasibility Report for 200kWp Solar Power Plant at Huaaini village Haryana.
4.	Vetting of DPR for "210 kWp grid connected solar power plant at Kesrisinghpur under garrison engineer Sri Ganganagar Military station" submitted by Nitasha Constructions Ltd.
5.	Vetting of DPR for "1.5 MWp solar power plant, at Air force station Nal, Bikaner Rajasthan, submitted by Nirman Encon Projects Pvt. Ltd.
6.	Site survey of Rooftop Solar Power plant & field verification of Street Lighting System of Government Organisations.

HYDROGEN ENERGY & FUEL CELLS FACILITY

9.41 A solar hydrogen production cum dispensing facility was installed and commissioned in the campus of the National Institute of Solar Energy (NISE) in December, 2014. The facility became operational in late 2015 after adequate hydrogen got accumulated in high pressure storage tubes of the facility. Thereafter, NISE has been operating and maintaining the facility for regular production and dispensing of hydrogen. This is the first of its kind facility in the country to utilize solar energy for the production, storage and dispensing of hydrogen.

Hydrogen facility at NISE

H2-Diesel Dual Fuel Vehicles developed by M&M

9.42 NISE continued to implement an R&D Project entitled "Demonstration and Performance Evaluation of Various Hydrogen Technologies" sanctioned by the Ministry of New and Renewable Energy in December, 2014 with a broad objective of demonstration and performance evaluation of various technologies of hydrogen energy at NISE. During the year, the facilitycontinued to be used for providing hydrogen for trial runs of two hydrogen-diesel dual-fuel vehicles, developed by M/s Mahindra & Mahindra under an R&D project assigned to them. This facility has been set up at NISE in accordance with clearance of Petroleum and Explosives Safety Organisation (PESO). Field trials of hydrogen-diesel dual fuel vehicles being carried out by Mahindra & Mahindra in association with NISE have indicated that the vehicles on one side showed improved performance in dual fuel mode and reduced emissions on the other compared to diesel only mode of operation. Two vehicles were run using hydrogen fuel in association with Mahindra and Mahindra. These vehicles have completed over 29800 kilometers on hydrogen fuel.

9.43 Efforts for setting up of a Fuel Cell Testing Laboratory were initiated and the infrastructure required for operation of fuel cell system was completed during the year. 1x2 kW and 2x1 kW Polymer Electrolyte Membrane Fuel Cell (PEMFC) systems that were procured earlier were operated under demonstration mode and these systems were operated for a cumulative total of 50 hours using commercial bottled hydrogen. Hydrogen leak detectors with alarms are installed for safety purposes. The up-gradation of the laboratory is likely to be taken up in the future.

9.44 An MoU has been signed between NISE and M/s Tiger Power, Belgium to have a collaborative project for the validation of a hybrid system comprising SPV system – Batteries – Electrolyser – Hydrogen Storage – Fuel Cell and its techno-commercial viability in Indian climatological conditions. The first segment of the project from M/s Tiger Power, Belgium has been installed in the campus of NISE. This segment consists of a 4.77 kWp PV panel along with storage batteries of 14.4kWh (24 number of batteries of 2V and 300Ah capacity of each) and inverter installed on the top of a shipping container. This facility has remote monitoring, which enables performance evaluation of the PV system in Indian conditions.

Fuel cell testing laboratory setup (inside the lab)

9.45 The 2nd National Workshop on Hydrogen Energy and Fuel Cells was organized successfully in NISE during 22-23 November 2017. This workshop provided a platform to researchers from academic institutions, research laboratories, industries and individual professionals to interact and exchange views on hydrogen and fuel cell technologies. Based on the deliberations during

A Hybrid System installed in NISE by M/s Tiger Power, Belgium under a collaborative project

the workshop, a report and recommendations have been prepared by the NISE and sent to MNRE for review.

Participants of 2nd National Workshop on Hydrogen Energy and Fuel Cells

NATIONAL INSTITUTE OF WIND ENERGY (NIWE)

9.46 The main activities of National Institute of Wind Energy (NIWE) include research and development to achieve and maintain reliable and cost-effective technology in Wind Power systems; Wind and Solar Radiation Resource Assessment; preparation of standards for wind turbine testing and certification of wind power system; information dissemination; human resource development; offer various consultancy services to customers; and to serve as a technical focal point for wind power development in India and support the growing wind power sector in the country.

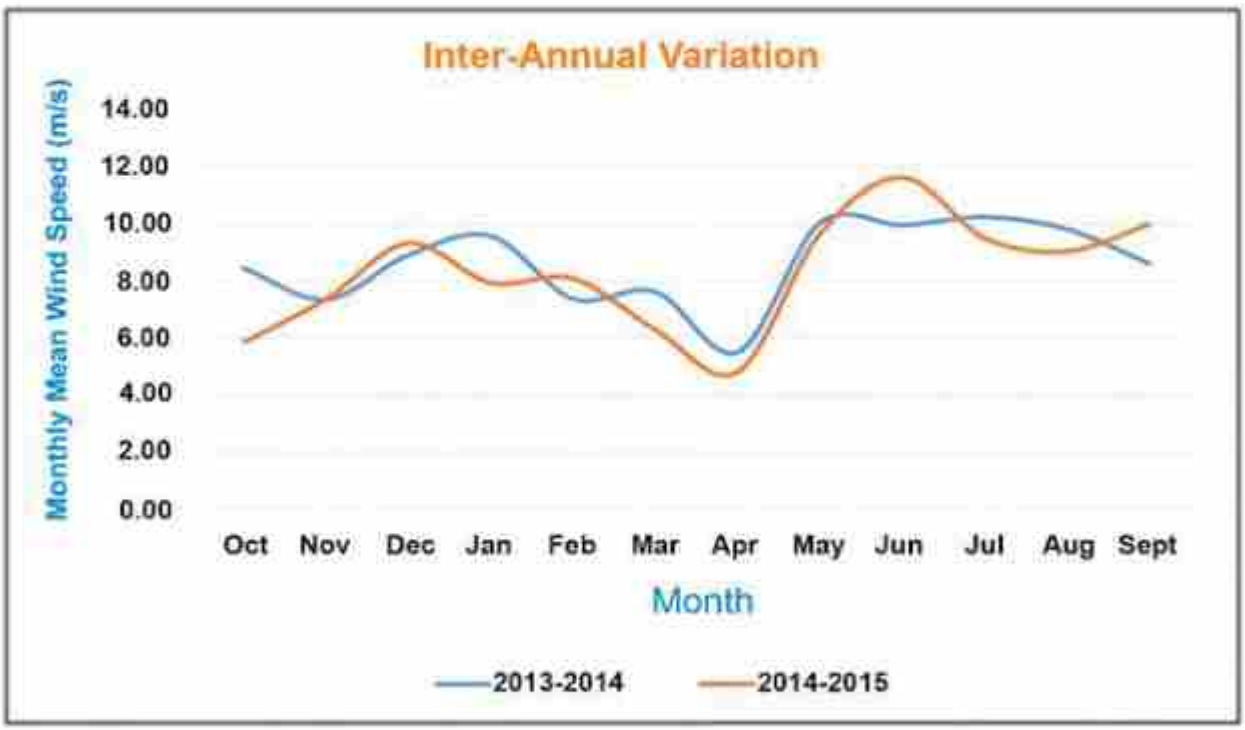
WIND RESOURCE ASSESSMENT & OFFSHORE UNIT

9.47 The objective of the Nation-wide WRA program is to quantify the wind resource availability in the country with a view to generate power from wind. The program envisaged setting up of dedicated wind monitoring stations at carefully chosen sites across the country under various WRA programs are of 50m 80m, 100m and 120m height. The data collected under the program is being used widely to establish wind farms in the country and is noted that all the wind farms established in the country till now is based on the reference data collected under this National Program of wind resource assessment. As on date, 832 dedicated wind monitoring stations have been established with the help of State Nodal Agencies. 34 Wind monitoring stations are under operation and 21 new wind monitoring stations commissioned (7 in Chhattisgarh, 7 in Assam, 6 in Meghalaya & 1 in Gujarat).

9.48 58 sites have been registered for wind measurement by private sector from various states in India. The wind data from over 46 private Wind Monitoring stations have been analyzed. Forty four consultancy projects focused in various wind farm developmental needs were undertaken for a variety of clients from public/government/private sector during this period.

Offshore Wind Resource Assessment at Dhanuskodi

9.49 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 obtained from the measurement campaign are promising and encouraging. The report on Offshore Wind Resource Assessment at Dhanushkodi is published in NIWE website:-(http://niwe.res.in/assets/Docu/Offshore_Wind_Resource_Report_Dhanuskodi.pdf).



Inter-Annual Variation Graph for Dhanuskodi Measurement at 102m

Research Met Mast

9.50 To conduct a R&D study on the influence of mountain pass on wind flow and its impact on the power generation, a study would be carried out by installing two 50m wind monitoring stations each at the entry (Dalmia site) and exit (Perungudi site) of the mountain pass. In addition to above study, another study for validating the various CFD tools such as WindSIM, MeteoDYN,

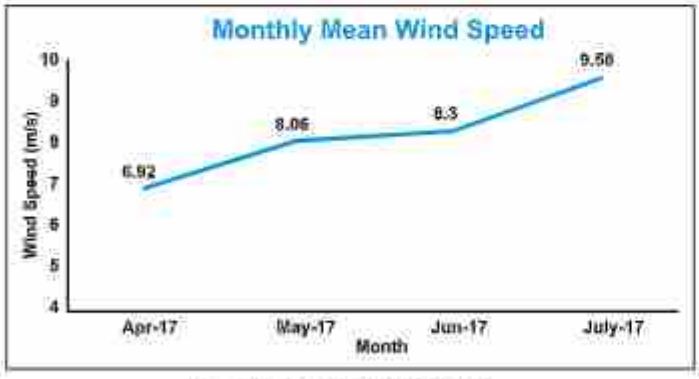
Zephy etc., is also being carried out using the data collected from these wind monitoring stations. The expected project duration to complete the aforesaid would be 2 years. The outcome of the study would be useful for validating various wind forecast models particularly for that region, repowering in that particular location (it is ascertained that nearly 6000 old wind turbines are existing within the vicinity of this region) and also other research studies. In addition, a wind monitoring station was installed at Manalmelkudi site to understand the land side & sea side wind flow pattern and impacts. Data acquisition is under progress.

Wind Potential GIS Map for 120m and 150m level

9.51 NIWE has assessed the wind potential within the country at 100m hub height with scientific rigor and based on authentic latest available data-sets, of wind as well as land, geologically spread across India. At present NIWE is in the process of extending the same scientifically rigorous methodology to estimate the indicative wind potential at 120m and 150m agl. With increasing hub heights, this indicative map would be a useful source for the wind farm developers and other stakeholders.

Offshore Wind Resource Assessment at Gulf of Khambhat, Gujarat

9.52 NIWE along with the support of ESSO-NIOT has established LiDAR-based offshore wind measurement structure near Pipavav in Gulf of Khambhat, Gujarat Coast at one of the zones identified by FOWIND. The remote sensing instrument LiDAR (Light Detection and Ranging) has been procured and installed in the Offshore platform on 31st Oct. 2017. Meanwhile, an additional Wind Monitoring Station or Automatic Weather Station has been installed on the platform. The measurements for a period of 2 years have commenced. The results of the analyzed data from the wind measurements by the Automatic Weather Station (AWS) / Wind Monitoring from April 2017. The data is continuously pushed by the AWS/WMS by the GSM communication to NIWE, Chennai. Data has been regularly analyzed and results are encouraging.

