



**RENEWABLE ENERGY IN NORTH  
EASTERN REGION STATES**

## RENEWABLE ENERGY IN NORTH EASTERN REGION STATES

- 8.1 Special attention is being given to the development of renewable energy in the entire North Eastern region through a separate budgetary allocation of 10% under various renewable energy programs for deployment of grid & off-grid solar energy systems, wind energy systems, small hydro projects, bio-gas plants, etc. in the region.
- 8.2 A total of estimated potential in for renewable energy in the North Eastern Region from solar, small hydro and bio-energy is around 65,838 MW, a substantial part of which is suitable for grid connected applications. State-wise details are given in **Table 8.1**.

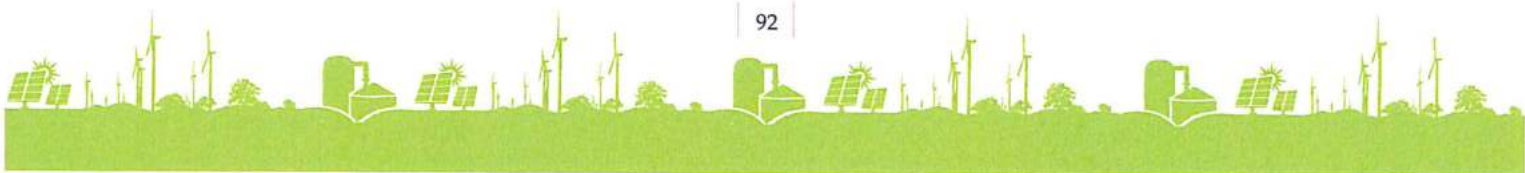
**Table 8.1 State wise details of Estimated Renewable Energy Potential in North Eastern Region**

S. No.	STATES / Uts	Small Hydro Power (MW)	Bio-Energy		Solar (MW)	Total (MW)
			Biomass Power (MW)	Waste To Energy (MW)		
1	Arunachal Pradesh	2064.92	8		8650	10723
2	Assam	201.99	212	8	13760	14182
3	Manipur	99.95	13	2	10630	10745
4	Meghalaya	230.05	11	2	5860	6103
5	Mizoram	168.90	1	2	9090	9261
6	Nagaland	182.18	10		7290	7482
7	Sikkim	266.64	2		4940	5209
8	Tripura	46.86	3	2	2080	2132
	<b>Total</b>	<b>3261.49</b>	<b>261</b>	<b>16</b>	<b>62300</b>	<b>65838</b>

- 8.3 The state wise status of grid connected installed renewable energy capacity as on 31st December, 2019 in the region is given in **Table 8.2**.

**Table 8.2: State-wise installed capacity of Grid Interactive Renewable Power (on 31.12.2019)**

S. No.	STATES / Uts	Small Hydro Power	Bio-Power	Solar Power	Total Capacity	Capacity Addition during 2019-20
		(MW)	(MW)	(MW)	(MW)	(MW)
1	Arunachal Pradesh	131.105		5.61	136.72	0.52
2	Assam	34.11		41.23	75.34	18.83
3	Manipur	5.45		4.58	10.03	1.14
4	Meghalaya	32.53	13.80	0.12	46.45	0
5	Mizoram	36.47		1.52	37.99	1.02
6	Nagaland	30.67		1.00	31.67	0
7	Sikkim	52.11		0.07	52.18	0.06
8	Tripura	16.01		9.41	25.42	4.32
	<b>Total (MW)</b>	<b>338.455</b>	<b>13.80</b>	<b>63.54</b>	<b>415.8</b>	<b>25.89</b>







## 8.4 SMALL HYDRO POWER PROGRAMME

- (i) 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. SHP projects can provide energy almost uninterrupted without any major maintenance or dependence on weather. The region, which is beleaguered by large energy deficits and poor quality of energy services, can benefit from greater decentralization and accountability associated with Small Hydro Power Projects. Small Hydro Power Projects can generate sufficient electricity to power domestic household, schools and clinics in rural areas and trigger entrepreneurship activities. The State-wise installed capacity vis-a-vis potential in North Eastern States & Sikkim is given in **Table 8.3**.

Table 8.3: State wise list of potential sites and installed projects SHP Projects in NER (as on 13.12.2019)					
Sl. No.	State	Total Potential		Total Installed	
		Nos.	Capacity (MW)	Nos.	Capacity (MW)
1	Arunachal Pradesh	800	2064.92	156	131.105
2	Assam	106	201.99	6	34.11
3	Manipur	110	99.95	8	5.45
4	Meghalaya	97	230.05	5	32.53
5	Mizoram	72	168.9	18	36.47
6	Nagaland	98	182.18	12	30.67
7	Sikkim	88	266.64	17	52.11
8	Tripura	13	46.86	3	16.01
<b>Total</b>		<b>1384</b>	<b>3261.49</b>	<b>225</b>	<b>338.455</b>

### SUCCESS STORY

Nuranang Small Hydro Power Project Phase-II (1.00MW) : - Nuranang SHP (1MW) project is located at Nuranang in Tawang district of Arunachal Pradesh. This project has been implemented under Prime Minister's announced package for Arunachal Pradesh. Ministry of New and Renewable Energy has provided 100% financial support for the project.



*Inauguration of Nuranang SHP (1MW) under Prime Minister's announced package for Arunachal Pradesh by Shri Kiren Rijiju, Hon'ble Minister of State (IC) of the Ministry of Youth Affairs and Sports.*

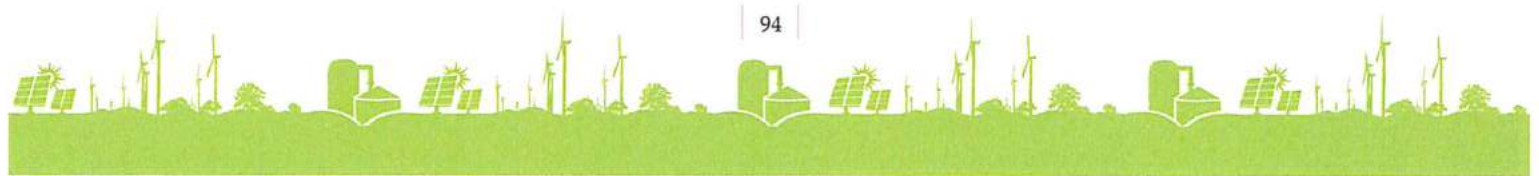


- (ii) The major Small Hydro Power Projects which are currently under implementation is given in **Table 8.4**.

### 8.5 PM PACKAGE FOR ARUNACHAL PRADESH

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 by installation of 5758 nos. of SPV Home Lighting Systems and 153 numbers of Micro Hydel/Small Hydel Projects. The project is completed except commissioning of five numbers of Small Hydro Power Projects by the Department of Hydro Power Development.

<b>Table 8.4: Small Hydro Power Projects which are currently under implementation in NE Region</b>			
<b>Sr. No.</b>	<b>Name of the Project</b>	<b>Capacity (MW)</b>	<b>Implementing Agency</b>
<b>Arunachal Pradesh</b>			
1	Namachik – I in Changlang District	0.5	Department of Hydro Power Development
2	Tirru nallah in Longding District	0.1	Department of Hydro Power Development
3	Fure in Kurukungme District	0.05	Department of Hydro Power Development
4	Pakhankha in Changlang District	0.5	Department of Hydro Power Development
5	Payu at Pinchi in Kurung Kumey District	0.5	Department of Hydro Power Development
6	Khajalong in West Kameng district	2.0	Department of Hydro Power Development
7	Sumbachu SHP in Tawang District	3	Hydro Power Development Corporation of Arunachal Pradesh
8	Taksang Chu SHP in Tawang district	3.4	Hydro Power Development Corporation of Arunachal Pradesh
9	Kinmey Gompa in Tawang District	0.1	Department of Hydro Power Development
<b>Meghalaya</b>			
10	Ganol SHP West Garo Hills District	22.50	Meghalaya Power Generation Corporation Limited
11	Riangdo SHP in West Garo Hills District	3.0	Meghalaya Power Generation Corporation Limited
<b>Mizoram</b>			
12	Kawlbem in Champhai District	3.50	Power & Electricity Deptt., Government of Mizoram
13	Tlawva SHP in Champhai District	5.00	Power & Electricity Deptt., Government of Mizoram
<b>Nagaland</b>			
14	Ponglefo SHP in Kiphire District	1.00	Department of Power, Government of Nagaland
<b>Sikkim</b>			
15	Chatten Stage-II in North Sikkim District	3 .00	Sikkim Power Development Corporation Limited







