

# 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 4<sup>th</sup> and 6<sup>th</sup> 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 through 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



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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**

<b>Table 1.1 Achievement in grid connected renewable power</b>		
	<b>Achievement (MW) (April - December, 2017)</b>	<b>Cumulative Achievements (MW) (as on 31.12.2017)</b>
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
<b>Total</b>	<b>5602.65</b>	<b>62846.86</b>

1.8 Major highlights are herein under:-

- i. Now, in terms of wind power installed capacity, India is globally placed at 4<sup>th</sup> 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



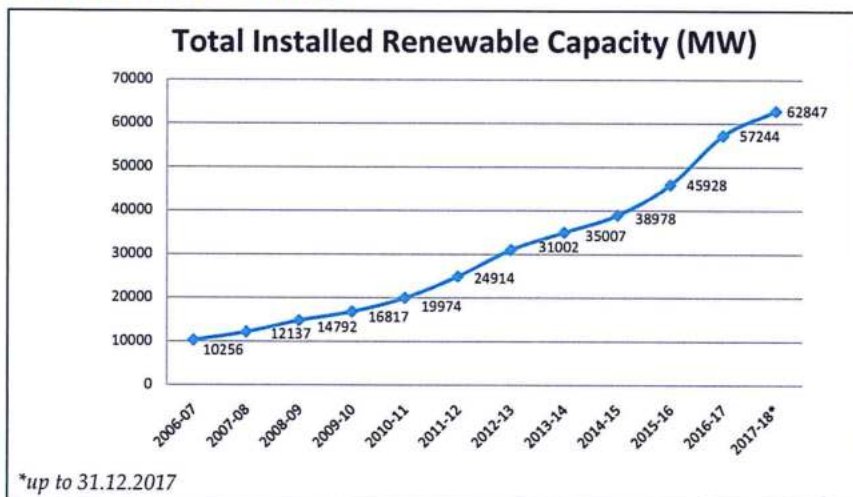


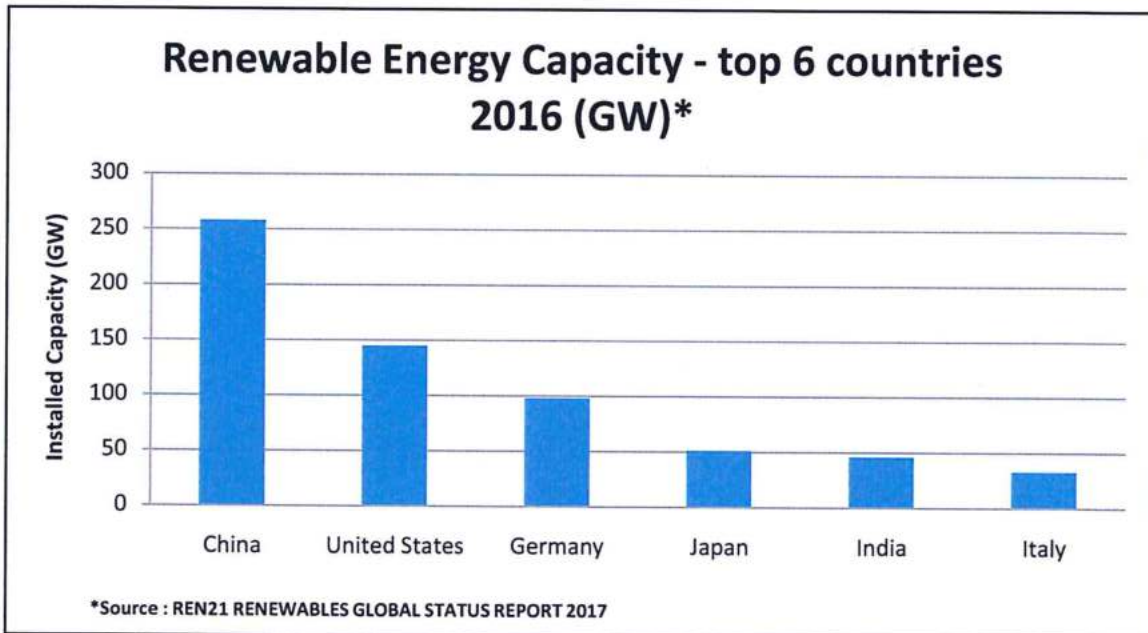
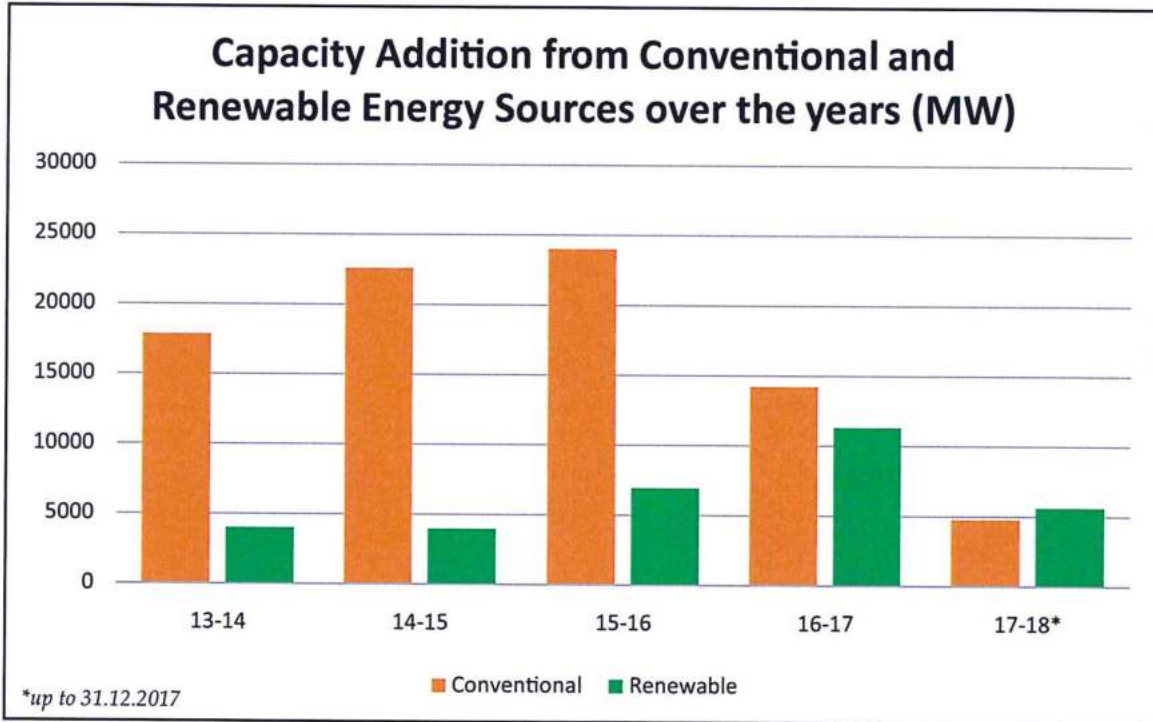
PV Power Projects, which clearly specify the Technical Requirements for Grid Connected Solar PV Power Plants, thereby ensuring the quality of material/ equipment being used in solar PV projects.

- 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 projects commissioned.
- 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.