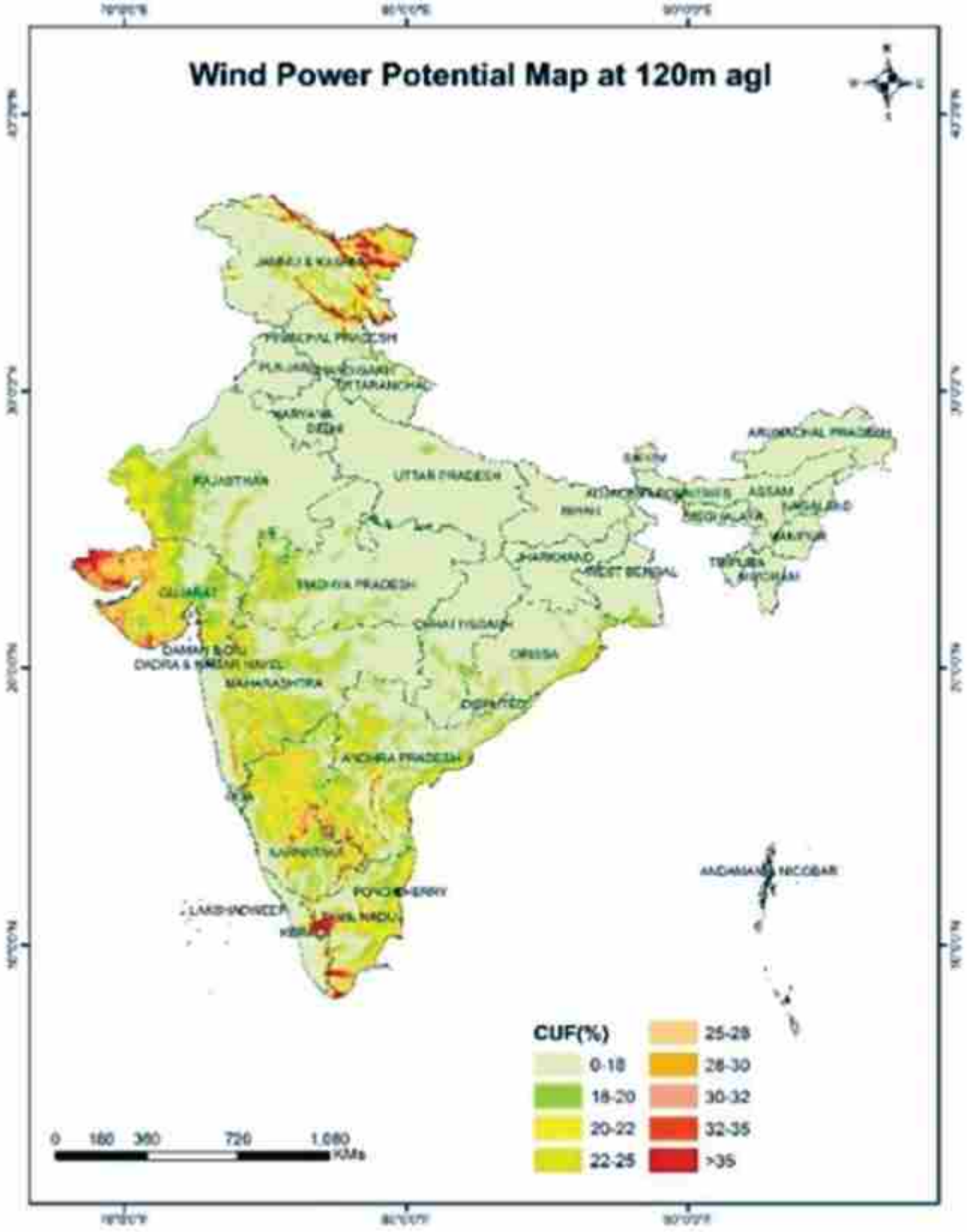


Monthly Average Wind Speed

Monthly Average Wind Power Density

Geo-Tagging (on line registry) of Wind Turbines

9.53 NIWE is in the process of developing a geo-tagged data base / online registry of wind turbines installed across the country with the support of central and state agencies. At present, NIWE



120 m wind Atlas - Indicative map

is working to devise the methodology for the static data collection and suitable procedure / guidelines for dynamic data collection are also being developed.

TESTING & FORECASTING UNIT

Large Turbine Testing

9.54 During this year, Type Testing of XYRON 1000 kW wind turbine at Richadewda, Ratlam District, Madhya Pradesh of M/s. XYRON TECHNOLOGIES LTD through measurements have been completed as per the signed agreement. An agreement has also been signed between NIWE & M/s. Inox Wind Ltd., on 18th August, 2017 for Power Curve Measurements of INOX 2000 kW wind turbine with 113 meter rotor diameter at Ranipat Village, MuliTaluk, Surendranagar (Dist.), Gujarat. The measurement work is under progress.

9.55 An agreement has been signed between NIWE & M/s. Para Enterprises Pvt Ltd on 04th September, 2017 for Power Curve Measurements & Special Measurements for Loads of Pioneer 750 kW wind turbine W49-HH60 with 49 meter rotor diameter at HTSC no. 2988, SF. No. 95/4, 5&6B Part, Poigai Village, TenkasiTaluk, Tirunelveli District, Tamil Nadu. The measurement work is under progress.

Small Wind Turbine Testing

9.56 In addition to large wind turbine testing, NIWE is also giving its service in the small wind turbine domain. The work carried out for the small wind turbine are summarized below

- Type Testing assignment of model Vaata Smart, Vertical Axis WT (5.5 kW) at Karungulam of M/s. Vaata Smart Ltd has been undertaken.
- Type Testing assignment of Nalwin 600 W at Wind Turbine Research Station, Kayathar, Tuticorin District, Tamil Nadu of M/s. Aparna Renewable Energy Sources Pvt.Ltd. has been undertaken.

Forecasting

9.57 The large scale integration of renewable energy calls for reliable forecasting and scheduling. It is also mandated by CERC and also other State Regulatory Authorities. NIWE has taken the pioneering step in forecasting of Wind energy with the support of Vortex, Spain. NIWE is also in the process of developing indigenous forecasting model. At present, the forecasting services is being given to SLDC TANTRANSCO under the agreement with IWPA.

Wind Turbine Test Station

9.58 NIWE has established a test facility at Wind Turbine Test Station (WTTS) near Kayathar in Tamil Nadu, where wind turbines are 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. WTTS 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 testing facilities are certified as per the requirements of ISO 9001:2008 and accredited as per the requirements of ISO / IEC 17025:2005.

WIND TURBINE RESEARCH STATION UNIT

Preventive and Breakdown Operation & Maintenance of Wind Electric Generators

9.59 It is also noteworthy to mention that NIWE has in-house capability for Regular Preventive and Breakdown Operation & Maintenance of turbines. As on date, NIWE has carried out renovation of its 28 years old first generation 200 kW MICON WEG'S (9 nos. of turbines installed in Kayathar).

Operation and maintenance

Grid Integration Solar PV with Wind Electric Generator on hybrid mode

9.60 The wind-solar hybrid is a new dimension in optimizing the available infrastructure and also to reduce the intermittency of these generation. In order to understand and offer research in this sphere, NIWE has commissioned 75 kW solar PV with one of the 28 years old under performing 200 kW MICON wind electric generator at WTRS, Kayathar. Research on this demonstration project is being carried out to understand optimization of connected grid capacity and flat power supply during peak wind season period by utilizing existing land, transformer, transmission line etc. The performance of the hybrid system was monitored during the windy season 2017. The mathematical modelling of the above integration of 75 kWp solar power with 200 kW wind electric generator is under progress.

DATA COLLECTION IN WIND SOLAR HYDRID SYSTEM @ WTRS, KAYATHAR

STANDARDS & CERTIFICATION AND R&D / S&T UNIT

9.61 During the year, NIWE has successfully undergone the first periodic audit and recommended for continuation of certification.NIWE has also successfully completed two type certification projects (Renewal) viz., V 39-500 kW with 47 m rotor diameter and Pawan Shakthi-600 kW. Renewed certificates have been issued to the respective wind turbine manufacturers. The following Certification Projects were taken up under NIWE -TUV Rheinland, Germany Co-operation:

- Inspection for the Manufacturing Evaluation at a wind turbine tower production unit.
- Evaluation of Grid Code Compliance of 2 MW wind turbines as per CEA Technical Standard.
- Witnessing of Safety and Function test and Personnel Safety assessment for a wind turbine model at the test site as a part of Type Certification.

INFORMATION TRAINING AND COMMERCIAL SERVICES UNIT

Training Programmes

9.62 This unit has conducted four International Training Course on wind energy wherein 76 International participants from 22 countries (Afghanistan, Argentina, Azerbaijan, Cameroon, Egypt, Ethiopia, Ghana, India, Iran, Jordan, Kenya, Mauritius, Myanmar, Nepal, Sri Lanka, Sudan, Suriname, Tanzania, Uganda, Vietnam, Zambia, and Zimbabwe) have been trained during this period with the sponsorship from the Ministry of External Affairs, Government of India under ITEC / SCAAP and AIFS – III programs.

NIWE participation in India International Science Festival (IISF) 2017 Exhibition

9.63 NIWE had participated in the Mega Science Expo by establishing stall with well-designed Information Panels showcasing the activities and services of NIWE to the visitors of India International Science Festival (IISF) 2017 during 13-16 October 2017 at Anna University by Ministry of Science & Technology, Ministry of Earth Sciences, Vijnana Bharathi and National Institute of Ocean Technology, Chennai.

Special International Training Course on Wind Turbine Technology & Applications specially for African countries

NIWE's Newsletter – Pavan

9.64 NIWE is publishing regularly a well received quarterly bilingual NIWE newsletter "PAVAN" [English and Hindi], which disseminates information about the activities & services of NIWE, wind energy news, technical articles and information on wind energy related events. During this period, 53rd (April-June) & 54th (July-September) issues have been published by ITCS unit and distributed among stake holders and the publication of 55th (October–December) and 56th issues will be published as per the schedule.

Visitors to the Campus

9.65 To create awareness and to motivate towards research on wind energy, 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 from April – December 2017, 353 students from 6 colleges and 130 students from 2 schools visited NIWE facilities at Chennai and 52 students from 2 University/college visited WTRS facility of NIWE at Kayathar and learned about Wind Energy through the presentations made by NIWE's Scientists and the showcasing of the renewable energy facilities available in the Campus. Also 99 training participants of other organizations have visited the facilities.

Global Wind Day Celebrations 2017

9.66 Global Wind Day is a worldwide event that is celebrated annually on 15 June and NIWE being the technical focal point for the development of wind energy in the country has been celebrating the Global Wind Day every 15th June since the year 2009. In this year's celebration held on 15th June 2017 at NIWE Shri. S. SubbaRao, Former Chief Scientist and Head, Information Division, Central Leather Research Institute, Chennai graced the occasion as the invited Chief Guest and delivered the commemorative lecture on the topic 'Global Wind Day'.

SOLAR RADIATION RESOURCE ASSESSMENT UNIT

9.67 MNRE has sanctioned a project for the establishment of nation-wide network of Solar Radiation Resource Assessment (SRRA) stations and an exclusive SRRA unit was established at NIWE. The following are the activities of SRRA Unit.

- Calibration of 18 Pyranometers& 9 Pyrheliometers from SRRA stations in the states of Andhra Pradesh, Karnataka, Kerala, Telangana, Madhya Pradesh & Assam were carried out under SRRA project.
- MoU between NIWE and SLDC-GETCO, Gujarat for the development of indigenous Solar Power Forecasting model funded by PSDF through SLDC-GETCO, Gujarat was signed on 22.09.2017.
- Short term training programme on Solar Energy for Mytrah Energy (India) Pvt. Ltd, Hyderabad was be taken up in November 2017.
- Establishment of 3 SRRA stations, one in Maharashtra and 2 in Kerala are likely to be established by March 2018.
- Final data from 4 advanced measurement stations at Gurugram, Howrah, Thiruvallur and Gandhi Nagar as per BSRN format will be submitted to BSRN, Bremerhaven by March 2018 for uploading in their website.

Awards and Honours

9.68 Dr. G. Giridhar, Deputy Director General & Group Head, SRRA received Dr. K.C.G. Verghese Excellence Award on 29.07.2017 from the Hindustan Group of Institutions, Chennai.

9.69 Dr. P. Kanagavel, Additional Director, ITCS received Excellence in Teaching Award – 2017 conferred by Madras Library Association (MALA) on the occasion of the 125th Anniversary Celebration of PadmashreeDr. S. R. Ranganathan held at Indian institute of Technology, Chennai on 12th August 2017.

SOLAR ENERGY CORPORATION OF INDIA LIMITED (SECI)

Introduction

9.70 Solar Energy Corporation of India Ltd. "SECI" is Section- 3 Company under the Companies Act, 2013, with 100 percent Government ownership, under the administrative control of the Ministry of New and Renewable Energy (MNRE).

9.71 The company was set up as an implementing and executing arm of the Jawaharlal Nehru National Solar Mission (JNNSM) for development, promotion and commercialization of solar energy technologies in the country. In 2015, the mandate of the company has been broadened to cover all segments of renewable energy, pursuant to the approval of the Government of India.

9.72 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, consultancy, decentralised solar systems, power trading, R&D initiatives etc.

9.73 It is a profit-earning PSU and has registered a total revenue of Rs. 798.16 Cr. and net profit after tax (PAT) of Rs. 46.54 Cr. during Financial Year 2016-17.

Organization

9.74 SECI's Board of Directors is headed by Chairman and comprises of Managing Director, four functional directors and a Government nominee Director.

9.75 Shri Anand Kumar, Secretary, MNRE, is also Chairman of SECI, with effect from 17.07.2017 after taking charge from Shri Rajeev Kapoor. Shri J. N. Swain is the Managing Director, SECI, with effect from 01.08.2017, upon superannuation of Dr. Ashvini Kumar in July, 2017. Appointment to the posts of Director (Solar) and Director (PS) are awaited.

Achievement highlights for the year 2017-18

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

9.76 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 the following table.

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

9.77 SECI has released VGF amount of Rs. 1.04 Cr. to developers in 2017-18 (till 31.12.2017) under the scheme.

2000 MW VGF Scheme of JNNSM Phase II, Batch III

9.78 The second batch of VGF scheme of 2000 MW capacity (JNNSM Phase II, Batch III) is under implementation by SECI. Tenders have been 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..79 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).

9.80 Under the scheme, PPAs have been signed for 2295 MW in 5 states. Out of this,390 MW has been commissioned and balance is under progress.

10 MW Solar Power Project in Maharashtra

5000 MW VGF Scheme

9.81 On the lines of the 2000 MW VGF Scheme, another VGF scheme of 5000 MW capacity (Phase-II, Batch-IV) has been assigned by MNRE to SECI for implementation. 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.