## 8.6 SOLAR PARKS

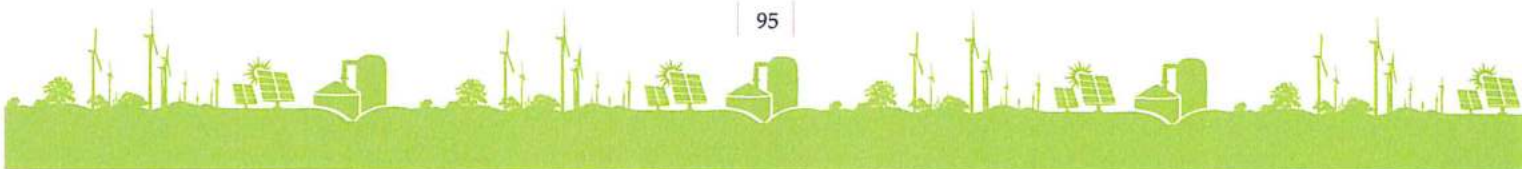
Ministry is implementing a Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects. The main objective of Scheme is to scale up setting up of solar projects in a short span of time. Under the Scheme, it is proposed to set up at least 50 solar parks targeting setting up of 40,000 MW of solar power projects by 2021-22. All the States and Union Territories are eligible for getting benefit under the scheme. The capacity of the solar parks shall be 500 MW and above. However, smaller parks are also considered in States where there is shortage of non-agricultural land. The following solar parks have been approved in the under mentioned States of NE region with a total Capacity of 113 MW in five states as given in **Table 8.5**.

Sl. No.	State	Capacity (MW)	Name of the Solar Power Parks Developer (SPPD)	Land identified at
1.	Arunachal Pradesh	30	Arunachal Pradesh Energy Development Agency (APEDA)	Tezu township in Lohit district
2.	Manipur	20	Manipur Tribal Development Corporation Ltd. (MTDCL)	Bukpi village, Pherzawl District
3.	Meghalaya	20	Meghalaya Power Generation Corporation Ltd. (MePGCL)	Thamar, West Jaintia Hills & Suchen, East Jaintia Hills districts
4.	Mizoram	20	Power & Electricity Department	Vankal, Champhai district, Mizoram
5.	Nagaland	23	Directorate of New & Renewable Energy, Nagaland (DNRE)	Ganeshnagar, Dimapur district and Jalukie, Parem district

*The Amguri solar park (70 MW) in Assam was cancelled due to its slow progress.*

## 8.7 GRID CONNECTED ROOFTOP SOLAR PROGRAM IN NORTH EASTERN STATES

- (i) Grid Connected Solar Rooftop Programme is being implemented in the Country including North Eastern States.
- During the year 2019-20, a total of 1.50 MW capacity has been sanctioned to Electricity Departments /DISCOMS of 2 States (i.e. 1 MW to Electricity Department of Nagaland and 0.5 MW to Electricity Department of Manipur), thereby leading to overall sanctioned capacity of 56.55 MW to 7 North Eastern States as on 31.12.2019 under the programme
  - Aggregate capacity of 23.12 MW has been reported as installed in FY 2019-20, thereby leading to overall installed capacity of 44.04 MW (with or without central financial assistance) as on 31.12.2019 as given in **Table 8.6**.
  - Over Rs. 16.85 crore have been released in FY 2019-20 to implementing agencies for implementation of the programme to the state of Assam, Manipur and Meghalaya.
- (ii) With effect from 20th August, 2019 the phase II of Rooftop Solar programme has been launched which is being implemented in all States including North East Region states. Major feature of phase-II programme includes:
- Phase II of the Grid connected rooftop solar programme was approved for with a target for achieving a cumulative capacity of 40,000 MW from Rooftop Solar (RTS) Projects by the year 2022 in





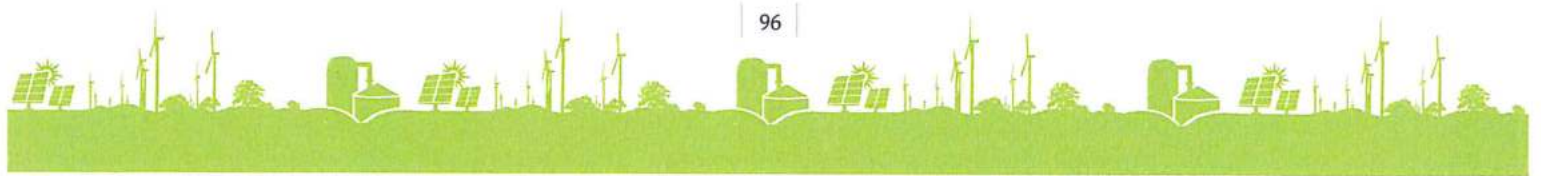


*10 kW Residential Grid Connected Solar Rooftop Plant at Koirengai, Imphal, Manipur*

February 2019. The programme will be implemented with the total central financial support of Rs 11,814 crore through DISCOMs.



*40 kW Grid Connected Solar Rooftop Plant at Kharupetia College, Distt. Darrang, Assam*







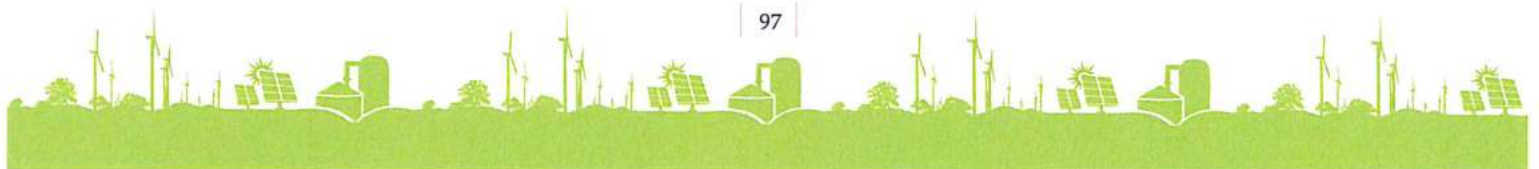
S. No.	State	Cumulative capacity sanctioned	Cumulative Installed Capacity (with/without CFA)
1	Arunachal Pradesh	10.00 MW	4.34 MW
2	Assam	23.48 MW	30.56 MW
3	Manipur	6.22 MW	4.55 MW
4	Meghalaya	8.00 MW	0.12 MW
5	Mizoram	7.35 MW	1.43 MW
6	Nagaland	1.00 MW	0.08 MW
7	Tripura	0.50 MW	2.96 MW
<b>Total</b>		<b>56.55 MW</b>	<b>44.04 MW</b>

- In the Phase-II Programme Central Financial Assistance (CFA) for the residential sector has been restructured with the availability of 40% CFA for RTS systems up to 3 kW capacity and 20% for RTS system capacity beyond 3 kW and up to 10 kW. For Group Housing Societies/Residential Welfare Associations (GHS/RWA), CFA will be limited to 20% for RTS plants for supply of power to common facilities. However, the capacity eligible for CFA for GHS/RWA will be limited to 10 kW per house with maximum total capacity upto 500 kWp, inclusive of RTS put in individual houses in the GHS/RWA. Central financial support will not be available for other category i.e. institutional, educational, social, government, commercial, industrial, etc.
- Performance based incentives will be provided to DISCOMs based on RTS capacity achieved in a financial year (i.e. 1st April to 31st March every year till the duration of the scheme) over and above the base capacity i.e. cumulative capacity achieved at the end of previous financial year.
- Model operating procedure along with suggested timelines developed for implementation of rooftop solar projects.