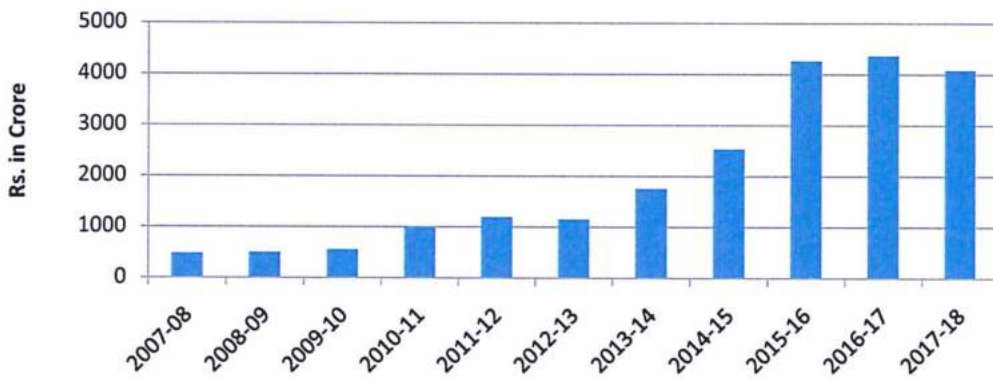
### ACHIEVEMENT AT A GLANCE



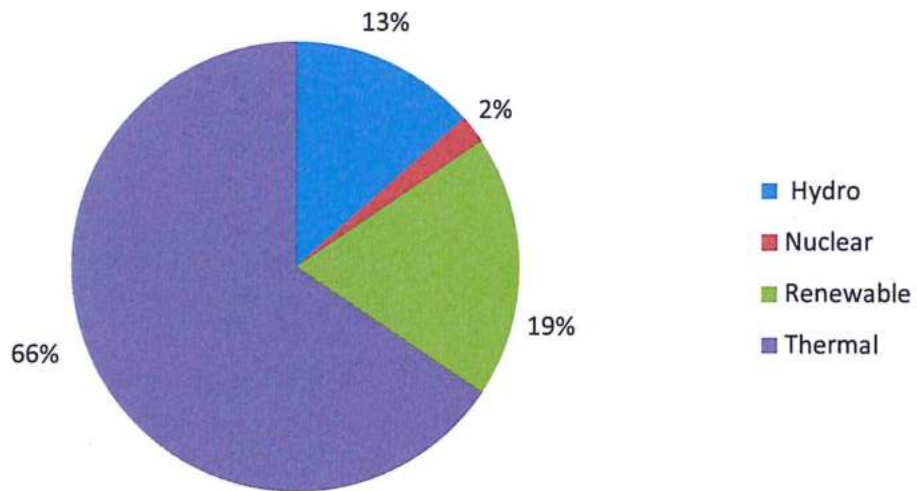




### Trends in Budgetary Support (Revised Estimate)

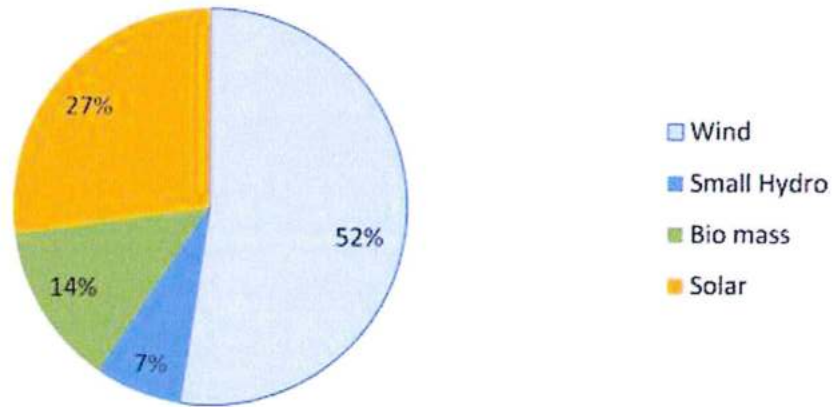


### Power Installed Capacity in Country : 333 GW

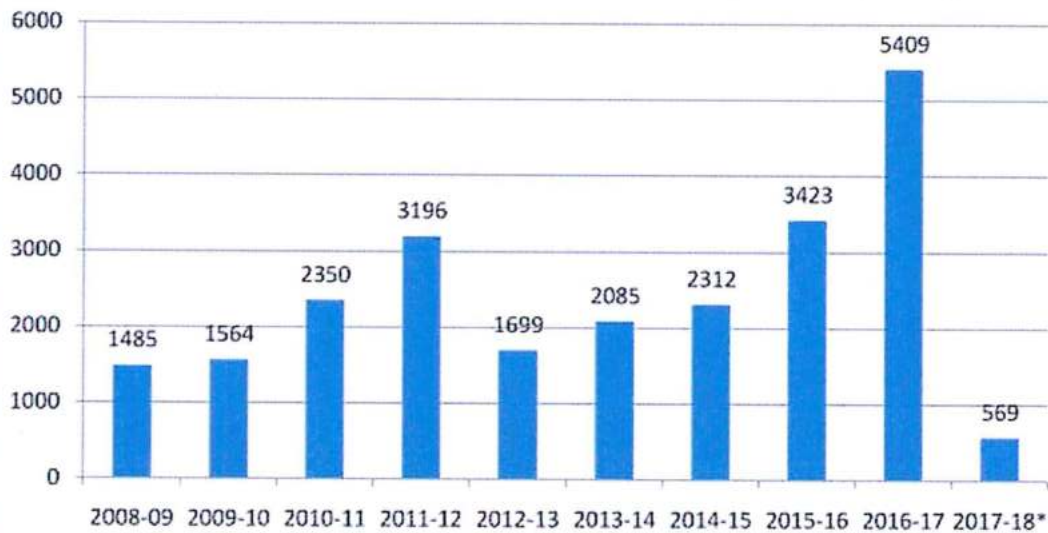




### Renewable Installed capacity : 62.8 GW

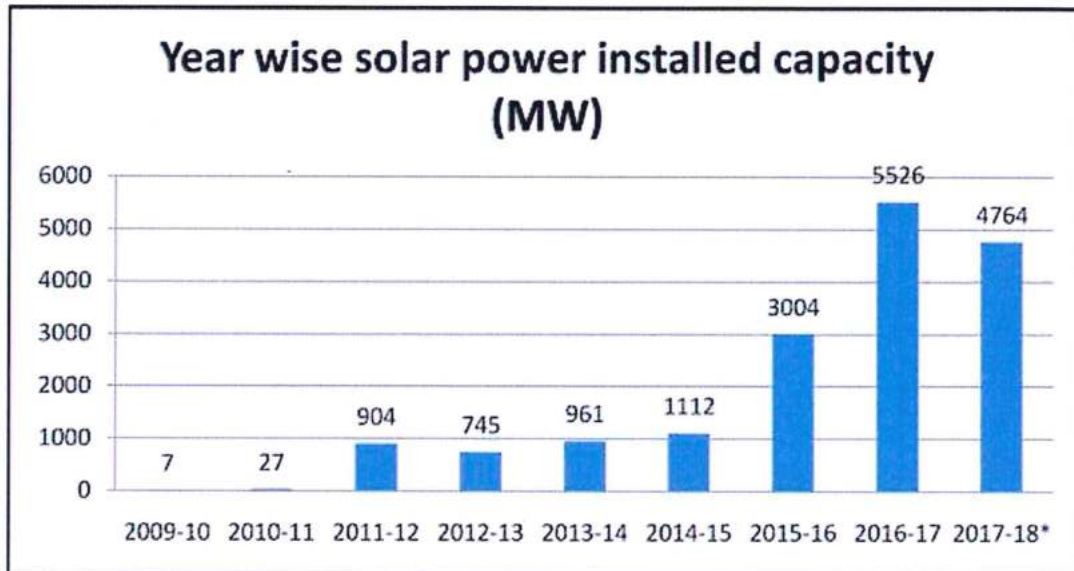