9.82 Under the scheme, PPAs have been signed for 1720 MW across 4 states. 280 MW capacity has been commissioned and balance is under execution. Tenders have been issued for 3975 MW in 2017-18.

9.83 One of the major highlights of the scheme has been the discovery of lowest ever solar tariff of Rs. 2.44 per kWh, in the tender issued by SECI for Bhadla solar park in Rajasthan (in May, 2017) and the discovery of solar power tariff of Rs. 2.47-2.48 per kWh (in Dec, 2017, post introduction of GST).

Scheme for 1000 MW Wind Power

9.84 SECI has been designated as the implementing agency by MNRE for implementation of the scheme for procurement of wind power on a pan-India basis. Till Dec, 2017, SECI has brought out tenders for 4000 MW (3000 MW in 2017-18), and aggregate capacity of 2049.9 MW has been awarded. The projects are under implementation.

9.85 The wind power tender is a unique endeavour on atleast two counts: firstly, it has heralded in the era of competitive procurement of wind power, that is expected to bring about rationalization of power tariffs and enhance competition in the industry; and secondly, that it has introduced large-scale inter-state transfer of wind power through the Central Transmission Utility (CTU) network, thereby allowing other than wind-rich states to avail the benefits of wind energy.

9.86 The tenders have resulted in discovery of record-low wind tariffs of Rs. 2.64-2.65 (in Oct, 2017).

Grid-connected Rooftop Programme

9.87 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 644 MW allocated,about 95.7 MW capacity has been commissioned across India under existing schemes. About 40.08 Cr. has been released as subsidy under these schemes in 2017-18 (till 31.12.2017).

9.88 SECI is operating rooftop solar tender (with 30% subsidy for general category States and 70% subsidy for special category States), in which, letters of award (LoA) were issued for a capacity of 292 MWp in the previous year. The scheme covers implementation of rooftop systems in Social, Residential, and Institutional sector. 7 MW capacity has been installed and balance capacities are under execution.

9.89 Letters of Award have been issued for 226 MW under the Grid connected rooftop tender (with 25% incentive for general category States and 60% subsidy for special category States) under the "Achievement Linked Incentive Scheme" for buildings in Government Ministries, Departments, Central and State and the scheme is in the process of implementation.

Grid connected solar rooftop plant of 170 kWp installed by SECI at Seth Anandram Jaipuria Education Society, Jaipuria Institute of Management, Indirapuram, Ghaziabad, Uttar Pradesh

500kWp solar Rooftop power Plant at MM Engineering College, Mullana, District Ambala, Haryana

Own Project Development

10 MW Jodhpur

9.90 SECI's first project under its ownership, commissioned in March, 2016, has been successfully under commercial operation. The project has generated 18.9 million units in 2016-17, corresponding to annual CUF of 21.61% on AC basis. In 2017-18, the CUF of the project has been 20.66% (till 30.09.2017).

1 MW Andaman & Nicobar (A&N)

9.91 This 1 MW rooftop solar project, spread over 13 buildings and supplying power to A&N administration under a long term PPA, has been installed in 2017-18. PPA has been signed at a tariff determined by the Joint Electricity Regulatory Commission (JERC). Project was commissioned in June, 2017.

160 MW Solar-wind hybrid project

9.92 For further development of SECI's portfolio, development of RE power projects using newer technology configurations and use applications, such as battery storage, floating solar etc. is under active consideration.

9.93 As an initial endeavour in this area, SECI is planning to set up a 160 MW of solar-wind hybrid power plant with battery storage in Andhra Pradesh, with World Bank financing. Project site has been identified and techno-commercial feasibility assessment of the project have been undertaken. Pre-tendering works are being undertaken.

10 MW at DRDO, Karnataka

9.94 A 10 MW project has been identified to set up at DRDO Kolar premises in Karnataka. The project will be developed by SECI on Build Own operate basis and the generated power will be sold to DRDO establishments in Karnataka under third party open access sale. An MoU was also signed with DRDO in this regard. Feasibility studies for power evacuation have been completed by KPTCL. Pre-tendering works are being undertaken.

Project Management Consultancy

9.95 Project Management Consultancy (PMC) is developed as an important revenue-generating activity of the company. SECI has taken up assignments on turnkey basis for a number of clients.

- **50 MW project at Kasargod, Kerala :** the project, owned by IREDA, is located in Kasadgod solar park, Kerala. The project has been commissioned in September, 2017.
- **16 MW at Medak, Telangana:** the project is being developed for for Bharat Electronics Limited in the state of Telangana. The plant has been synchronized in Oct, 2017.
- **5 MW at Bhanur, Telangana:** A 5 MW plantis being for Bharat Dynamics Limited in Telangana. The project has been commissioned in Sept, 2017.A second project of similar capacity is under execution.
- **Vizag Port (10 MW)** : SECI has taken up development of 10 MW solar plant in

Vishakhapatnam port. The project has been commissioned in May, 2017.

- **New Mangalore Port (4 MW) :** The project is located in the New Mangalore port premises, for meeting the captive power demand of the port. The project was commissioned in December, 2016.
- **5 MW at Pata, Uttar Pradesh :** SECI has provided PMC service for design, engineering construction, installation, testing & commissioning of India's second largest grid-connected rooftop power plant of 5.76 MW capacity at GAIL, Pata (Uttar Pradesh). The project has been commissioned in Dec, 2017.

9.96 Several other PMC assignments are being undertaken by SECI for prestigious clients. Notable among these projects are: Coal India (200 MW), UPJVN (200 MW), THDC (50 MW), Banaras Hindu University (8 MW), VO Chidambaranar Port (5 MW), MES- Meerut (2 MW), Kolkata Port etc.

Inauguration of 16 MW BEL project at Medak, Telangana by Hon'ble Ministry of Defence, Shri Arun Jaitley

4 MW New Mangalore Port Project

9.97 Further, SECI is also undertaking specialised projects, such as solar with battery storage etc. Notable among these are:

- **2X7 MW at Leh-Kargil** : The project comprises of grid-connected solar PV plants of aggregate capacity of 14 MW, with 3 hour battery storage, at different locations in Leh and Kargil. The projects are being developed under the Prime Minister Development Package for Jammu & Kashmir (PMDP).Tenders is likely to be issued shortly.
- **2 X 1.5 MW for MES Leh**-the projects are also being developed with battery storage. Pre-tendering activities are in progress.

Solar Parks

9.98 SECI has been designated as MNRE's agency for handling the scheme for development of solar parks (40000 MW), for providing infrastructural support for setting up of solar projects, such as developed land and power evacuation facility, to project developers. 37 solar parks totalling 21284 MWcapacity have been granted administrative approval by MNRE (till Dec, 2017).

9.99 The parks are in various phases of development. 2,230 MW capacity has been commissioned, 3,165 MW capacity is under progress, 5,125 MW is under tendering and balance is in the DPR stage.

9.100 CFA of Rs. 292.06 Cr. has been released by SECI in 2017-18 (till 31.12.2017) for development of these parks.

9.101 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. Details of the JV companies incorporated are given in Table below.

Details of the JV companies incorporated by SECI for Development of Solar Parks

State	Park Capacity (MW)	Solar Park Implementation Agency	JV Partners	Location(s)
Andhra Pradesh	4000	Andhra Pradesh Solar Power Corporation Private Limited	SECI, APGENCO & REDCAP	Anantpur, Kadapa, Kurnool in Andhra Pradesh.
Karnataka	2000	Karnataka Solar Power Development Corporation Private Limited	SECI & KREDL	Tumkur in Karnataka.
Madhya Pradesh	2750	Rewa Ultra Mega Solar Limited	SECI & MPUVNL	Rewa, Neemach, Agar, Mandaur, Rajgarh, Shajapur, Chhatarpur, Morena in Madhya Pradesh.
Uttar Pradesh	600	Lucknow Solar Power Development Corporation Limited	SECI & UPNEDA	Kanpur Dehat, Mirzapur, Allahabad and Jalaun in Uttar Pradesh.
Kerala	200	Renewable Power Corporation of Kerala Ltd.	SECI & KSEB	Kasargod in Kerala.
Himachal Pradesh	1000	Himachal Renewables Ltd.	SECI & HPSEB	Pooh, Kibber, Hikkim, Hull, Losar in Himachal Pradesh.

CPSU Scheme

9.102 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 Cr./MW and Rs.0.5 Cr./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 963.26 MW approved under the scheme by MNRE, 805 MW has been commissioned, 71.76 MW is under execution and 86.50 MW is under tendering/yet to be tendered. CFA of Rs. 53.44 Cr. has been released by SECI in 2017-18 (till 31.12.2017).

Canal Top/ Canal Bank Scheme

9.103 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. 69 MW has been commissioned and balance 31 MW is under execution.

Defence Establishments Solar Scheme

9.104 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. Out of total sanctioned capacity of 356 MW, 20 MW has been commissioned.

9.105 CFA of Rs. 26.71 Cr. has been disbursed by SECI in 2017-18 (Till 31.12.2017).

Power Trading

9.106 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 VGF schemes of JNNSM. Over 3000 million units have been traded across 15 states from projects under the schemes mentioned (cumulative).

Information Technology

9.107 SECI has deployed a new responsive corporate website and has 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.

9.108 The company has implemented a web based application to record and report scheduled solarpower for trading of solar power. A web-based portal for facilitating the processes between

the company and selected bidders under 500 MW solar rooftop scheme for institutions has also been recently implemented.

Human Resource Management

9.109 SECI total permanent staff was 69 (as on 31.12.2017). Codification of personnel policies by way of publication of a bilingual personnel Manual, was carried out, which has been appreciated by the Hon'ble Minister of State (I/c), PCNREM and it has also received Rajbhasha award. Keeping in line with the continuous efforts of the Human Resource department to propagate knowledge and skill enhancement, 54 employees were sent for various training programmes 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. SECI contributed Rs. 29.01 Lakh to Swachh Bharat Kosh 'SBK' under CSR.

Equity support from Govt. of India

9.110 SECI has been set up with an Authorized Share Capital of Rs. 2000 Cr. and Rs. 354 Cr. has been released by the Govt. of India as budgetary support. During Financial Year 2016-17, a turnover of Rs. 798.16 Cr. and net profit after tax of Rs.46.54 Cr. have been registered. SECI has paid dividend of Rs. 13.96 Cr. to the Government for the year 2016-17.

Awards & Accolades:

9.111 SECI has received the CBIP Award for "Outstanding Contribution for Development in Renewables".

9.112 SECI has been conferred with the "50 Top PSU Organization with Innovative Practices" Award by Asia Pacific HRM Congress.

SARDAR SWARAN SINGH NATIONAL INSTITUTE OF BIO-ENERGY (SSS-NIBE)

9.113 Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE) Kapurthala (Punjab), an autonomous Institution of the Ministry of New and Renewable Energy, Government of India, has taken various initiatives on Research, Brainstorming Consultations on Biogas Development, energy efficiency and training for promotion of bioenergy in the country during the current year. The 14th Finance Committee Meeting and 27th Governing Council Meeting of the Institute were held on 4th august, 2017, wherein were discussed the various issues including new initiatives for the current year. The major activities carried out by the Institute are as follows:

R&D Projects

9.114 Three R&D projects on Biobutanol production and Bioethanol and Platform Chemicals generation from lignocellulosic biomass, sponsored by the Department of Biotechnology (DBT), Science and Engineering Research Board (SERB) an autonomous body under the Department of Science and Technology, Government of India, are being implemented by the Institute. One research project on biofuel was completed.

Energy Efficiency Measures

9.115 The Institute initiated action on the concept of the 'Zero Energy Institute Building' in association with the Punjab State Council for Science & Technology, Chandigarh, who will carry out assessment of energy consumption and energy efficiency of the Institute. In addition, the Institute has proposed to set up a 400 KW Solar Roof Top Power Plant on its building for in-house consumption of electricity. The project is proposed to be implemented by SECI, New Delhi.

Bio-energy Alliance

9.116 'Bio-Energy Alliance' constituted at Sardar5waran Singh National Institute of Bio-Energy, Kapurthala in 2017. The Bio-Energy Alliance (BEA) registered under the Societies Registration Act, 1860 with its registered office at SSS-NIBE. The main objective of the Alliance is to encourage networking between R&D institutions for joint projects between R&D institutions and industries for the development of bio-energy and biofuel technology.

Brainstorming Consultation Experts Meeting

9.117 The Institute, organized a day long "Brainstorming Consultation Experts Meeting on Biogas Development" on 23rd June, 2017 at NIBE, Kapurthala for discussion and preparing an Action Plan for R&D, Testing, Evaluation and Standardization of Biomass Energy Systems. Selected Experts in the subject from key RD&D/academic and industry were invited for participation in the meeting. The overall RD&D, technology validation, technology development package, testing, standardization, certification and training in bio-energy in general and biogas in particular was discussed in detail at the meeting. It was considered that Bioenergy needs to be given greater attention to make rural/urban area's energy efficient for their energy needs. Necessity of standards and protocols in all areas of Bioenergy was discussed. It was discussed that NIBE can play a key role in biomass resource assessment, technology validation, testing field evaluation, standardization and training for widespread promotion of bioenergy in the country.

Brainstorming Consultation Experts Meeting in 23rd June, 2017 at SSS-NIBE Kapurthala.