## 8.8 OFF GRID SOLAR PV PROGRAMME

- (i) Solar Off-grid Programme has been strengthened in the North Eastern States through introduction of new scheme viz., Atal Jyoti Yojana (AJAY) Phase-II and PM KUSUM Scheme. Further, under Off-grid and Decentralised Solar PV Applications Programme Phase-III, new projects have been sanctioned as shown in **Table 8.7**.
- (ii) Under PM KUSUM Scheme following allocations have been made in the States of Meghalaya and Tripura :

State	Component-A Grid-connected Power Plants up to 2 MW	Component-B Standalone Solar Pumps (Nos.)	Component-C Solarization of existing grid based agricultural pumps (Nos.)
Meghalaya	10 MW	1700	60
Tripura	5 MW	1300	1300

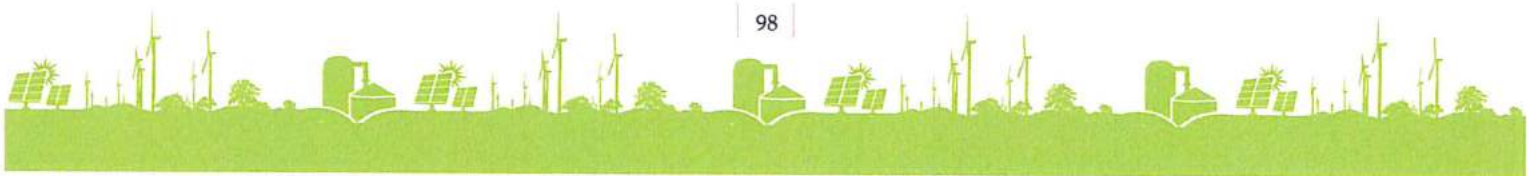




S. No.	State/UT	Capacity/ Numbers Sanctioned		
		Solar Street Lights (Nos)	Solar Study Lamps (Nos)	Off-Grid SPV Power Plants (kWp)
1	Arunachal Pradesh	20,000	2,00,000	-
2	Assam	20,000	2,32,342	-
3	Manipur	20,000	75,000	25
4	Meghalaya	-	1,02,000	-
5	Mizoram	20,000	1,50,000	939
6	Nagaland	9,810	24,000	415
7	Sikkim	-	43,034	-
8	Tripura	12,000	3,00,000	-

- (iii) Under Phase-I of the AJAY Scheme, which was available in the State of Assam, 6659 nos. of solar street lights have been installed in that State. Under the Atal Jyoti Yojana (AJAY): Phase-II, 2000 nos. of solar street lights are available for installation in each of the Lok Sabha constituencies of the North Eastern States including Sikkim. As on 31.12.2019, consent have been received for installation of 16,000 solar street lights and sanction from MPLADS has been received for 10,125 solar street lights.
- (iv) Details of all SPV systems and standalone SPV power plants in the North Eastern region states as on 31.12.2019 is given in **Table 8.8**.

S.no.	Agencies	Solar Home Light (Nos)	Solar lamp (Nos)	Solar Street Light (Nos)	Solar Pump (Nos)	Solar Power Plant (kW)
1	Arunachal Pradesh	35065	18551	5008	22	963.2
2	Assam	46879	642996	9554	45	1605
3	Manipur	24583	9058	11205	40	1580.5
4	Meghalaya	14874	40750	5800	19	2004
5	Mizoram	12060	10512	5325	37	2955.6
6	Nagaland	1045	6766	6235	3	1506
7	Sikkim	15059	23300	504	0	850
8	Tripura	32723	64282	1199	151	867





## 8.9 BIOGAS PROGRAMME

- (i) The New National Biogas and Organic Manure Programme (NNBOMP) is being implemented for providing clean gaseous fuel mainly for cooking, lighting and organic manure to rural and semi-urban households in the North Eastern Region States through State Government Nodal Departments/ State Nodal Agencies. MNRE has allocated targets to the State Rural Development Departments for implementing the NNBOMP in the States of Assam, Arunachal Pradesh, Manipur Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura during the year. A target of 7,400 number of biogas plants has been set in the North Eastern region for the year 2019-20.
- (ii) A Biogas Development and Training Centre for all the NER States for providing training and technical support under the NNBOMP has been continued and functional at Department of Mechanical Engineering, Indian Institute of Technology, Guwahati, Assam.
- (iii) The progress of implementation of the Biogas Programmes i.e. New National Biogas and Organic Manure Programme (NNBOMP); Biogas based Power Generation (Off-Grid) Programme ; and Activities & Targets of Biogas Development and Training Centre in North Eastern Region States during the year 2019-20 has been reviewed under the Chairmanship of Joint Secretary MNRE, on 8th November, 2019 at Indian Institute of Technology, Guwahati (Assam).

## 8.10 WIND ENERGY PROGRAMME

- (i) National Institute of Wind Energy (NIWE) in collaboration with RISO DTU, Denmark had prepared the Indian Wind Atlas for the country including NE Region during the year 2010. According to this Indian Wind Atlas, the wind potential of NE at 50 m level is estimated to be 406 MW. The State-Wise break-up is shown in **Table 8.9**.

<b>Table 8.9: State-wise break-up of Wind Energy Potential in North Eastern States</b>		
<b>S.No</b>	<b>States</b>	<b>Estimated potential (MW) @ 50 m</b>
1.	Arunachal Pradesh	201
2.	Assam	53
3.	Manipur	7
4.	Meghalaya	44
5.	Nagaland	3
6.	Sikkim	98
<b>Total</b>		<b>406</b>

- (ii) In NE States, there are scattered potential pockets available for wind farm development due to the localized wind flows and hence, Ministry decided to carry out extensive wind resource assessment studies in NE regions including Sikkim. Accordingly, as on 31.12.2019, Wind Resource Assessment has been carried out using cumulative 97 nos. of met masts at 25 m & 50 m in NE regions and currently 26 nos. of Wind Resource Assessment stations are operational and the remaining stations were closed down after completion of requisite data collection. The State-Wise break-up is shown in **Table 8.10**.



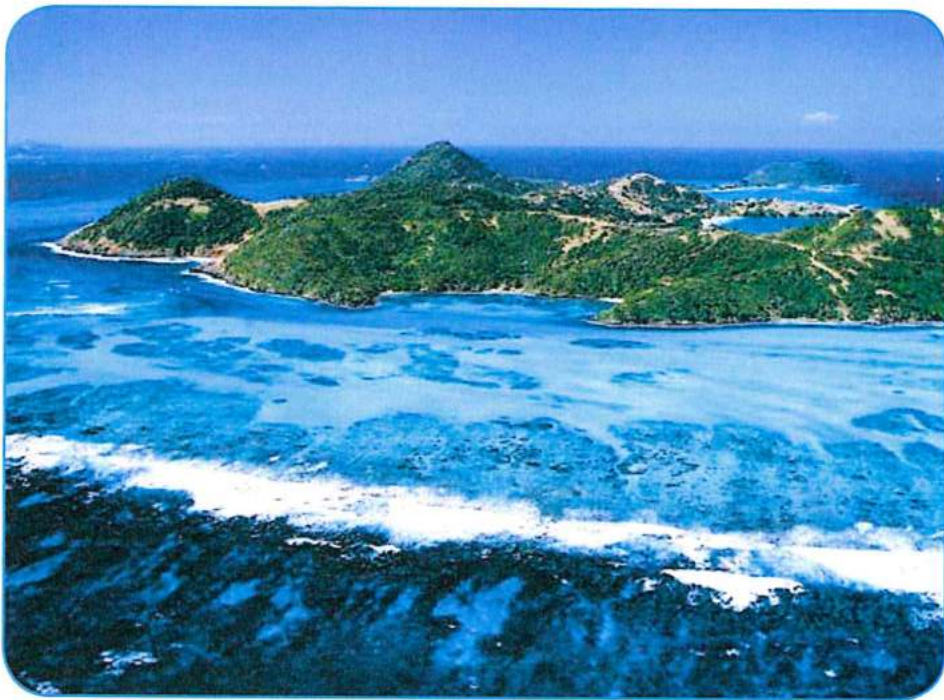


<b>Table 8.10: State-wise break-up of Met Masts for Wind Resource Assessment in North Eastern States</b>			
<b>State</b>	<b>No. of Stations installed &amp; commissioned</b>	<b>Level of Wind Resource Assessment stations</b>	<b>No. of Stations in operation</b>
Arunachal Pradesh	17	25 m & 50 m	8
Assam	18	25 m & 50 m	4
Tripura	11	25 m & 50 m	3
Manipur	14	25 m & 50 m	3
Mizoram	9	25 m & 50 m	2
Nagaland	6	25 m & 50 m	Nil
Meghalaya	18	25 m & 50 m	6
Sikkim	4	25 m	Nil
<b>Total</b>	<b>97</b>		<b>26</b>

- (iii) In addition, Wind Resource Assessment are also carried out at NE region using the existing telecom towers and as on 31.12.2019, a total 73 nos. of telecom towers of heights ranging from 40m to 60 m were utilized for this purpose. The details are shown in **Table 8.11**