### Year wise wind power installed capacity (MW)

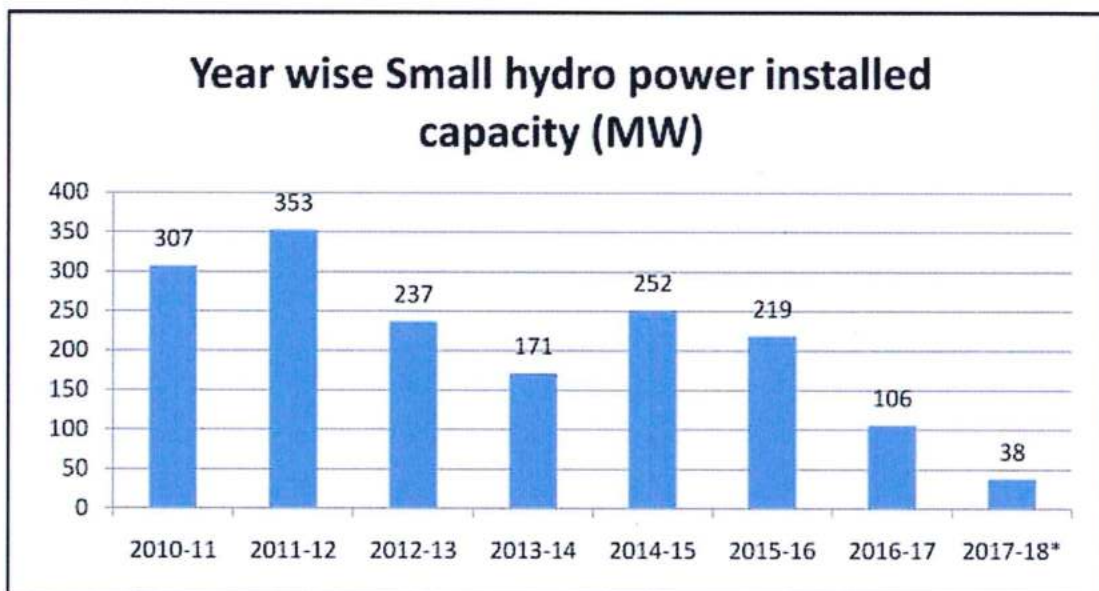


\*up to 31.12.2017





\*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 GW at a hub height of 100 meter, solar potential of ~750 GW assuming 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

S.No	States / UTs	Indicative Installable Potential (MW)	
		@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
	<b>Total</b>	<b>49130</b>	<b>102788</b>

\*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.

<b>Table – 3.2: Wind Power Potential in India @ 100m above ground level</b>				
<b>State</b>	<b>Rank I</b>	<b>Rank II</b>	<b>Rank III</b>	<b>Total</b>
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
<b>Total in MW</b>	<b>153020</b>	<b>145743</b>	<b>3489</b>	<b>302251</b>
<b>Total in GW</b>	<b>153</b>	<b>146</b>	<b>3</b>	<b>302</b>