Demonstration of the R &D Projects at the Institute SSS-NIBE to experts of Brainstorming Consultation Experts Meeting, 23rd June, 2017

Training

9.118 A three days National Training Programme on Biogas and Bioenergy Technology is scheduled to be held on 7-9 March, 2018 for SNAs/ project developers/implementer and related stakeholders, including researcher for the promotion at SSS-NIBE, Kapurthala. The training will focus on design, development, installation performance evaluation, policy and financing aspects of biogas technology for cooking, power generation and transport applications.

Publications

9.119 SSS-NIBE, Scientists have published five research papers in National/International Journals, seven research papers published in the proceedings of National/International conference and seven chapters published in different books in this duration in the area of bioenergy.

INDIAN RENEWABLE ENERGY DEVELOPMENT AGENCY LIMITED

9.120 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".

9.121 During the Financial Year 2017-18 (up to 31.12.2017), IREDA has sanctioned loans to the tune of Rs.7500.72 Crore (corresponding previous year Rs.7027.20 crore) and disbursed Rs.5795 crore (corresponding previous year Rs.4850.35 crore) against the annual target of Rs.13,000 crore and Rs 8,100 crore for sanction & disbursements respectively. The above said sanctioned loan (includes co-financed projects/takeover loans) would support capacity addition of 1899.88 MW. The sector wise breakup of sanctions and disbursements for the said period are given below in Table:

Table: Sector-Wise Break-Up of Sanctions and Disbursements During the Year 2017-18 up to 31.12.2017 (Rs. in crore)

Sector	Loan Sanction	Disbursement *
Wind Power	2496.09	2,024.34
Hydro Power	450.27	230.47
Cogeneration and Biomass	164.00	59.25
Solar Energy	3039.39	2,364.92
Bridge Loan	26.06	22.59
Bill Discounting	42.01	22.01
Energy Efficiency	0	0
Miscellaneous (STL+ Manufacturing + Waste to Energy+ NCEF+ Guarantee Scheme)	1282.89	1,071.58
TOTAL	**7500.72**	**5,795.16**

**It includes the amount sanctioned by IREDA during the financial year 2016-17*

9.122 The sector-wise break-up of cumulative sanctions and disbursements up to 31.12.2017 is given in the table below:

Table : Sector-Wise Break-Up of cumulative Sanctions and Disbursements up to 31.12.2017 (Rs. in crore)

Sector	Cumulative Loan Sanction	Cumulative Disbursement
Wind Power	22128.69	14,044.60
Hydro Power	7955.62	4,213.56
Cogeneration and Biomass	5271.89	3,338.13
Solar Energy	14111.36	6,972.81
Bridge Loan	122.76	141.53
Bill Discounting	75.11	55.12
Energy Efficiency	1271.10	339.58
Miscellaneous (STL+ Manufacturing + Waste to Energy+ NCEF+ Guarantee Scheme)	**5396.06**	4480.00
TOTAL	**56332.60**	**33,585.33**

MoU with MNRE

9.123 Based on the audited accounts of financial year 2016-17, the Memorandum of Understanding (MoU) rating is"Excellent". IREDA has also signed MoU with the MNRE for the year 2017-18.

Resource Mobilization

9.124 Paid up capital of IREDA is Rs.784.60 crore with a net worth of Rs.2652.44 crore based on the audited accounts for the period ended September 30, 2017. During April-December, 2017, IREDA has successfully raised Rs. 1950 Crore (approx. USD 300 Million) from Off-shore market by way of the issue of Masala Bond.

9.125 The Company has spent Rs. 4.60 crore during the FY 2016-17 on CSR activities (including ₹2.94 Crore paid for the projects which were sanctioned during the year 2016-17). Projects aggregating to ₹7.05 Crore were sanctioned and in progress of completion at the end of the financial year 2016-17. 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 Swachh Bharat Kosh, Skill Development, Rural Development, Electrification of Community Areas, provided benefits to the armed forces widows and their dependents.

10: SUPPORT PROGRAMMES

SUPPORT PROGRAMMES

INFORMATION AND PUBLIC AWARENESS PROGRAMME

10.1 The role of renewable energy has been assuming increasing significance in recent times with the growing concern for the country's energy security and environmental sustainability of energy use. In order to percolate the benefits and usage of renewable to the masses, information dissemination and publicity has to be crucial role. Information and Public Awareness (I&PA) activities has become vital for creating mass awareness. In this background, the I&PA programme for renewable are conceptualized and developed in implementation of the activities under the overall framework of the media strategy for renewable.

10.2 The Programme is implemented through use of existing Government channels viz. (i) Directorate of Advertising & Visual Publicity (DAVP); (ii) National Films Development Corporation (NFDC); (III) Doordarshan; (iv) All India Radio (AIR); (v) Songs & Drama Division; (vi) State Nodal Department/Agencies for renewable; and (vii) NGOs/Academic institution etc. and participation in exhibitions of national importance by the Ministry and also through other relevant Institutions/Organization.

10.3 During the year, following I&PA activities were developed and implemented under the overall framework of the media strategy for renewable:-

i. Radio Sponsored Programme (RSP) titles "Akshay Urja Aur Hum", having a duration of 15 minutes, on various technologies, systems and devices of renewable energy produced and broadcast in Hindi and 19 regional languages (Assamese, Bengali, Gujarati, Konkani, Kannada, Kashmiri, Khasi, Malyalam, Manipuri, Tamil, Marathi, Mizo, Nagamese, Nepali, Oriya, Pubjabi, 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 through National Film Development Corporation.

ii. Publicity campaign with video spot of 30 second duration " On Screen Digital Cinema Advertising Media" in 1500 cinema halls through NFDC in 33 States/UTs for two times of each spot in each show for four shows in a day for a period of 30 days.

iii. Publicity campaign with video spots of 30 seconds duration each on renewable energy systems and devices has been done through different channels of Doordarshan.

iv. Publishing of the Ministry's bi-monthly newsletter "Akshay Urja" continued in English and Hindi.

v. Advertisement on Solar Rooftop Systems for Delhi released in the newspapers through DAVP dated 28.01.2018.

vi. In order to develop a Creative Vision and Strategy for taking forward the "Renewable Energy" campaigns of the Ministry to a new height, the Ministry has invited Request for Proposal (RFP) to appoint a Creative Agency for designing and production of the required creative and publicity material of the Ministry for the year 2017-18 to 2019-20.

PLANNING AND COORDINATION

10.4 The Planning and Coordination Division is responsible for overall planning and Coordination, plan & annual budgeting of schemes/programmes of the Ministry and matters related to

reforms, policy measures, fiscal concessions, etc. Its work also involves maintaining a close liaison with different Programme Divisions of the Ministry and with other concerned Ministries/ Departments/ State Nodal Agencies, etc. on a regular basis.

10.5 Major activities handled by the Division during 2017-18 includes preparation of background notes/write ups for Standing Committee on Energy related to the Ministry's Demand for Grants and other specific subjects selected for examination, preparation of reports/database on major achievements/ new initiatives for PMO and Cabinet Secretariat/Press Information Bureau (PIB)/ NITI Aayog, preparation of multi-sectoral inputs/state briefs for various meetings, speeches of Minister/ Secretary, replies to VIP references and other RTIs/ questionnaires and Parliament Questions involving multiple schemes/ programmes/policy issues, conveying of regular review meetings/conference with state governments/ implementing agenises, comments of the ministry on draft cabinet notes, preparation of Outcome Budget for 2017-18, Economic Survey, Action taken reports, etc.

HUMAN RESOURCES DEVELOPMENT

10.6 Human Resource Development (HRD) scheme of MNRE supports trainings manpower at all levels including promoting higher studies/research courses in R&D/academic institutions in renewable energy by providing fellowships to students/scholars. Support is also provided to R&D/academic institutes for up-gradation of their libraries and labs for conducting higher degree courses such as M.Sc, M.Tech, and Ph.D in new and renewable energy. A Suryamitras Training Programme was introduced in 2015 as Skill Development Programme to create trained workforce for installation, commissioning and operation and maintenance of solar projects.

10.7 The following are various components of HRD scheme:

i) Support to educational and other organizations for conducting short-term trainings on various aspects of renewable energy with focus on skill development at all levels.

ii) Fellowships

   a. National Renewable Energy Fellowship Scheme for pursuing M.Sc./M.Tech/ PhD/ PDFdegree courses.

   b. National Solar Science Fellowship Scheme for eminent scientists working in research institutes with an innovative idea in solar energy.

iii) Support to higher educational institutions for lab and library upgradation.

iv) Suryamitra Skill development Programme

v) Development of course/ study materials through experts/expert institutions

National Renewable Energy Fellowship Programme

10.8 Ministry continued its support to students/scholars for pursuing higher studiessuch as M.Sc, M.Tech, Ph.D, PDF courses in renewable energy in 16no.of select educational institutions by way of providing fellowships/stipend under National Renewable Energy Fellowship Scheme. National Solar Science Fellowship is awarded to eminent scientists working in research institutes with an innovative idea in solar energy. So far out of 140 fellowships awarded by MNRE for PhD, 80 fellows have been awarded Ph D degree, which includes 18 fellows who got Ph D degress in 2017-18, 11 students got M.Tech degree, 10students got M.Sc degree in 2017-18. These fellows/students have published 540 research papers in the national and international journals

of repute, besides presenting 156 papers in seminars. Three patents were also filed. The list of supported institutes are given in Table below: -

Institutions Allotted

Sl. No.	Institutions allotted Fellowships for M. Sc, M.Tech, Ph.D, PDF and NSSF.
1	Indian Institute of Technology, Delhi
2	Indian Institute of Technology, Roorkee
3	Indian Institute of Technology, Delhi
4	Malaviya National Institute of Technology, Jaipur
5	Anna University, Tamilnadu
6.	Indian Institute of Technology, Roorkee
7.	Pune University, Pune, Maharashtra.
8.	Pondicherry University, Pondicherry.
9.	Tamil Nadu Agriculture University, Tamilnadu.
10.	Shri Mata Vaishno Devi University Katra, J&K.
11.	Jadavpur University, Kolkata
12.	Cochin University of Science and Technology, Cochin
13.	Indian Institute of Engineering Science &Technology, Shipbur , West Bengal.
14.	Gandhigram Rural Institute deemed University, Tamilnadu
15.	University of Lucknow, Lucknow.
16.	National Physical Laboratory(NPL), CSIR, New Delhi

10.9 As part of the National Solar Science Fellows (NSSF), Dr.Aldrin Antony, fellow completed the fellowship tenure in the current year. His work is mainly focussed on the thin film silicon solar cells and a new task of silicon hetero junction solar cells has been introduced and fabricated a novel PECVD -Sputter system for the fabrication of silicon hetero junction solar cells. Three Solar Science fellows who were awarded National Solar Science Fellowship have filed four patents and one is under process for filing.

Enhancement of Library and Labs

10.10 The Ministry supported two institutions, namely, Pandit Deendayal Petroleum University, Gandhi Nagar and Tejpur University, Assam in the current year for up-gradation of their laboratory and library facilities.

Trainings

10.11 The Ministry continued supported five institutes for conducting short term training programmes with varied levels and target groups. Training of Women for Solar Systems (10 courses covering 233 women) was done by Barefoot College, Tilonia, Solar energy technicians program and RE Law & Management programmes at Centre for Sustainable Development (CSD), Bangalore, Solar energy technicians as well as RE awareness programmes (80 training programmes under 6 training courses MLAs, MLCs, CEOs, Engineers, ZP, TP, GP elected representatives)

at Mahatma Gandhi Institute of Rural Energy Development(MGIRED), Bangalore, Certificate Course on Solar Energy at The Gandhi Gram Rural Institute of Higher education , Tamil Nadu and Operators Training programme (53 no.) at Cogeneration Association of India, Pune. In the current Year, Central Electronics Limited, Ghaziabad completed its 6th six month training programme in solar PV Installation in the present year supported by the Ministry.

Solar Mama' repairing a controller trained by Barefoot College

Rural women busy with circuits during training programme conducted by Barefoot college

Suryamitra Training

10.12 Suryamitra Training are being organized through 177 training centres\organisation in different states across the country. 11,013 no. of Suryamitras have been trained up to 31st March, 2017. During the current year, 2208 Suramitras are trained and 2974 Nos. are undergoing training by 31.12.2017 against the 10000 target of 2017-18. 2208 Suramitras are trained and 2974 Nos. are undergoing training by 31.12.2017 against the 10000 target of 2017-18.

ADMINISTRATION – e-Governance, Vigilance, Library, Right to Information

E-GOVERNANCE

10.13 National Informatics Centre (NIC) is a premier S&T institute of the Government of India, working as an active catalyst and facilitator in "Informatics-led-development" programme of the government for providing e-Government / e-Government Solutions adopting best practices, integrated services and Global solutions in Government sector.

Mobile App – ARUN – Atal Rooftop solar User Navigator

10.14 National Informatics Centre has developed a mobile application namely ARUN ,"ARUN - Atal Rooftop solar User Navigator" for promoting Solar Rooftop installations among the general public.

10.15 ARUN will enable residential and non – residential consumers to understand the basics, state specific framework & knowhow of the Rooftop Solar implementation.