<b>Table 8.11: State-wise break-up of Wind Resource Assessment using existing Telecom Towers in North Eastern States</b>			
<b>State</b>	<b>No. of Stations commissioned</b>	<b>Level of telecom tower stations</b>	<b>No. of Stations in operation</b>
Meghalaya	15	50 m & 60 m	11
Mizoram	5	40 m & 60 m	3
Tripura	6	50 m & 60 m	3
Arunachal Pradesh	5	40 m & 50 m	5
Nagaland	7	50 m	7
Manipur	9	40 m & 60 m	9
Assam	26	50 m & 60 m	26
<b>Total</b>	<b>73</b>		<b>64</b>





**GREENING OF ISLANDS OF ANDAMAN &  
NICOBAR AND LAKSHADWEEP**



## GREENING OF ISLANDS OF ANDAMAN & NICOBAR AND LAKSHADWEEP

### 9.1 SCHEME FOR SETTING UP OF 52 MW DISTRIBUTED GRID-CONNECTED SOLAR PV POWER PROJECTS IN ANDAMAN & NICOBAR & LAKSHADWEEP ISLANDS WITH CAPITAL SUBSIDY FROM MNRE

9.1.1 MNRE, on 05.04.2016 had 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 (now increased to 52 MW) in Andaman & Nicobar (A&N) and Lakshadweep Islands with an estimated Central Financial Assistance (CFA) of Rs.192.20 crore.

#### 9.1.2 OBJECTIVE

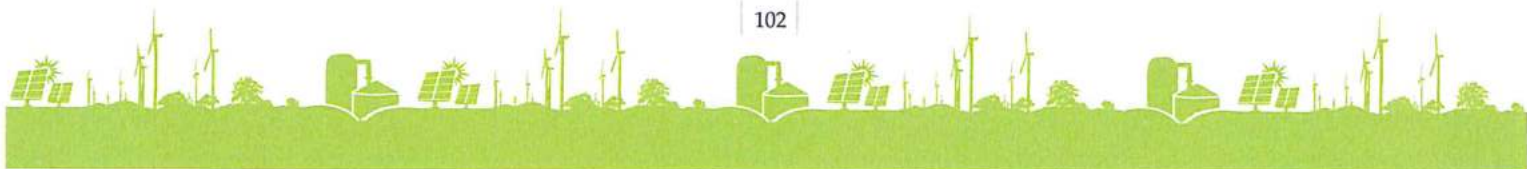
The objective of the scheme is to develop carbon free islands by phasing out use of diesel for generation of electricity and to contribute to the National Action Plan on Climate Change. The initiative will also help in reduction in cost of electricity generation.

#### 9.1.3 SPATIAL COVERAGE

Distributed grid-connected solar PV power projects of an aggregate capacity of 52 MW would be established in different islands in Andaman & Nicobar Islands and Lakshadweep Islands.



SECI 1 MW solar project in Andaman & Nicobar







#### 9.1.4 TYPE OF PROJECTS SUPPORTED

The Scheme supports setting up of standalone Solar PV Power Project, standalone Battery Energy Storage System (BESS), Solar PV plant with Battery Energy Storage System (BESS), Transmission System for Solar PV Power Plant and Floating Solar PV power plants (with or without Battery Energy Storage System) in Andaman & Nicobar Islands and Lakshadweep Islands.

#### 9.1.5 IMPLEMENTATION ARRANGEMENT

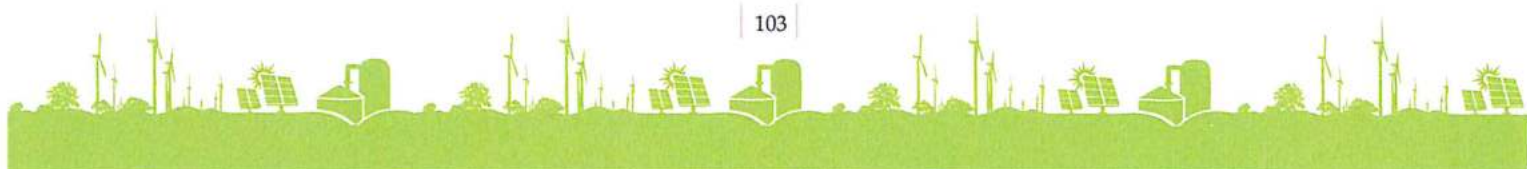
- (i) The scheme will be implemented through Central Public Sector Undertakings (CPSUs) viz., NTPC Limited (NTPC), NLC India Limited (NLC), Rajasthan Electronic & Instruments Ltd. (REIL), Solar Energy Corporation of India Limited (SECI) etc. or by UT Administration on Build, Own and Operate (BOO) basis.
- (ii) Procurement of all Services and Hardware for setting up the power plants by Implementing Agencies (IAs) viz. NTPC, NLC, REIL, SECI etc. or UTs would be done through competitive bidding process.
- (iii) The total project cost will include cost of solar power plant, battery storage of upto six hours and cost of infrastructure development such as land development, evacuation & transmission etc.
- (iv) A&N and Lakshadweep Administrations will buy the electricity from the Implementing Agencies at a tariff determined by JERC/CERC by taking into account the Central Financial Assistance (CFA).

#### 9.1.6 CENTRAL FINANCIAL ASSISTANCE (CFA)

- (i) Total eligible Financial Assistance and its release pattern will be as under:
  - Ministry will provide 40% of the project cost discovered through competitive bidding process as grant;
  - No additional grant for the preparation of DPR, conducting field survey, fund handling / service charge will be provided
  - The Capital Subsidy will be released in three tranches as mentioned below:
    - 15% on completion of site development and civil works at site;
    - 60% on successful commissioning of the plant; and
    - Balance 25% after one year of operation of the plant.
- (ii) The release pattern mentioned above can be modified if felt necessary during implementation with the approval of the Competent Authority.

#### 9.1.7 STATUS OF PROJECTS UNDER IMPLEMENTATION (AS OF 31.12.2019)

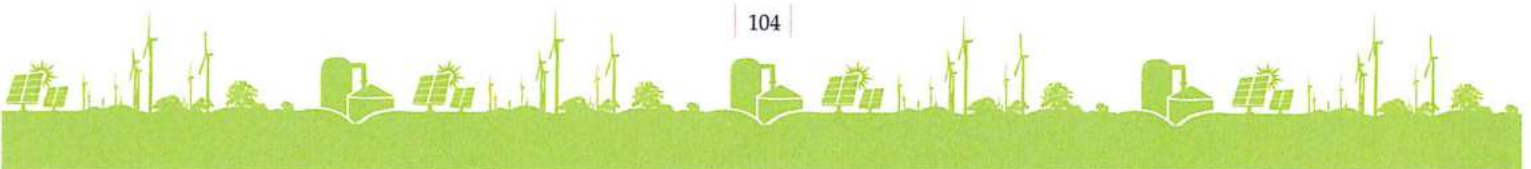
- (i) A 20 MW SPV Plant with 8 MWh Battery Energy Storage System (BESS) at Attampahad & Dollygunj in UT of Andaman & Nicobar Islands is under advanced stage of implementation and 2.5 MW SPV capacity of this project has been commissioned.
- (ii) SECI has issued tender for Design, Engineering, Supply, Construction, Erection, Testing &





Commissioning of cumulative 1.95 MW (AC) Solar PV Power Plant with 2.15 MWh BESS having 10 years Plant O&M at four different Islands of Union Territory of Lakshadweep, as per following details:

Sl. No.	Island	Solar PV Capacity (kWp)	BESS Capacity (kWh)
1.	Agatti	300	0
2.	Kavaratti	1400	1400
3.	BangaRam	150	450
4.	Thinnakara	100	300
	<b>Total</b>	<b>1950</b>	<b>2150</b>







**SPECIALIZED INSTITUTIONS**



## SPECIALIZED INSTITUTIONS

### 10.1 NATIONAL INSTITUTE OF SOLAR ENERGY

- 10.1.1 National Institute of Solar Energy (NISE), an autonomous institution of Ministry of New and Renewable (MNRE), is the National Research and Development (R&D) institution in the field of Solar Energy. NISE supports the Ministry of New and Renewable Energy (MNRE) in implementing the National Solar Mission (NSM), R&D activities in Solar Energy and various Skill Development Programmes.
- 10.1.2 NISE has established itself as a leading Institute in the field of Solar Energy through Resource Assessment, Research & Development, Design, Development and Demonstration of Solar Energy Technologies for various applications such as, testing, certification and standardization, monitoring and evaluation, economic and policy planning, human resource development and active collaborations with prominent National & International organisations, etc.
- 10.1.3 NISE is maintaining an NABL accredited Solar Photovoltaic module testing laboratory, lighting system test laboratory, battery testing facility and solar 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 equipment.