- 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

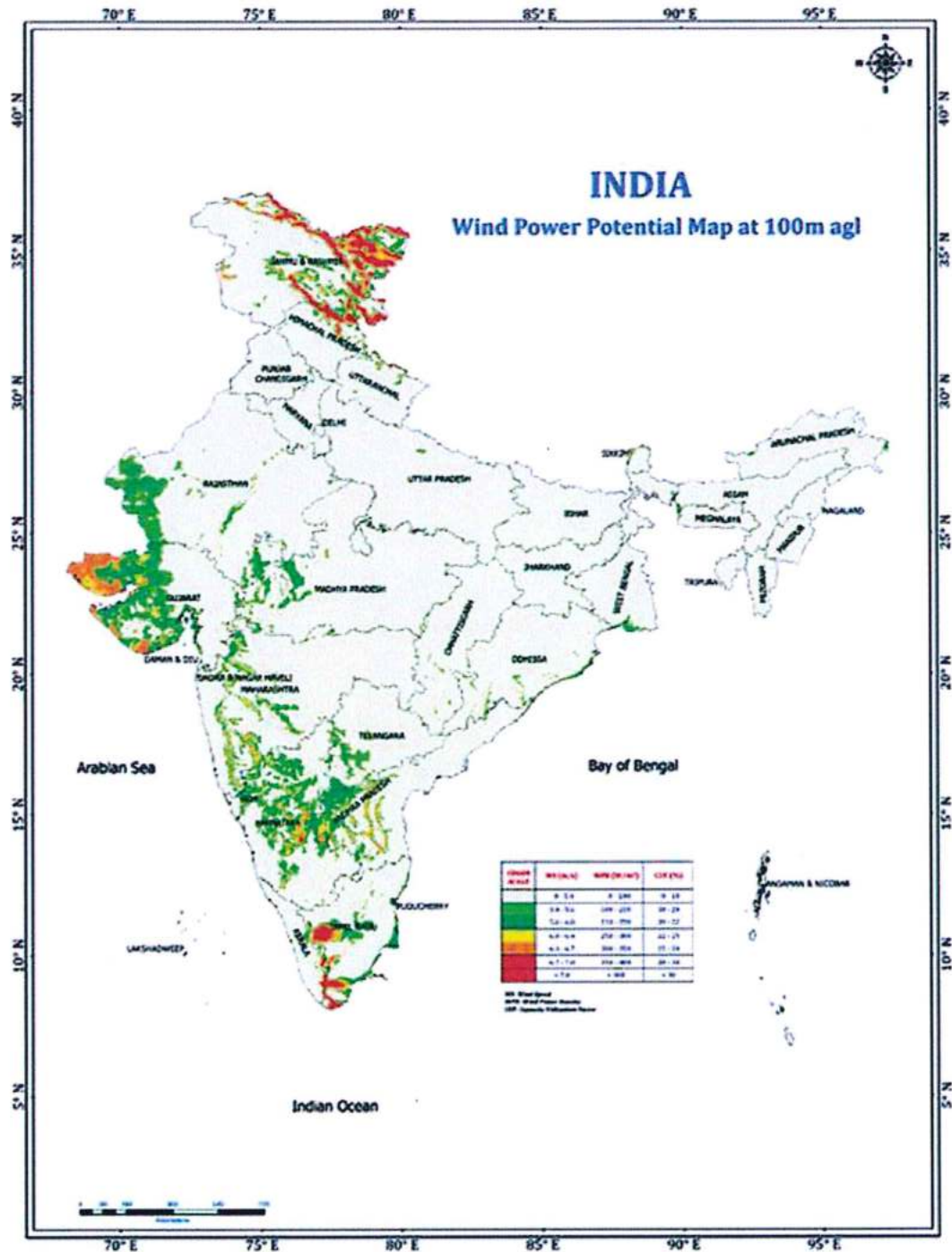
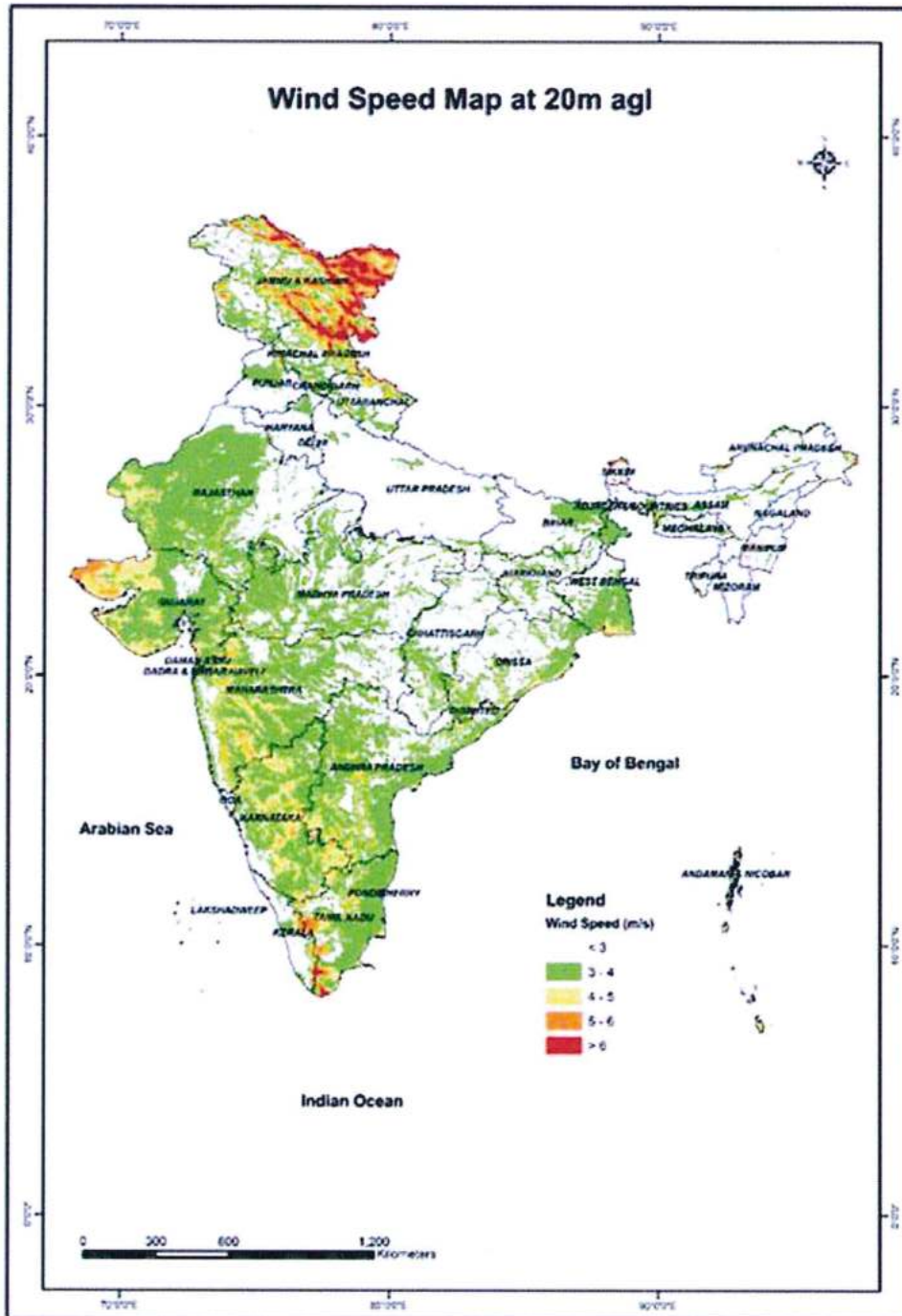