10.16 It brings all Rooftop Solar Information, Schemes and Policies of MNRE and States at a simple readily accessible platform where the user can also place the installation request to cater his requirement. It will also provide up to date circulars / notifications published by MNRE related to solar rooftop.

Highlights of the "ARUN"

10.17 The following are highlights of mobile application ARUN :

- Provides basic knowledge and guidelines on how to install Rooftop Solar System;
- Enables user to carry-out preliminaryassessment using basic details like available rooftop area, capacity required or budget available, using the Rooftop Solar Calculator;
- Accepts online interest application through a simple Installation Request Form;
- Summary ofSchemes, Regulations & Policies applicable in each State/UT;
- One tap voice call feature for contact numbers of State Nodal Agencies & Channel Partners;
- Frequently Asked Questions clear almost all doubts about solar rooftop installation;
- Circulars / notifications issued from MNRE will be viewed instantly.

Provision to submit feedback & suggestions to MNRE.

10.18 The Android version of the mobile application was launched on 24th January 2017.

10.19 In-order to create awareness and provide easy access to information for the installation of Rooftop Solar Systems in the country, Ministry of New and Renewable Energy, has introduced a mobile application "ARUN - Atal Rooftop solar User Navigator",developed by the National Informatics Centre. The mobile application was launched on 24th January 2017.

10.20 iOS version of the ARUN was launched on 24/03/2017. Now the ARUN is available both in English and Hindi languages in both platform. It can be downloaded from the corresponding stores or by clicking the links,Androidhttps://goo.gl/hX3Xxj and for iOShttps://goo.gl/zHKydB.

On Line Application for Small Hydro Project

10.21 An online application for monitoring Small Hydro Projects is under implementation. Through this application developer can register the in MNRE and submit the DPR (Detailed Project Report). This application will monitor right from submission of DPR to the completion of projects. There are different schemes and each scheme is to be completed before 4 years. There can be delay in the completion of projects. This portal will monitor the status of all projects and

the disbursement of subsidy to the developers. It is also integrated with NGO DARPAN portal in the sense that before disbursement of subsidy it will ensure that the NGO should register in the Darpan Portal. Once this portal become live then MNRE is able to monitor each and every project through the application and easy to answer different queries from Parliament, RTI etc. As the project completion period is 4 years it will be easy for MNRE to find the exact status of each projects at any point of time

Ministry Website: (http://mnre.gov.in)

(G-2-C) Application

10.22 Ministry of New and Renewable Energy (MNRE) website was designed in-house using latest ICT tools. Website contains the information such as, Schemes/Programmes of the ministry, List of manufacturers/industries of Solar Water Heater System, SPV, Major achievements, Grid interactive & off grid / distributed renewable power project, Research, Design and Technology development (R&D) notifications, Results framework Documents, Citizen Charter , 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 and is being maintained by NIC.

Expenditure Management System

10.23 An online application for monitoring the progressive financial concurrences and the expenditure by all the divisions has been designed, developed and implemented. The digitization of the concurrence data along-with other relevant information cater to the needs of the divisions by way of keeping tab on financial sanctions /Releases in a quick and efficient manner. It also simplifies the process of retrieval of data pertaining to financial issues.

10.24 This application helps in monitoring the pace of expenditure of all the division.

- Division can view the concurrence on a real-time basis.
- Substitute as central repository for expenditure register maintained by each division individually.
- Provides online access to concurrence/expenditure summary report.
- Pinpoints the Division/Schemes/Files where releases are not affected despite concurrence by IFD.

E-office:

10.25 It is a web-based system implemented and maintained for effective online monitoring of movement of files and receipt in the ministry. NIC's e-Office product is based on an Open Architecture Framework that contains the required flexibility for scaling and meeting the dynamic needs of the Government. Features such as the workflow and rule based file routing, role based access mechanism, central repository of documents, electronic file movement and online forms helps to create a near-paperless office. Information sharing between systems leads to effective decision making. In-house training has been provided to ministry officials time to time as per their requirement. E-office is fully implemented in the ministry.

Project Monitoring Through Video Conferencing Facility

10.26 A studio based video conferencing (VC) system has been implemented in the ministry. VC is actively used in the ministry for monitoring different renewable programmes of the ministry with all State Nodal Agencies, Developers and Manufactures by Secretary, Joint Secretary, Advisor and Directors of the ministry. This year we have conducted many national and international video conferences.

PRAGATI (Pro-Active Governance And Timely Implementation):

10.27 Prime Minister is reviewing the projects through video conferencing on every 4th Wednesday. Ministry participated all the programmes through video conferencing. It is being attended by the Secretary, Additional Secretary, Joint Secretaries and other Senior Officers of the Ministry.

VIGILANCE

10.28 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 looks after such activities within the Ministry and 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 Board Level Officers of its two Public Sector Undertakings namely Solar Energy Corporation of India (SECI) and Indian Renewable Energy Development Agency (IREDA) in its functioning. The Division is entrusted with upkeep of Annual Performance Appraisal Reports (APARs) and Immovable Property Returns (IPRs) of officials of the Ministry.

10.29 During the year 2017, 22 complaints were received out of which 8 are pending for which action is being taken

10.30 The Vigilance Awareness Week was observed in the Ministry from 30th October, 2017 to 4th November, 2017. Following activities were undertaken as part of Vigilance Awareness Week:

i. Administering the Integrity Pledge to all the staff and officers by the Additional Secretary in MNRE on 30.11.2017 at 11AM.

ii. Expert lecture by Ex Faculty member of ISTM on vigilance atters and importance of FR 56 (j) for the Ministry officials.

iii. Essay competition for the officials of the Ministry was organized on **"Corruption in India- whom to Blame "**.

iv. Slogans on curbing corruption and preventive vigilance with banners were placed in premises of the Ministry.

10.31 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.

10.32 Probity related matters on e-portal was uploaded in respect of this Ministry and its Autonomous Organisations and vigilance related information in respect of Board Level Officers is being updated monthly on e-portal SOLVE.

LIBRARY

10.33 The Library of the Ministry of New and Renewable Energy acts as a reference centre and knowledge house in the field of renewable energy. At present about 15230 books (including gifted books) are available in the library covering very diverse areas including the subjects such as Renewable Energy, Climate Change, Natural Sciences, Sustainable Development, History, Sociology, Indian Literature, Computer Science, etc. In addition to these books, about 17 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.

10.34 The Library Committee constituted in the Ministry scrutinizes and recommends the books for procurement by the library.

10.35 The library is currently subscribing to 41 periodicals in Hindi and English languages. Besides, as per requirement, a total number of 24 newspapers in Hindi and English languages are also being subscribed by the library.

RIGHT TO INFORMATION ACT

10.36 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 .

10.37 The Ministry has designated Central Public Information Officer (CPIO) and First Appellate Authorities (FAA) to respond the RTI applications and first Appeals in accordance with subjects assigned to them.

10.38 The progress report in terms of RTI applications/First Appeals received, disposed-off as well as pendency during the period (01.01.2017 – 31.12.2017) is given below:

(Figures in Numbers)

Item	Received	Disposed off	Pending as on 31.12.2017
RTI Applications	1054	1027	27
First Appeals	252	249	03

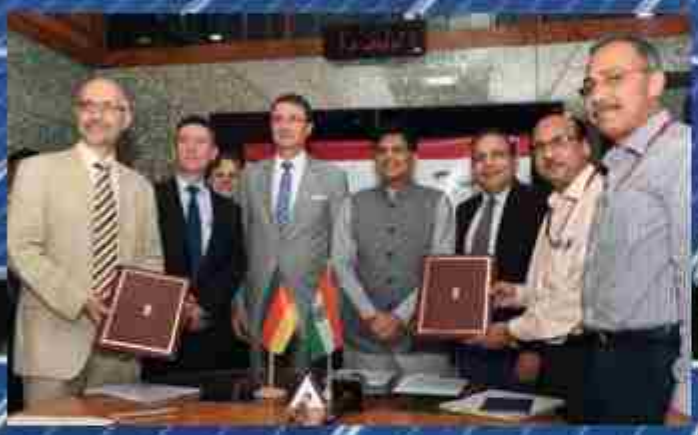
List of Designated Central Public Information Officers (CPIOs) and First Appellate Authorities based on re-allocation of Work (As on 11/01/2018)

Sl. No.	Subject	CPIO	First Appellate Authority
1	Climate Change related initiatives including Clean Development Mechanism (CDM), Renewable Purchase Obligations (RPO) related issues, REC Policy, INSPA, NCEF, Hydrogen, Fuel Cell and IREP, Electrical Vehicle and National Board of Electric Mobility, New Technology, Specific references of Information & Public Awareness and Renewable Energy Policy and Regulations.	Shri Dipesh Pherwani, Scientist 'B'	Dr. P.C. Maithani, Scientist 'G'
2	Planning and Coordination, IREDA	Shri Anubhav Uppal Scientist 'B'	Dr. Pankaj Saxena, Scientist 'F'
3	Setting up of New Institutions of RE University RE Museum & National New Energy Centre, EAP for women's sustainable Energy Entrepreneurship with UN women and UNEP, Gridinteractive policy UNDP/GEF project on barriers to Biomass powergeneration , Grid Interactive Policy	Shri Vijay Kumar Bharti, Scientist 'B'	Shri. V. K. Jain, Scientist 'G'
4	Waste to Energy	ShriVijay Kumar Bharti, Scientist 'B'	Dr. D. K Khare, Scientist 'F'
5	Greening of Islands, Swedish Energy Agency, Andaman Projects	Shri Vijay Kumar Bharti, Scientist 'B'	Shri Ruchin Gupta, DS
6	Solar Scheme for Farmers, Green Energy Corridor , Geothermal, Ocean /Tidal,	Shri Rohit Thakwani, Scientist 'B'	Shri Girish Kumar, Scientist 'E'
7	Solar Thermal Group- Solar Concentrator and Solar Cookers	Shri Aravindh MA, Scientist 'B'	Dr. R.P. Goswami, Scientist 'F'
8	Biogas Power , National Biogas Programme, Biogas Training Centres and Biogas R&D	Shri S.R. Meena, Scientist 'C'	Shri G. L. Meena, Scientist 'G'
9	HRD & Training including ITEC Innovation Centre, R& D Coordination ,Lab Policy, Standards & Quality Control	Ms.Vasantha V. Thakur, Scientist 'D'	Dr. B. S. Negi, Scientist 'G'
10	Off-Grid Solar, Agri Pump Scheme, Street Light , Home Light	Shri Shobhit Srivastava, Scientist 'C'	Shri Jeevan Kumar Jethani, Scientist 'E'
11	Small Hydro Projects (Private Sector) Watermills, Small Hydro Projects (Government Sector) of Uttarakhand, North East Watermills, Mini -Micro Hydel	Shri S. K Shahi, Scientist 'C'	Dr. P. C. Pant, Scientist 'F'

12	VGF Scheme, GBI	Shri Neeraj Kumar, Scientist 'C'	Shri B.L Ram, Scientist "G"
13	Energy Storage, E-Mobility and International Solar Aliance and Specific references of Renewable Energy Policy and Regulations	Shri Tarun Singh Scientist 'C'	Dr. P.C. Maithani, Scientist 'G'
14	Solar Rooftop	Shri Hiren Borah, Scientist 'C'	Shri Jeevan Kumar Jethani, Scientist 'E'
15	Small Wind Energy, Off – Shore Wind, Wind Resources Assessment, Fiscal Incentive (CCDC and EDEC) (Concessional Custom Duty Certificate, Excise Duty Exemption Certificate) in respect of Wind Energy	Shri P.K Dash Scientist 'C'	Shri G Upadhyay Scientist 'F'
16	Wind Energy, Wind RPO (Renewable Purchase Obligations), REC (Renewable Energy Certificate), NIWE	Shri A. Hari Bhaskaran, Scientist 'C'	Shri G Upadhyay Scientist 'F'
17	Solar (R&D), (ST&SPV), Solar Water Heater, Solar Thermal Group – Flat Plate/ Evacuated Tube Collector / Non concentrating Collector Systems – Air Heaters, driers, direct cooking system and All issues relating to Application relating to Regional Testing Centre,	Shri Anil Kumar, Scientist 'C'	Shri I.P Singh, Scientist 'F'
18	NTPC Building Scheme, Solar Manufacturing Scheme , 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 Sanjay Karandhar, Scientist 'C'	Shri B.K. Bhatt, Scientist 'G'
19	CCDC Solar Power	Shri Arun Kumar, Scientist "C"	Shri Anand Narvane, Scientist 'E'
20	Solar City Programme Green Building	Shri Arun Kumar, Scientist "C"	Shri B.K Bhatt, Scientist 'G'
21	Biomass Cookstove, SSS-NIBE,	Dr. Preeti Kaur, Scientist 'D'	Dr. D.K. Khare, Scientist 'F'
22	Organization of RE – Invest	Dr. P.C. Pant, Scientist 'F'	Shri Bhanu Pratap Yadav, JS
23	Biomass gasifier based Energy Projects for rural area, industry including grid connected,	Dr. D.K. Khare, Scientist 'F'	Shri A.N Sharan, JS
24	DBT Cell	Shri Sohail Akhtar, Scientist 'G'	Shri Bhanu Pratap Yadav, JS