#### 10.1.4 SOLAR RADIATION RESOURCE ASSESSMENT (SRRA)

The Solar Radiation Calibration Laboratory (SRCL) at NISE has been calibrating the solar radiation measuring sensors of the solar radiation resource assessment (SRRA) network of the country to create reliable, accurate solar radiation data base for the country. During the year, SRCL has calibrated sensors from 13 SRRA station from different regions indicated in the table below. A total of 39 sensors from 2 SRRA stations consisting of 26 Pyranometer sensors and 13 Pyrheliometer sensor were successfully calibrated as per International Standards. A total of 8 number of Pyranometer sensors from the various other organizations were calibrated under commercial mode program. Depending on the availability of suitable local climatic conditions at facility, further calibration of 6 SRRA is proposed to be achieved till March 2020.

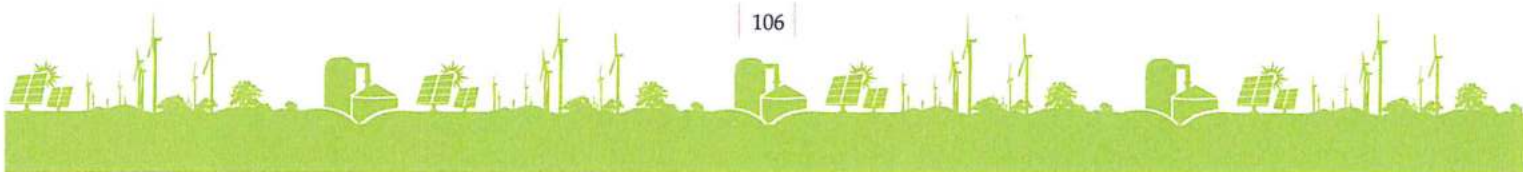
#### 10.1.5 R&D ACTIVITIES

##### (i) PERC Project

NISE has completed the procurement process and have procured six equipment in this FY 2019-20 under the Passivated Emitter Rear Cell (PERC) Project. The commissioning of all equipment is expected to be completed by March 2020. The ISO class 8 clean room construction for testing and characterisation was completed while maintaining the quality of



*ISO class 8 clean room for Testing and Characterisation*







this laboratory. Quokka Software for PERC Solar Cell simulation was acquired and an extensive literature search was also carried out to stay abreast of the latest developments in PERC Solar Cells. NISE has joint venture with BHEL-ASSCP, Gwal Pahari, Gurugram for this project and as a course of action two process equipment were commissioned at BHEL. The cell fabrication and testing is expected to be initiated by the next financial year.

## (ii) Solar Product Development

### a) Solar Dryer

NISE has designed and developed an innovative solar drier cum space heating system (SolDry). In 2019 based on the satisfactory performance of the system, Horticulture department of J&K requested NISE to supply and install 670 Units (300 units in phase 1 and remaining in phase 2) of Solar Dryer cum space heating system (335 units in Kargil and 335 units in Leh). NISE has taken-up the project on turnkey basis and is presently carrying out supply and installation of systems under phase 1.



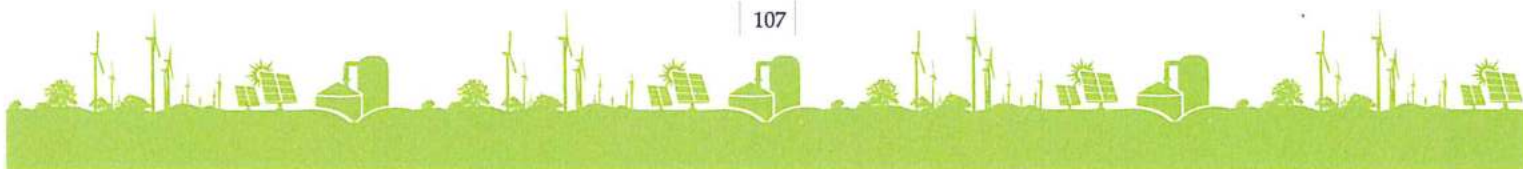
*Installation of Solar Apricot Dryer cum Space Heating System at Minjee Village, Kargil District*

### b) Solar Cold Storage

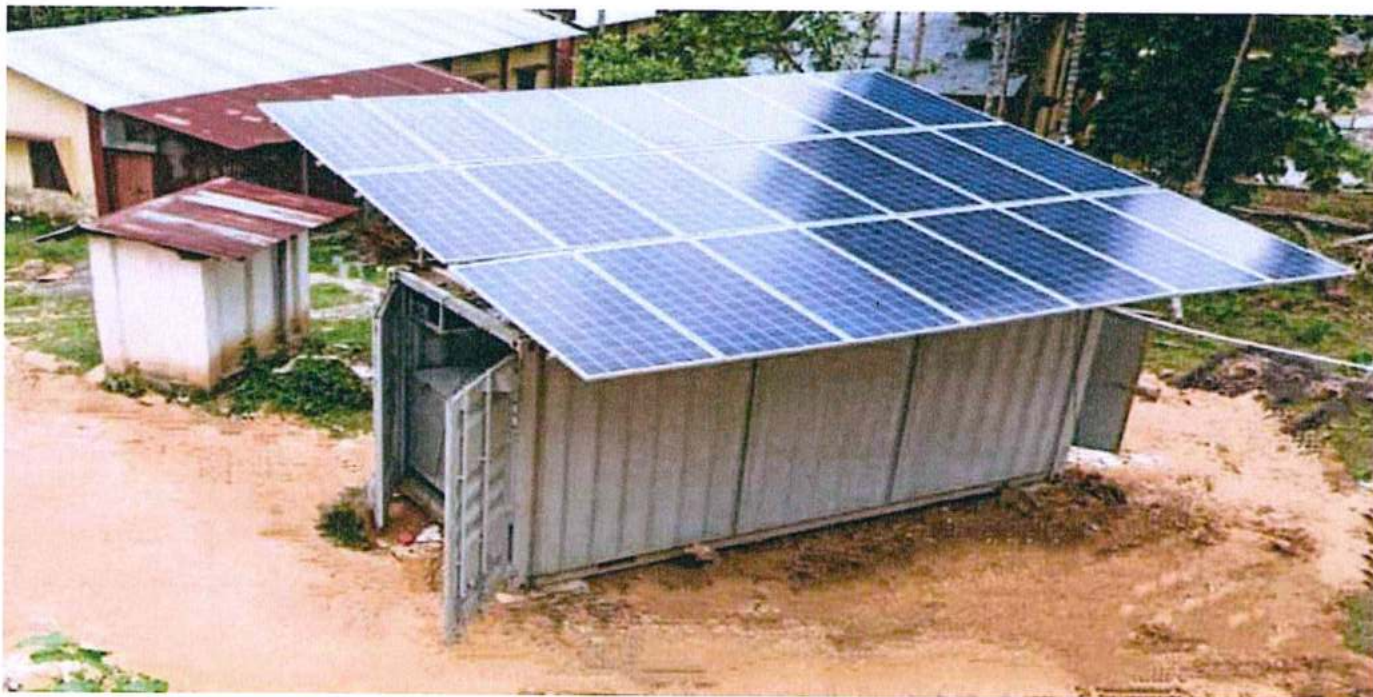
National Institute of Solar Energy (NISE) along with M/s. Inficold India Pvt. Ltd has started the R&D on solar powered cold storage from the beginning of 2016. With continuous joint R&D efforts the performance of the product was improved by 40%. NISE in the year 2019-20 has installed 7 pilot solar cold storage systems under Mission for Integrated Development of Horticulture (MIDH) scheme of Ministry of Agriculture and Farmer Welfare at various states like Karnataka, Tripura, Kerala and Uttar Pradesh.