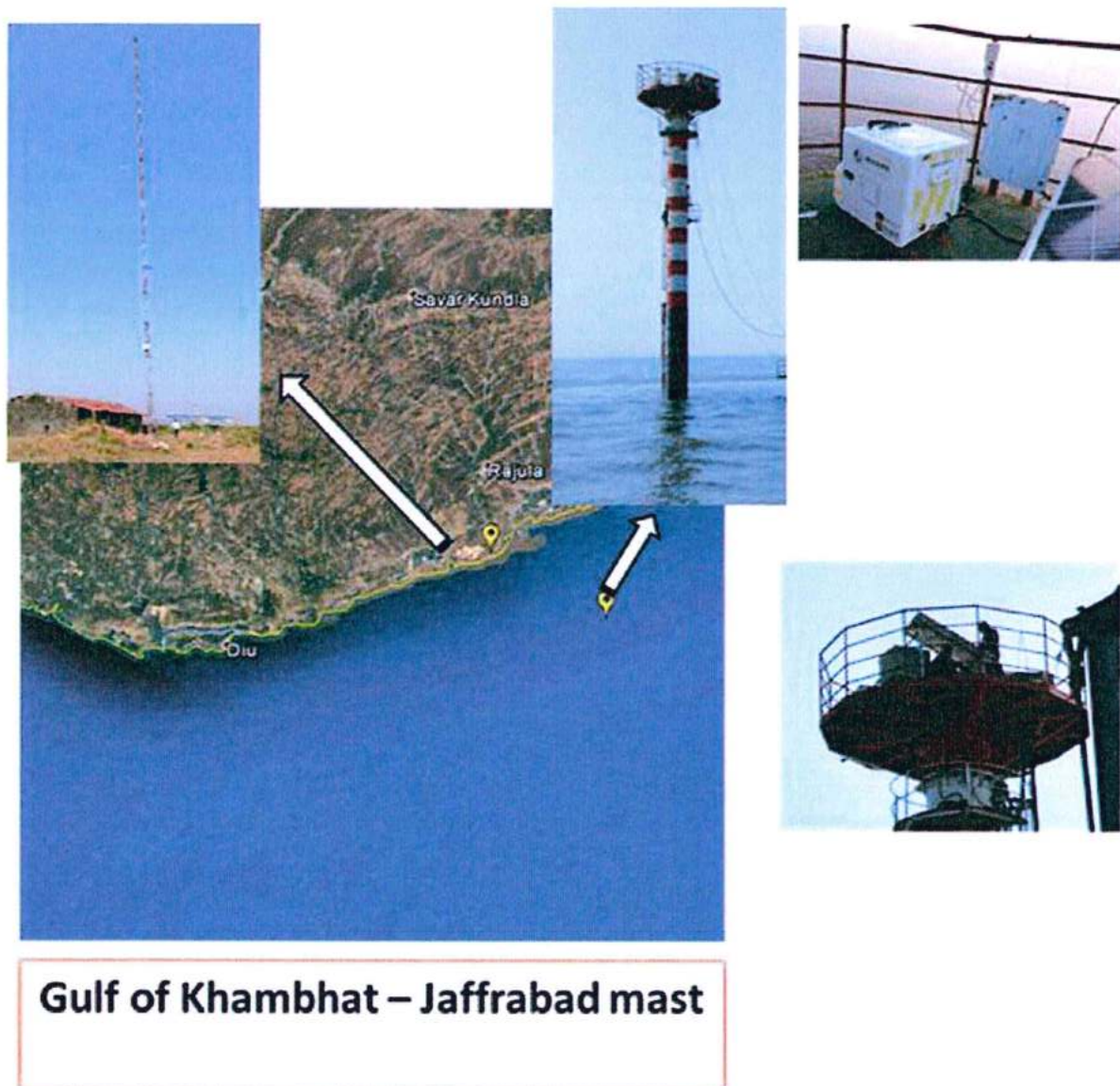
Figure 3.2: Wind Speed Map of India at 20 m above ground level





based wind measurement device 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
	<b>Total</b>	<b>32848.46</b>

## 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.
- 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.
  - Scheme to support for setting up new SHP projects in the private/ co-operative/ joint sector etc.
  - Scheme to support for setting up new SHP projects in the Government Sector.
  - Scheme to support for Renovation and Modernisation of existing SHP projects in the government sector.
  - Scheme to support for development / Upgradation of Water Mills (mechanical/ electrical output) and setting up Micro Hydel Projects (up to 100 kW capacity).
  - 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)							
S I . 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
<b>Total</b>		<b>7134</b>	<b>21133.62</b>	<b>1089</b>	<b>4418.155</b>	<b>136</b>	<b>754.16</b>





- 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 Biarass 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 of study/ 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
	<b>Total</b>	<b>1516</b>	<b>3287</b>



### 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<sup>3</sup> 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 m<sup>3</sup>/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<sup>3</sup> Biogas Power Generation (Off-grid) Plant at Vill.-Yellemla, Teh. Jangaum, Distt.- Warangal (Telangana).*

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