25	NIC Matters, Work related to Dashboard and E-office.	Shri S.K Jagawani Scientist 'F'	Shri Bhanu Pratap Yadav, JS
26	GST related to Biogas	Shri S.R Meena, Scientist 'C'	Shri Ruchin Gupta, DS
27	GST related to Wind CDC/EDE	Shri P.K Dash, Scientist 'C'	Shri Ruchin Gupta, DS
28	GST related to Soldar CDC/EDE	Shri Arun Kumar, Scientist 'C'	Shri Ruchin Gupta, DS
29	GST related to Grid Silar	Shri Sanjay Karandhar, Scientist 'C'	Shri Ruchin Gupta, DS
30	GST related to Off Grid Solar	Shri Shobhit Srivastava, Scientist 'C'	Shri Ruchin Gupta, DS
31	GST related to Biomass	Ms.Priya, Scientist 'B'	Shri Ruchin Gupta, DS
32	Biomass Power Schemes and Policies, Bio Energy Mission	Shri S. K Khurana, US	Dr. G. Prasad, Scientist 'F'
33	Seminar & Symposia	Raghunath, US	Ms.Alka Joshi, DS
34	I & PA	Raghunath, US	Dr. P.C. Maithani, Scientist 'G'
35	Vigilance	Ms. Sunita Dhewal, US	Shri Ruchin Gupta, DS
36	National Solar Mission, , Solar RPO (Renewable Purchase Obligations), REC (Renewable Energy Certificate), Solar Park, Defence Schemes,	Shri Devendra Singh, US	Shri Dilip Nigam, Scientist 'G'
37	Guidelines & SBDs, CPSU Scheme, Grid Connected PV & ST-1 Canal Top Solar Project, NISE, SECI	Shri Devendra Singh, USUS	Shri Ruchin Gupta, DS
38	International Relations (IR)	Shri Sachin Tulsi, US	Dr. D.K Khare, Scientist 'F'
39	O/o Minister of State (IC), NRE	Shri Sachin Tulsi, US	Shri A.N Sharan, JS
40	Parliament Work,	Shri A.K. Singh, US	Dr.Pankaj Saxena, Scientist 'F'
41	Public Grievances	Shri A.K. Singh, US	Ms. Alka Joshi, DS
42	Administration	Shri Arvind Pokhriyal, US	Dr. G Prasad, Scientist 'F'
43	Integrated Finance Division (IFD)	Shri K.G Suresh Kumar, US	Ms. Gargi Kaul JS & FA
44	SADP, AkshayUrja Shop, RTI, Hindi, Library	Ms.Alka Joshi, DS	Ms. Sutapa Majumdar, EA
45	PAO, Budget	Shri Kedar Nath Sr. AO	Shri Sanjay Pandey, Controller of Accounts

11: INTERNATIONAL RENEWABLE ENERGY CO-OPERATION



INTERNATIONAL RENEWABLE ENERGY CO-OPERATION

11.1 The Ministry of New and Renewable Energy has been interacting with both developed and developing countries for cooperation in the field of Renewable Energy with the following objectives:

a) Learn 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 2017-18, the Ministry took various initiatives to promote cooperation with other countries in the field of renewable energy. Memoranda 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 53 Memoranda of Understanding (MoUs)/Agreements /Letter of Intent (LoI) in Renewable Energy Sector with 38 countries. The Joint Working Groups (JWG) were set up to oversee identification, selection and formulation of joint activities for implementation. Interaction with such other 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 projects and activities for cooperation are 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, African Development Bank (AfDB), United Nations Development Programme (UNDP), Asian Development Bank (ADB), United Nations Industrial Development Organization (UNIDO), GIZ and Global Environment Facility (GEF), who are providing project based assistance for renewable energy projects in India.

11.5 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 fields 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.

11.6 During the year, 5 Memoranda of Understandings (MoUs) were signed. The details are as under:

- A Memorandum of Understanding (MoU) was signed between the Ministry of New and Renewable Energy, Government of Republic of India and the Ministry of Economy of the Portuguese Republic on 6th January, 2017 at New Delhi, India.
- A Memorandum of Understanding (MoU) was signed between the Ministry of New and Renewable Energy of the Republic of India and the Ministry of Energy, Tourism and Digital Agenda of the Kingdom of Spain in the field of Renewable Energy signed at Madrid on 30th May, 2017.
- A Memorandum of Understanding (MoU) was signed was signed between the Ministry of New and Renewable Energy, Government of Republic of India and the Ministry of Environment of the Italian Republic on 30th October, 2017.
- A Memorandum of Understanding (MoU) was signed was signed between the Ministry of New and Renewable Energy, Government of Republic of India and Ministry of Infrastructure and transport of the Government of the republic of Fiji on 24th May, 2017.
- A Memorandum of Understanding (MoU) was signed was signed between the Ministry of New and Renewable Energy, Government of Republic of India and Ministry of Environment and Energy of the Hellenic Republic on 27th Nov, 2017.

11.7 During 2017-18, following meetings were held as a part of bilateral/multilateral cooperation, in the Renewable Energy sector:

(i) India – UK Joint Working Group Meeting held on 8th February, 2017 in New Delhi via Video Conference.

(ii) 1st Joint Working Group (JWG) meeting between India and Myanmar was held on 21st March, 2017 in Ministry of New and Renewable Energy, New Delhi.

(iii) US-India energy Dialogue-New Technology and Renewable Working Group (NTRE) Meeting held on 18th April, 2017 through DVC in Ministry of New and Renewable, New Delhi.

(iv) 1st Joint Working Group (JWG) meeting between India and Indonesia was held on 20th April, 2017 in Ministry of New and Renewable Energy, New Delhi.

(v) Project Steering Committee meeting for EU – India "Energy" and "Ecocities" projects meeting held on 20th April, 2017 in Ministry of New and Renewable Energy, New Delhi.

(vi) 2nd Joint Working Group (JWG) Meeting between India and Belgium through digital video conference (DVC) in the field of Renewable Energy on 22nd June 2017 in New Delhi.

(vii) India and Belarus JWG meeting held through DVC on 24th August, 2017, in MNRE, New Delhi.

(viii) Technical Assistance (TA) programmes/projects of UNDP meeting held on 2nd May, 2017 in Ministry of New and Renewable Energy, New Delhi.

(ix) Meeting of Mr. Nick Bridge, UK Foreign Minister's Climate Envoy with Secretary MNRE on 1st September, 2017, New Delhi.

(x) India-Indonesia Parliamentary Friendship Group meeting with the Hon'ble Minister, for Power and NRE on 26th September, 2017 New Delhi.

11.8 In order to keep the Ministry abreast of the latest developments, bilateral discussions in the Renewable Energy sector Ministry officials participated in the following events :-

(i) 18th Session of India- Finland JEC and the 9th Session of India-Slovak JEC in Slovak from 19-21 April, 2017. During the meeting, discussions were held on the further development of bilateral economic and business cooperation, especially in the auto, energy and tourism sectors.

(ii) 46th Session of the Subsidiary Body for Implementation (SBI 46) and subsidiary body for scientific and technology Advice (SBSTA 46) and 3rd part of the first session of the Ad-hoc working Group on the Paris Agreement (APA 1-3) in Bonn, Germany as a part of delegation from Ministry of Environment Forests & Climate Change from 8-18 May, 2017.

(iii) 73rd Annual Session of UN Economic and Social Commission for Asia and the Pacific (UNESCAP) from 15-19 May, 2017, as a part of delegation led by Hon'ble Minister of State (I/C), Ministry of Commerce & Industry on Regional cooperation for sustainable energy.

(iv) 13th International Renewable Energy Agency (IRENA) Council meeting and other related meetings in Abu Dhabi, UAE from 22-25 May, 2017..

(v) 4th India-Germany Inter-Governmental Consultations (IGC) from 31st May-1st June, 2017 wherein 12 cooperation documents in various sectors were signed.

(vi) 10th meeting of Asia Solar Energy Forum (ASEF) and Asia Clean Energy Forum (ACEF) from 5-8 June 2017 .

(vii) Meeting of Misssion Innovation, Clean energy Mission-8 and BRICS in Beijing, China from 5th-9th June, 2017 as part of delegation led by Hon'ble Minister of Science and Technology and Earth Sciences, Govt. of India.

(viii) 1st Joint Steering Committee in Naypyitaw, Myanmar on 16th June, 2017.

(ix) Study Mission organized under the aegis of the European Union (EU) Technical Cooperation for Environment in India Project, to Sweden and Germany from 17th to 24th June, 2017.

(x) Study of the Energy needs of Mauritius by a technical team including MNRE representative from 26-28th July, 2017.

(xi) SPI Expo, NREL and High Level India-US Clean Energy Finance Task Force Meeting and other related events in USA from 12-15 September 2017.

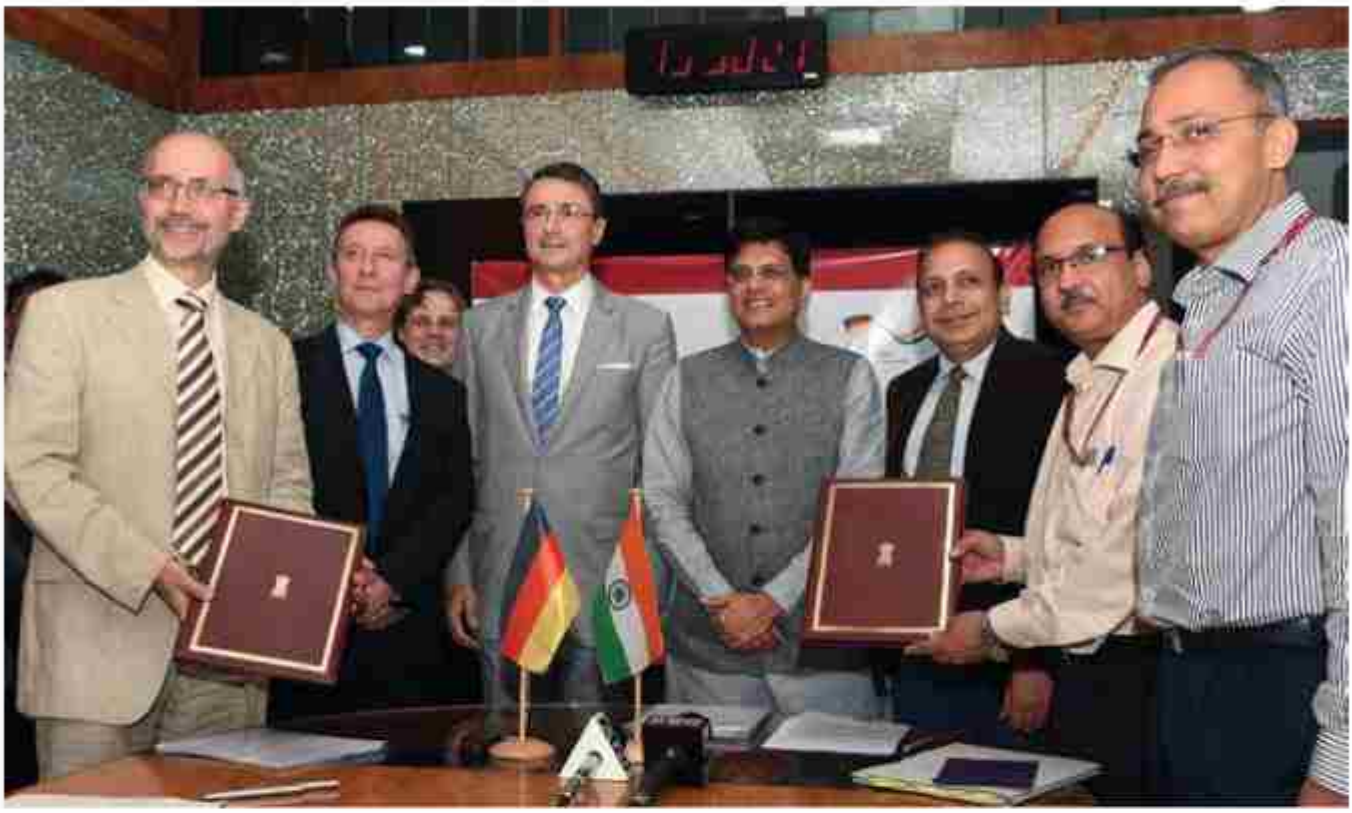
(xii) Market Opening Ceremony of Masala Green bonds in London Stock Exchange, London, United Kingdom and discussion with potential investors in RE Sector like Light House & with Energy Efficiency Services Ltd. On 29th September, 2017.

(xiii) India-UK Steering Committee meeting and Indo-UK Energy Dialogue and other related visits/meetings to London, UK from 25-27 October, 2017.

(xiv) 23rd Session of the Conference of the Parties (COP-23) under United Nations framework Convention on Climate Change (UNFCC) from 13-16 November, 2017 in Germany.

11.9 Following International events were organized by Ministry of New and Renewable Energy during 2017-18:

(i) Signing of agreement between Ministry of New and Renewable Energy (MNRE) and Deutsche Gesellschaft Fur Internationale Zusammenarbeit (GIZ), on Indo German Energy



An Agreement was signed between India-Germany on Indo German Energy Program-Green Energy Corridors (IGEN-GEC)

Program-Green Energy Corridors (IGEN-GEC) on 28th August, 2017 in Shram Shakti Bhawan, New Delhi.