*Installation of Solar Cold Storage at Udaipur, Chhataria, District Gomati, Tripura*







*A solar powered cold storage system installed Bilascherra Kamalpur, Tripura*

**c) Solar thermal based Space Heating System**

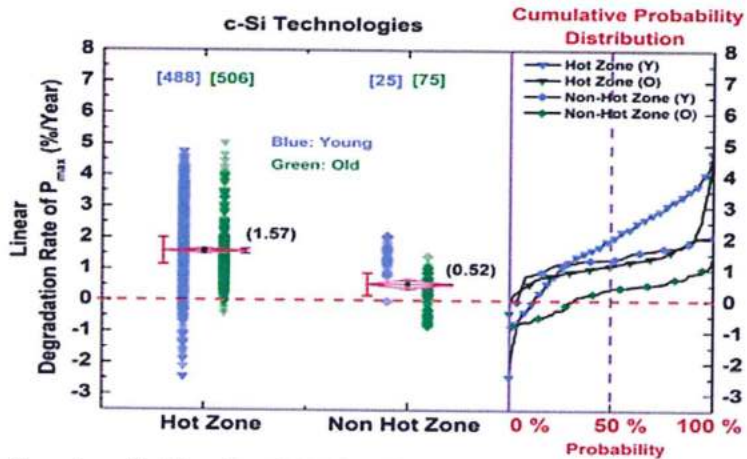
National Institute of Solar Energy (NISE) is working on development of solar thermal based space heating solutions for colder regions. The R&D focuses on the design of radiant floor heating systems with use of solar thermal technology with storage tank for non-sunshine hour requirement. This will help in offering sustainable solutions for energy demand in Ladakh and other Himalayan regions with cold climate.

**d) All India Survey of Solar PV Module (2019-20) – Joint Project between NISE and NCPRE, IIT Bombay**

This is a joint project between the Solar Photovoltaic division, NISE, and NCPRE, IIT Bombay to study the field performance and reliability of SPV modules installed in different climatic conditions of India. The 2018 All-India Survey of Photovoltaic Module Reliability is the fourth in a series of such Surveys conducted in different parts of India. It was carried out from March to May of 2018. The modules in the Cold & Sunny climate of Ladakh were surveyed in the month of September 2018. The report of the All India survey of PV module reliability was published and is available on the website of NISE. Some of the observations from the survey are: (i) due diligence should be exercised while selecting and procuring modules. (ii) The tender specifications need to be much more elaborate than currently being used. (iii) Cases of ‘over-rating’ of modules have been observed. It is recommended that a field-based electroluminescence (EL) study be performed after receiving the modules at the site and after installation to reveal micro-cracks which may have been caused during the transport and installation phases. The installation of the power plant, as well as module, should be PID free. The degradations of PV modules are high in the Hot climate, so special attention is required for this. It is felt that some of the quality issues seen especially in the young modules are the result of aggressive pricing and timelines and improper handling/installation.



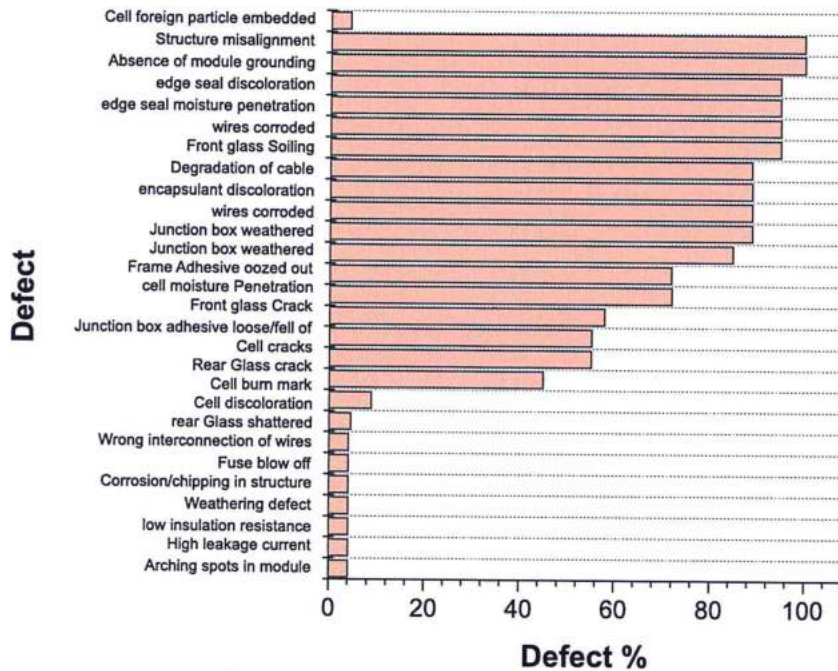




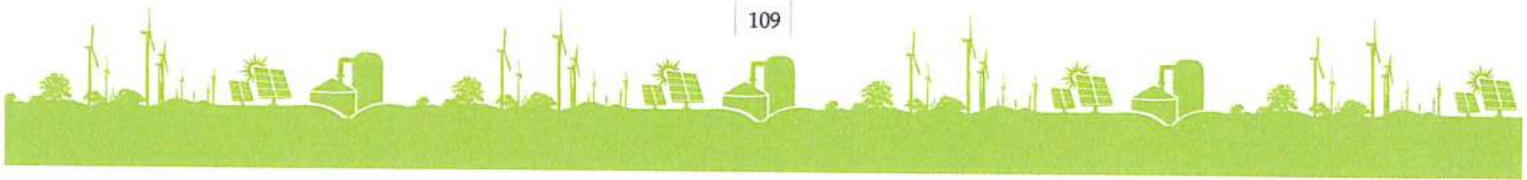
Comparison of the Linear Degradation Rate of P<sub>max</sub> in Hot and Non-Hot climatic zones. The blue and green symbols represent Young (<5 year) and Old (>5 year) modules.

e) **Cost Priority number and its methodology for assessing the economic impact of PV system failures of photovoltaic power plant**

NISE has developed a methodology to assess the economic impact of technical risks occurring in the PV system located in different climatic zones of India based on the method of assigning Cost Priority Number (CPN) unlike conventional Failure Mode Effect Analysis (FMEA) approach. This will help to address various PV system failures that occur due to the different reasons in the field in different climatic zones and geographical locations of India. The impact on return on investment of PV system of different failure modes has been assessed so that people can easily estimate the cost of PV power plant after long term operation in the field.



Defects observed in a 2 MW thin film PV power plant





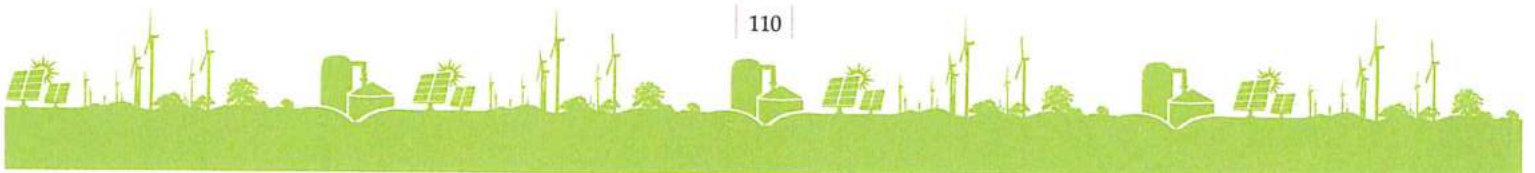


**(f) Design and Development of High efficiency Solar Water Pumping System**

The Government has launched the scheme Kisan Urja Suraksha Evam Utthaan Mahaabhiyan (KUSUM) to provide 7.5 lakh solar pumps for irrigation purpose. This scheme has led to the development of highly efficient & reliable as well as cost effective Solar Water Pumping System with improvement in their performance. This enhanced performance in terms of higher daily water discharge (around 10%) would essentially mean the additional benefit (i.e. proportionate reduction in the overall costing) to the farmers. NISE was sanctioned a project entitled Design and Development of High Efficiency Solar Water Pumping Systems by MNRE on 28th February 2019 for the development of improved solar water pumping controllers, motors, pump sets and SCADA solar pump testing system. NISE has associated with industry including reputed indigenous pump manufacturers and Indian Pump Manufacturers Association (IPMA) for study, research, development and analysis under this project. The project envisages the following activities, (i) design and development of low cost high efficiency controllers, (ii) design and development of variable frequency drive to work optimally under summer and winter profiles, (iii) to increase the overall wire to water efficiency of the solar water pumping systems up to 45%, (iv) to improve daily water discharge of solar water pumping system by at least 10%, (v) The test facility of Solar Pumping System established at NISE is in redesigned process and a new state of the art facility for testing of solar PV Pumps is developed at NISE which includes the following facilities: (i) simultaneous testing of multiple Solar Water Pumps under real time conditions, as well as with Solar Array Simulators, (ii) 'SCADA' would be installed to control and log the performance, (iii) Remote Monitoring Arrangement would also be configured, (iv) Development of testing procedures as per IEC, (v) Test Setup configuration, (vi) Test procedure for both AC & DC Solar Water Pumping Systems.

**(g) Supply of Clean Drinking Water through IoT based solar powered station at a large village in Haryana through automated dispensing while improving the water table: Pilot- Faridpur**

- (i) Ground water year book of Haryana state published by Central Ground Water Board in 2016 has studied 964 ground water observations points throughout the state and listed the quality of water and impurities.
- (ii) National Institute of Solar Energy (NISE) and M/s. Saurya Eneritech. Pvt. Ltd. have jointly developed solar powered water purification system. Five prototype of such systems ranging from 100 LPH to 500 LPH capacity were installed and are functional in various locations. Encouraged by the success of these prototypes. Now, NISE along with M/s. Saurya Eneritech. Pvt. Ltd. is installing a full scale pilot project to test the solar powered drinking water station at village community level.
- (iii) The Project envisages to provide safe drinking water to the entire population of Faridpur village in district Gurgaon, Haryana. It employs Solar Power to operate the water purification system. Quality of raw water has been tested and found to have a TDS of 1973 (mg/l). Water has large amount of Chlorine (990 mg/l) in addition to many other impurities. Based on the quality of raw water including a factor of safety, the membrane based purification system has been designed. Energy efficient membranes have been selected. Pumps with SS fittings are selected in view of large quantity of Chlorine in the water. A 30 kW solar system has been designed to take care of water needs of the population. A battery bank of desired size is designed for an autonomy of two days. An IoT based remote monitoring has been designed.







#### 10.1.6 TESTING AND PERFORMANCE EVALUATION

#### 10.1.7 SOLAR PHOTOVOLTAIC TESTING LABORATORY

The Photovoltaic module test lab is a NABL (National accreditation board for testing & calibration laboratories) accredited laboratory as per standard IS 17025:2005 for qualification testing of PV module. This lab got accreditation by BIS for PV module testing as Type 2 lab. During the year, the laboratory has capability of testing these IEC/IS standards i.e. (i) IEC 61215/ BIS 4186, (ii) IEC 61701, (iii) IEC 61730-1, 61730-2 (partial, accreditation process going on), (iv) IEC 61853/IS 16170: Part 1 (accreditation process going on), (v) IEC TS 62804/MNRE specifications (accreditation process going on). Presently Lab has also started testing of the bifacial module as per IEC TS 60904-1-2:2019 and Energy rating of PV module for different climatic zones as per IEC 61853-1, 2, 3 and 4. Upgradation of the lab set up is also going on for full testing set up for IEC 61730-1, 2 (including fire test also). The lab has completed the testing of the PV module along with other laboratories of the world for LETID testing of the PV module as IEC 61215. This new methodology of module testing will be going to add up in the newer version of IEC 61215. The commercial LETID testing of PV module at NISE will be initiated in the upcoming financial year. A total of 379 Modules of different technologies were tested and certified by NISE.

#### 10.1.8 ELECTROLUMINESCENCE (EL) TEST & CHARACTERIZATION LABORATORY

Electroluminescence (EL) test and characterization facility for PV modules at NISE is used to identify micro cracks and other invisible defects in solar cells and PV modules which are invisible to the human eyes. The greateseyes LumiSolar Professional BL 16Mpx (Bottom Load) System is a high resolution Electroluminescence module inspection utility to in PV module. The Laboratory follows the standard DIN IEC 60904-Part 13 (Electroluminescence of photovoltaic IEC 82/1062/CD: 2016) for Electroluminescence study of PV module.

#### 10.1.9 MOBILE TEST SET UP

Mobile Solar testing facility developed at NISE continues to conduct the PV power plant inspection, reliability testing of crystalline silicon as well as thin film PV modules & power plant as per International standards and user specifications.

#### 10.1.10 SOLAR CELL CHARACTERIZATION & OUTDOOR MODULE TESTING FACILITY

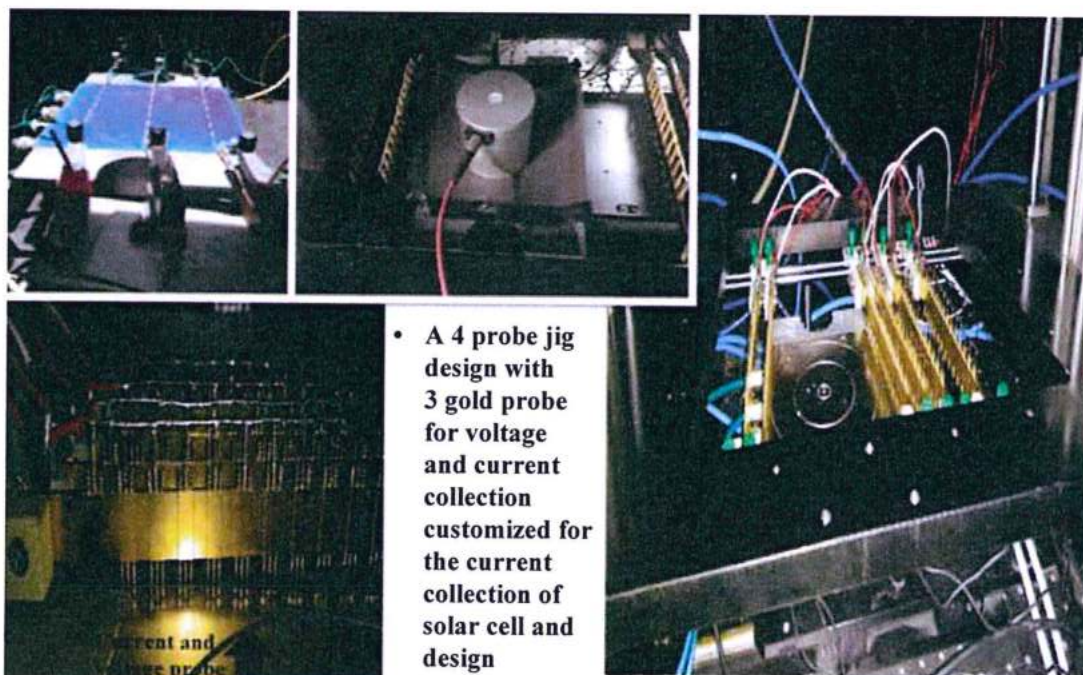
Solar cell characterization group at NISE has added a new spectro-radiometer facility for testing spectral content of light for different wavelength. The lab is now capable of estimating mismatch current factor of solar cell with known spectral response data. The spectral response system installation in solar cell is under process. NISE is undertaking a process to incorporate new advanced testing facility for different solar cells. Presently, NISE has a 6 inch 6 bus bar customized solar jig is introduced in the design structure for the development solar cell testing for the proper collection of current and fill factor and reduce a shading losses due to the bus bar.

#### 10.1.11 POWER ELECTRONICS LABORATORY

NISE has established facilities for testing and evaluation of Solar Inverters/ power conditioning Units (PCU) of capacity ranging up to 100 KVA. All types of PCUs, hybrid, standalone, Grid-tied inverters (GI) pump controllers and Charge Controller can be tested. A total of 15 inverters were tested as per International standards and MNRE specifications.







Development of solar jig for solar cell testing design

#### 10.1.12 ADVANCED SPV SYSTEMS AND LIGHTING LABORATORY

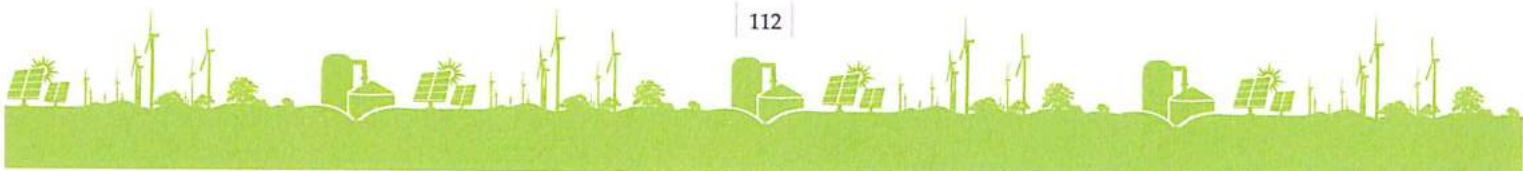
In the FY 2019-2020, lighting system Laboratory has initiated testing for Solar Home Cooking System and has put through a new Integrating Sphere with temperature controlled system specifically designed to test photometric and colorimetric performance as per IES LM-82 and LM-79 recommended practices. NISE has revised the technical specifications and design guidelines for various MNRE Advanced SPV Systems and Lighting Laboratory at NISE programmes. This lab has tested and certified 52 different samples for various indoor and outdoor application such as Solar Street light, Solar Home lighting system, Solar Power Pack (DC & AC model) and Charge controllers as per MNRE, User specifications and Standards.