(ii) Signing of agreement on the US-India Clean Energy Finance Facility (USICEF) between Shri K.S.Popli, Chairman & MD, Indian Renewable Energy Development Agency (IREDA) and Shri Gireesh Shrimali, Director, Climate Policy Initiative (CPI) on 15th September, 2017.

Agreement Signing of US-India Clean Energy Finance Facility (USICEF) between IREDA & CPI

(iii) Signing of 4th Addendum to the Implementation Agreement between Deutsche Gesellschaft Fur Internationale Zusammenarbeit (GIZ) and Ministry of New and Renewable Energy (MNRE) on Commercialization of Solar Energy in Urban and Industrial Areas (ComSolar) on 21.11.2017.

(iv) Signing of Supplementary Agreement on Indo-German Energy Programme-Access to Energy in Rural Areas (IGEN-ACCESS) on 21st November, 2017.

EXTERNALLY AIDED PROJECTS

11.10 Following Externally Aided Projects are being implemented in 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);

c) GIZ assisted Project on "Green Energy Corridor (GEC), Integration of Renewable Energies (I-RE) and Access to Energy in Rural Areas(ACCESS);

d) US assisted project on "Promoting Energy Access through Clean Energy" ("PEACE"), Partnership to Advance Clean Energy (PACE) and US India Clean Energy Finance (USICEF)

11.11 A brief write up on each Project is as under:-

A) UNDP/GEF assisted Project on "Scale up of Access to Clean Energy for Rural Productive Uses":

Project Brief

11.12 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 reducing 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 and Service Providers to enhance Rural Livelihoods, (iii) Providing Support in development of Policy and Regulatory Support for RE - Rural Livelihoods Applications, and (iv) Assessing and Improving 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.

11.13 Physical Progress during 2017-18

a. The workshops were organized to create awareness about the Project and the RETPRLs and also to develop proposals which were to be received against RFP which were later uploaded on MNRE and SNAs' website. About 800 Stakeholders including Prospective Beneficiaries, NGOs, State Govt. Officials, and Academicians etc. participated in the workshops.

b. Technical Specifications and Benchmark Costs for 10 RETPRLs were finalized and approved through a Secretary approved committee.

c. Proposals for implementation of Solar Micro Pumps in Assam and MP have been received from AEDA & MPUVN respectively whereas proposal from OREDA for implementation solar pumps projects is expected to be received soon.

d. RFP was floated inviting proposals from Rural Entrepreneurs. A total of 22 proposals were received out of which 5 proposals (3 from Odisha, 1 each in Assam and MP) were shortlisted after initial screening. The Proposals are not processed further as the agencies who were shortlisted are found to be not capable of delivering on deliverables after further inspection.

e. Workshops have been organized to create awareness about RETPRLs amongst Officials of State Govt./RRBs/ Academicians etc. Also Compendium, Audio-Visuals on RETPRLs are being developed and are under Final Stages of Completion and actions on developing a Project website is also under process.

B) DFID Assisted Project on Energy Access Policy Fund (EAPF):

Project Brief

11.14 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.

C) GIZ assisted Project on "Green Energy Corridor (GEC), Integration of Renewable Energies (I-RE) and Access to Energy in Rural Areas (ACCESS);

Indo-German Energy Programme - Green Energy Corridor (GEC) Project

Project Brief

11.15 The main objective of this programme component is to improve the sector framework and conditions for grid integration of renewable energies. The programme component supports directly the implementation of the Green Energy Corridors scheme of the Government of India, which is a prerequisite for large scale integration of renewable energy to achieve the 175 GW target of the Government of India for renewable energy generation capacity by 2022.

Indo-German Energy Programme- Access to Energy in Rural Areas (ACCESS) Project

Project Brief

11.16 The main objective of this Project is to improve the sector environment for Rural Energy Enterprises. Other project objectives are;

a. At least 75% of rural energy enterprises supported by the project directly or indirectly confirm that the business conditions (e.g. business models, training programmes, financing, public support programmes, market intelligence) have improved significantly during the programme period.

b. Twenty rural energy enterprises – 6 of which are managed by women – have been trained by programme partners and have developed business plans which addresses 25,000 households.

c. Two additional financial instruments which provide loans to 10,000 rural households are available on National or State level.

d. Four National or State level programmes or regulations to support access to energy whose development has been supported by the programme are adopted.

Indo-German Energy Programme- Integration of Renewable Energies (I-RE) Project

Project Brief

11.17 The objective of the project is to support the Government of India in achieving its objectives of promoting renewable energy with focus on achieving the target of 175 GW of installed renewable energy capacity by 2022. Specifically, the project will attempt to:

a.) Support the Ministry of New and Renewable Energy (MNRE) in developing a long-term renewable energy based electricity sector "vision" for India.

b.) Support integration of renewable energies and, specifically, rooftop photovoltaic plants into the distribution grid at low and medium voltage levels.

D) US assisted project on Promoting Energy Access through Clean Energy (PEACE), Partnership to Advance Clean Energy (PACE), PACEsetter and US India Clean Energy Finance (USICEF).

Project Brief- PEACE

11.18 In September 2013, the Governments of the United States (USG) and India (GOI) announced the launch of a new initiative "Promoting Energy Access through Clean Energy (PEACE)". The objective of PEACE is to support four key elements to improve energy access: 1) sharing best practices; 2) developing new approaches to increase financing for clean energy access; 3) technology innovation; and 4) building technical capacity of stakeholders.

Project Brief- PACE

11.19 Launched in 2009, it combines the effort of several government and nongovernment stakeholders on both the US and Indian side and includes three key components i.e. research (PACE-R), deployment (PACE-D) and off-grid energy access (PEACE), to work on range of issues related to energy security, clean energy and climate change by supporting research and deployment of clean energy technologies and policies. Seven US government agencies in PACE are , department of energy, department of state, department of commerce, USAID, overseas private investment corporation, export-import bank of the united states, US trade and development agencies.

Project Brief- PAC Esetter

11.20 This was launched as per the approval of Cabinet. It supports accelerating commercialization of innovative off grid clean energy access solutions by providing early stage grant funding. India and United States have each committed to contribute approx. Rs. 25 crores to improve the viability of Off-Grid RE businesses. Steering Committee is co-chaired by Secretary, MNRE and Ambassador of USA to India.

Project Brief- USICEF

11.21 The objective of USICEF is to address the early-stage project preparation needs of distributed clean energy projects. USICEF will target mini-grid, distributed rooftop and off-grid solar projects, as well as smaller-scale grid connected solar projects throughout India. USICEF will support project preparation activities, which may include engineering costs, feasibility studies, legal costs for due diligence and finance documentation, transaction advisory services, customer evaluation, internal controls and payment mechanisms.

Engagement with the International Renewable Energy Agency (IRENA)

11.22 India is one of the Founder Members 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 centre 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.

11.23 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.

11.24 India served as a Member of the IRENA Council and also Chaired the IRENA Council Meetings in 2015which is accountable to the Assembly and facilitates consultations and cooperation among Members and considers the draft work programme, draft budget and annual report.

11.25 IRENA is actively associated with MNRE and provides policy suggestions for scaling up of Renewable Energy target of 175 GW set by India. IRENA has already prepared "REmap 2030 – India Country Report". MNRE is collaborating with IRENA on Global Atlas for Renewable Energy. IRENA has also helped in establishing the International Solar Alliance (ISA).

Training Programme for SAARC Member Countries

SAARC-(SOUTH ASIAN ASSOCIATION FOR REGIONAL COOPERATION- 12th September to 29th September, 2017)

11.26 The National Institute of Solar Energy (NISE), Gurugram had successfully completed International Training programme for SAARC member countries, which was held from 12th September to 29th September, 2017 with financial support from Ministry of New and Renewable Energy. The programme was organised to enhance the capacity of Solar Technologies. During the programme, NISE took the International participants to Jaipur city for showing them solar water pump and other solar equipment.

11.27 The participants also visited all the labs and other facilities at NISE. Internal and external speakers delivered lectures in different fields of solar energy.16 participants attended the programme from 5 different countries viz. Nepal, Bhutan, Sri-Lanka, Bangladesh and Afghanistan.

Skill Development Programme on Solar Technologies for SAARC member states (12th – 29th September, 2017)

12: PROMOTION OF OFFICIAL LANGUAGE- HINDI

First meeting of the reconstituted Hindi Advisory Committee held on 1st November, 2017 under the Chairmanship of Shri R.K. Singh, Hon'ble Minister of State (I/C) for Power and New & Renewable Energy.

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 2017-18 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 :

(i). Website of the Ministry is being redesigned. Efforts are being made to make the website completely bilingual.

(ii). Notings of day to day nature are being printed on file covers bilingually.

(iii). 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.

(iv). Standard Drafts and Standard Forms have been prepared in Hindi and placed on the Website of the Ministry for convenience of officers/staff.

(v). 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 are presented bilingually.

(vi). Letters received in Hindi are invariably replied in Hindi and Rule (5) of the Official Language Rules 1976 was fully complied with.

(vii). First working day of every month is celebrated as Hindi Divas in the Ministry. On this day the work is done mostly in Hindi.

12.3 During the year 2017-18, various measures were taken for effective implementation of Official Language Policy in the Ministry. As per the Quarterly Progress Report for the quarter ended on 30th September, 2017, the percentage of Hindi correspondence with offices in Regions 'A' 'B' and 'C' was 70%, 57% and 59% respectively.

12.4 With a view to create awareness and to increase the use of Hindi in official work, a 'Hindi Fortnight' was observed in the Ministry during 14th to 28th September, 2017. A number of competitions were held and there was good participation 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. Hindi Fortnight was also observed in various offices and Undertakings of the Ministry.

12.5 Hindi Advisory Committee of the Ministry was reconstituted vide resolution, dated 11th September, 2017. First meeting of the reconstituted committee was held on 1st November, 2017 under the Chairmanship of Hon'ble Minister of State (I/C) for Power and New & Renewable Energy.

13: RENEWABLE ENERGY IN NORTH EASTERN REGION STATES

RENEWABLE ENERGY IN NORTH EASTERN REGION

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 systems, remote village electrification, small hydro projects, wind energy systems and energy parks. Against the Revised Estimate of Rs. 394.00 crore from Gross Budgetary Support towards NE Region, an amount of Rs. 68.09crore was released during the year upto 31.01.2018.

GRID SOLAR POWER PROGRAMME

13.2 National Solar Mission aims 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 13.1.**

Table 13.1 State-wise Solar Energy Potential vs. Installed Solar Capacity in NE Region as on 31.12.2017

Sr. No.	State/UT	Solar Potential (GWp)	Installed Capacity (MW) as on 31.01.2018
1	Arunachal Pradesh	9	4.39
2	Assam	14	12.45
3	Manipur	11	1.33
4	Meghalaya	6	0.06
5	Mizoram	9	0.20
6	Nagaland	7	0.50
7	Sikkim	5	0.01
8	Tripura	2	5.09
	TOTAL	**43**	**24.03**

SOLAR PARKS

13.3 The following solar parks have been approved in the under mentioned States of NE region as given in **Table 13.2**.

Table 13.2 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	80	APGCL	Amguri in Sibsagar district
2	Meghalaya	20	Meghalaya Power Generation Corporation Ltd (MePGCL)	Thamar, West Jaintia Hills &Suchen, East Jaintia Hills districts
3	Nagaland	23	Directorate of New & Renewable Energy, Nagaland	Ganeshnagar (12 MW) of Dimapur and Jalukie (11 MW) of Paren districts
4	Arunachal Pradesh	30	Arunachal Pradesh Energy Development Agency (APEDA)	Tezu township in lohit district
5	Manipur	20	Manipur Tribal Development Corporation ltd	Bukpi village, Pherzawl District
6	Mizoram	20	Zoram Energy Development Agency (ZEDA)	Vankal, Mizoram

GRID CONNECTED ROOFTOP AND SMALL SOLAR POWER PLANTS PROGRAMME IN NORTH EASTERN STATES

13.4 Government of India has setup an ambitious target of installing 100 GW of Solar Power by 2022 out of which 40 GW of solar power has to be achieved through rooftop solar (RTS) power plants. In order to achieve this task, MNRE is implementing Grid Connected rooftop and small solar power plants programme for installation of 4.2 GW of RTS power by 2019-20 with a financial outlay of Rs. 5000 Crore.

13.5 The scheme provides central financial assistance to residential, institutional and social sectors to the tune of 30% of benchmark cost/project cost

Solar Photovoltaic Power plant and Solar Water Heating Systems at District hospital in Arunachal Pradesh

(whichever is lower) for general category States/UTs and 70% of benchmark cost/project cost for Special category States/UTs including North Eastern States and Andaman Nicobar and Lakshadweep island. The benchmark cost of the system varies from Rs. 60,000 to Rs. 70,000 per kWp. For government sector achievement linked incentives are being provided.

13.6 As on 31st December 2017, Ministry has sanctioned RTS projects of 59.58 MWp capacities to different North-Eastern States of which 29.865 MWp have been sanctioned in FY 2017-18 (**Table No-13.3**). So far, aggregate 6.73 MWp capacities have been reported as installed in these States. In addition, net-metering regulations have been notified by respective state regulatory commissions of these States. Rooftop solar policies have also been notified by Manipur State.

Table 13.3- Sanctioned RTS projects in North Eastern States

Sr. No.	State/UT	Installed Capacity (MW) as on 31.01.2018
1.	Assam	24
2.	Arunachal Pradesh	10
3.	Manipur	5.715
4.	Mizoram	3.855
5.	Tripura	0.5
	Total	**44.07**

Solar Photovoltaic Power plant and Solar Water Heating Systems at District hospital in Arunachal Pradesh

OFF GRID SOLAR PV PROGRAMME

13.7 During 2017-18, the Ministry has sanctioned a 'SOLAR STUDY LAMP SCHEME' where 70 lakh solar study lamps will be distributed to school going children across the selected states including Assam, where SC population and Kerosene consumption is more than 50% as per census 2011, by December 2018.

13.8 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.

13.9 Details of all SPV systems and standalone SPV power plants in the North Eastern region states as on 31.12.2017 is given in **Table 13.4**

Table 13.4 Details of SPV systems and standalone SPV power plants in the North Eastern region states as on 31.12.2017

S.no	State/UT	Lanterns & Lamps Nos.	Home Lights Nos.	Street Lights Nos.	Pumps Nos.	Stand Alone Power Plants (KWp)
1	Arunachal Pradesh	14433	18945	1671	22	650.1
2	Assam	13379	6926	318	45	1605
3	Manipur	4787	3900	1888	40	1241
4	Meghalaya	24875	7844	4900	19	1084.5
5	Mizoram	9589	6801	5056	37	2019
6	Nagaland	6766	1045	6235	3	1506
7	Sikkim	23300	15059	504	0	850
8	Tripura	64282	32723	1199	151	667
	Total	**1,61,411**	**93,243**	**21,771**	**317**	**9622.6**

Wind Resource Assessment Programme

13.10 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, 72 Wind monitoring stations have been established in North Eastern region at 20 m, 25 m & 50 m level to carry out Wind Resource Assessment.

13.11 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 50 wind monitoring stations at 50 m level with a cost sharing ratio of 90:10 among MNRE and concerned State Nodal Agency.

Small Wind Energy Hybrid Systems (SWES) Programme

13.12 Till date, a cumulative capacity of 413 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.**

Table 13.5 Cumulative Installed Capacity of Small Wind Energy Hybrid Systems in NE Region

Sl. No.	Name of State	Cumulative Installed Capacity upto 31.12.2017 (in KW)
1	Assam	6
2	Meghalaya	201
3	Mizoram	21
4	Nagaland	20
5	Sikkim	16
6	**Tripura**	**2**
7	**Arunachal Pradesh**	**7**
8	**Manipur**	**140**

Small Hydro Power Programme

13.13 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.**

Electrification/illumination of un-electrified border villages of Arunachal Pradesh under PM Package.

13.14 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 / illuminate 1053 un-electrified villages of all international border districts of Arunachal Pradeshthrough Solar photovoltaic (SPV) lighting systems and Micro/Small Hydro Power projects. The project is now in the final stages of implementation. Out of 1053 villages, 1022 villages have been illuminated / electrified. These include, 523 villages, where all households have been provided with solar home lighting systems. 11 nos. of Micro/Small Hydro Projects remains to be completed, for which the Government of Arunachal Pradesh has requested to provide a Gap funding of Rs. 32.2641 crore to complete the remaining 11 nos. of projects. The Ministry is in the process of considering the request of providing the Gap funding.

13.6 Small Hydro Power Plants installation status as on 31.12.2017							
S.no	State/UT	Potential		Projects Installed		Projects under Implementation	
		Nos.	Total Capacity (MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)
1	Arunachal Pradesh	800	2064.92	152	104.605	16	41.05
2	Assam	106	201.99	6	34.11	1	2
3	Manipur	110	99.95	8	5.45	0	0
4	Meghalaya	97	230.05	4	31.03	2	24
5	Mizoram	72	168.9	18	36.47	4	8.7
6	Nagaland	98	182.18	12	30.67	2	1.15
7	Tripura	13	46.86	3	16.01	0	0
8	Sikkim	88	266.64	17	52.11	0	0

BIOGAS PROGRAMME

13.15 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 further allocated targets for implementing the programme in the States of Assam, Nagaland, Meghalaya, Arunachal Pradesh, Tripura and Sikkim during the year. The State-wise family type biogas plants installed in the NE Region during the year is given in **Table: 13.7**. 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 (capacity m³) installed at Vill. Gobinpur, P.O-Laholial, Dist-Lakhimpur, Assam

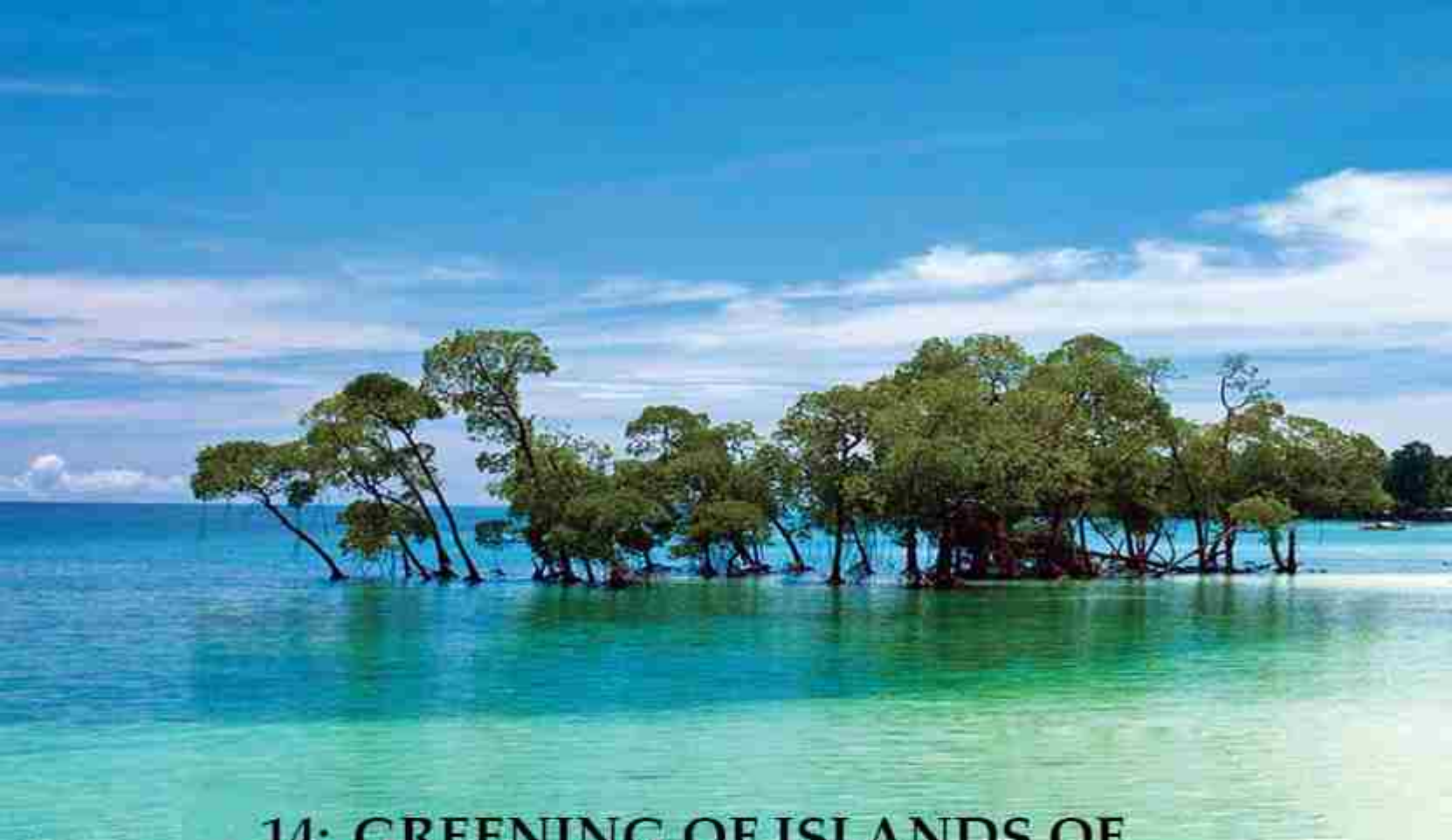
Table 13.7: Family Type Biogas Plants installed in North Eastern Region States under NBMMP		
Sl. No.	Name of State	Plants installed up to 31.12.2017
1	Assam	4200
2	Meghalaya	0
3	Mizoram	146
4	Nagaland	0
5	Sikkim	0
6	Tripura	33
7	Arunachal Pradesh	0

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.

14: GREENING OF ISLANDS OF ANDAMAN & NICOBAR AND LAKSHDWEEP



GREENING OF ISLANDS OF ANDAMAN & NICOBAR AND LAKSHDWEEP

14.1 MNRE, on 05.04.2016 has issued the Administrative Approval for Implementation of a scheme for setting up distributed Grid-Connected Solar PV Power Projects of an aggregate capacity of 40 MW in Andaman & Nicobar and Lakshadweep Islands with an estimated Central Financial Assistance (CFA) of Rs. 192.20 crore. The objective of the scheme is to develop carbon free islands by phasing put 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.

Status of Projects under Implementation:

14.2 A brief status of the projects being implemented by different agencies in Andaman & Nicobar Islands, is as follows:

Sl. No.	Implementing Agency	Project Capacity (MW) & location	Status as on 31.12.2017
1.	Rajasthan Electronics & Instruments Ltd. (REIL)	1 MW SPV Plant with Battery Energy Storage System (BESS) at Havelock Island	Notice Inviting Tender (NIT) for selection of EPC Contractor has been issued
		1 MW SPV Plant with Battery Energy Storage System (BESS) at Neil Island	Notice Inviting Tender (NIT) for selection of EPC Contractor has been issued
2.	Solar Energy Corporation of India (SECI)	1 MW Solar PV rooftop Projects in Port Blair at Government Buildings	The Project has been completed and commissioned in March 2017.
3.	NLC India Limited (NLC)	CEA in October, 2017, has submitted a Report regarding the optimal energy mix forPort Blair (South Andaman) inAndaman & Nicobar Islands. The Report has, inter-alia, suggested a mix of LNG based power plants, Solar PV Power Plants and Battery Energy Storage Systems (BESS) for South Andaman. Accordingly, efforts are being made for expeditious implementation of clean, non-polluting power projects including solar projects through NLC Limited and NTPC Limited.	
4.	NTPC Limited (NTPC)		

ANNEXURES

ANNEXURE I

Strength of Staff in Ministry of New and Renewable Energy for the year 2017-18 are as under:

GROUP	A	B	C	TOTAL
SANCTIONED	124	87	85	296
IN POSITION	78	58	77	213
SC	9	15	27	51
ST	2	2	4	8
OBC	6	9	10	25
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 31.12.2017 are as under;-

Group	A	B	C	D	Total
Sanctioned	1	6	9	-	16
In Position	1	5	9	-	15
SC	-	1	1	-	2
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 & Renewable energy as on 31.12.2017

Group	Board Level	A	B	C	D	Total
Sanctioned	26	21*	1	4	-	26
In-Position	8	3	1	4	-	8
SC	-	-	-	-	-	-
ST	-	-	-	-	-	-
OBC	-	-	-	-	-	-
PH	-	-	-	-	-	-

*The recruitment of 16 posts of Scientist of Group 'A' is under process.

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	41
In Position	3	0	0	0	3
SC	0	0	0	0	0
ST	0	0	0	0	0
PH	0	0	0	0	0
PH	-	-	-	-	-

Note : The posts are sanctioned for the institute have all been advertised and the process for recruitment is on.

NIWE

Group –wise details of Posts in National Institute of Wind Energy (NIWE) as on 31.12.2017 are as follows:-

Group	Group			Total
	A	B	C	
Sanctioned	18	13	17	48
In Position	17	9	15	41
SC	3	2	5	10
ST	1	-	-	1
OBC	7	4	10	21
PH	-	-	-	-

IREDA

The Indian Renewable Energy Development Agency Limited (IREDA) a public sector undertaking under the Ministry provides loans for setting up projects relating to renewable energy and energy efficiency. The staff strength of IREDA as on 31.12.2017 are as under:-

Classification	Board Level	Group				Total
		A	B	C	D	
Sanctioned	3	90	64	59	-	216
In-Position	1	108	19	24	-	152
SC	-	19	1	7	-	27
ST	-	6	2	1	-	9
OBC	-	17	3	3	-	23
PH	-	1	-	1	-	2

SECI

Strength of staff in Solar Energy Corporation of India (SECI) as on 31.12.2017 are as under:-

Group	Board Level	A	B	C	D	Total
In-Position	3	59	7	0	0	69
SC	0	03	02	0	0	5
ST	0	02	0	0	0	2
OBC	0	08	01	0	0	9
PH	0	0	1	0	0	1

ANNEXURE II

Ministry of New and Renewable Energy Statement showing the pendency position of Audit Paras of C&AG Reposts as on 31.12.2017:-

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.