#### 10.1.13 BATTERY TEST & CHARACTERIZATION

The Battery Test & Characterization laboratory has applied for the NABL accreditation for different tests under different standards. The battery test & characterization laboratory is engaged in different analysis, performance evaluation & research work as follows: (i) Development of Testing Profile/Test Methodologies for emerging battery technologies, (ii) Life Cycle Tests on different secondary battery, (iii) Exploring Battery health analysis technique, (iv) Degradation Analysis of secondary battery/Effect of different parameter on the degradation of battery. A total of 8 batteries were tested as per different National/International Standards.

#### 10.1.14 SOLAR WATER PUMPING TEST FACILITY

NISE has a fully Automated SPV Water pump system testing facility for 0.5 HP to 10 HP pump capacity for both submersible and surface pump. A total of 41 solar water pumps Submersible AC/DC and Surface AC/DC pumps have been tested in the year 2019-20. An enhancement of testing capacity of Solar Water







*Advanced SPV Systems and Lighting Laboratory at NISE*

Pump from 100 meters head to 400 meters head was developed in this solar water pumping test facility at NISE.

#### **10.1.15 SOLAR THERMAL TECHNOLOGIES, RESEARCH, TESTING & CERTIFICATION**

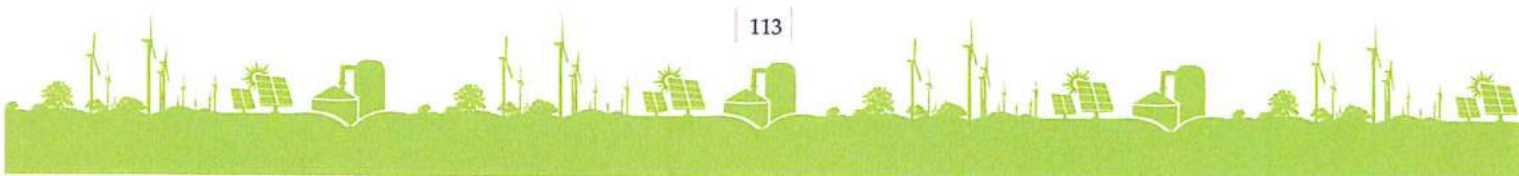
NISE has undertaken various research projects on solar thermal energy for cooking, heating, cooling, power generation, process heat applications, desalination, thermal storage, bulk milk chilling system using thermal storage, cold storage facility with thermal storage and in-house research and development etc. In the area of Solar Thermal Power Generation Technologies, various RD&D Projects have been setup in the campus of NISE with financial assistance from the Ministry of New and Renewable Energy. During the FY 2019-20, a total of 4 solar thermal technologies were tested and certified at NISE.

#### **10.1.16 SOLAR THERMAL RESEARCH AND DEVELOPMENT PROJECTS**

An R&D Project was sanctioned by MNRE for completion of the pending works and achieving the objective of a project on 'Central Receiver Facility' during March, 2018. NISE undertook repair, overhauling and refurbishment of the major sub-systems and preliminary operation of 50 kW<sub>th</sub> receiver for focusing on the target as well as cavity of the receiver.

#### **10.1.17 HYDROGEN ENERGY CENTRE & FUEL CELL TESTING**

A R&D Project entitled Setting up of a Centre of Excellence on Hydrogen Energy at National Institute of Solar Energy (NISE), Gwal Pahari, Gurugram, supported by the Ministry of New and Renewable



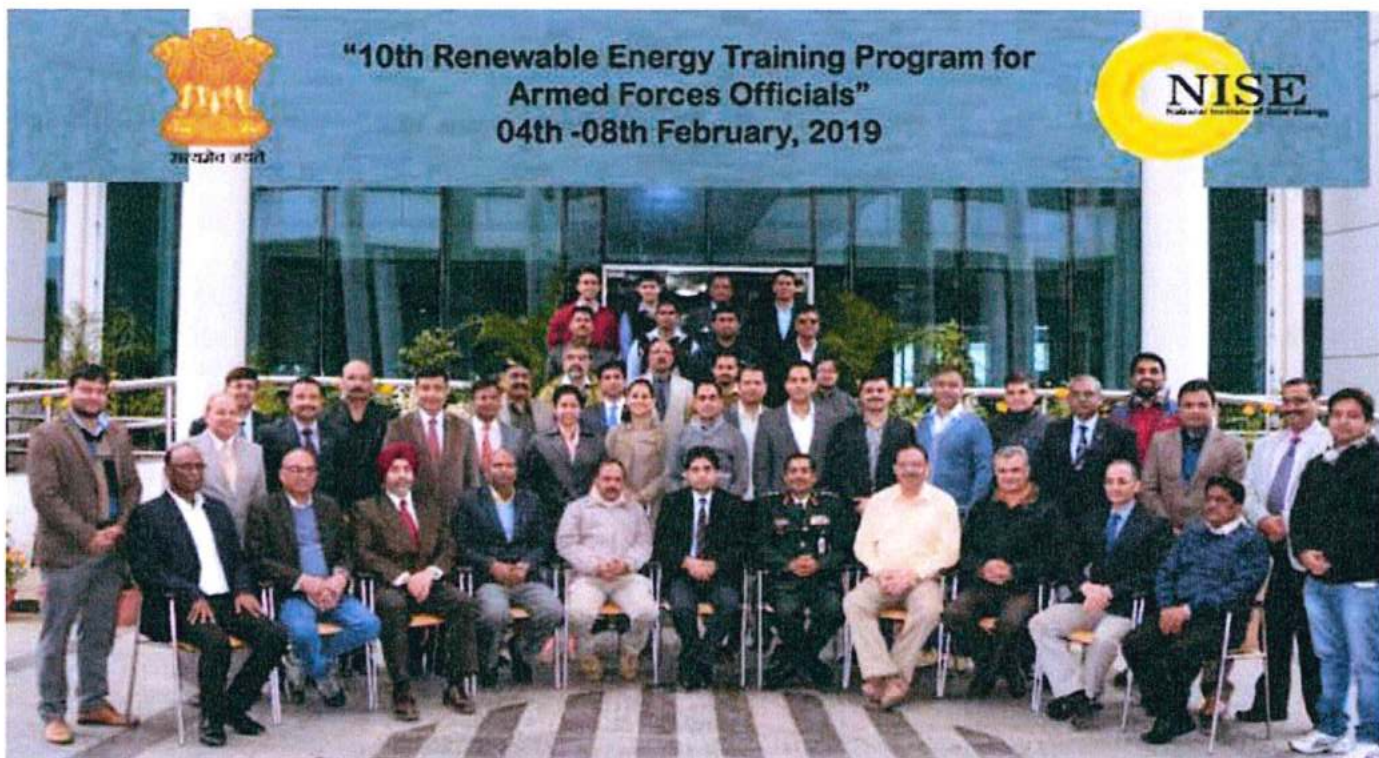




Energy on 28th February, 2019 was initiated with the objectives of (i) operating and maintaining the existing hydrogen production cum dispensing station, (ii) augmenting its hydrogen production capacity by installing another electrolyser, (iii) facilitating completion of field trials and demonstration of hydrogen fueled vehicles at NISE, and (iv) organizing workshops, training and awareness programmes on different aspects of hydrogen energy. The following activities have been undertaken during 2019-20 (up to 31.12.2019); (i) Recruitment of the sanctioned manpower under the project; (ii) Placing an order for Annual Maintenance Contract on the supplier of the existing hydrogen production cum dispensing facility for acceptance based on the offer received from then for this purpose; (iii) Placing an order for supply of recommended spares for the facility based on an offer received from the supplier; and (iv) Issuing an International Competitive Bid for procurement of an electrolyser of 10 Nm<sup>3</sup>/hr capacity for augmenting hydrogen production capacity of the existing facility.

#### 10.1.18 TRAINING AND SKILL DEVELOPMENT

NISE is organizing various skill development programmes throughout the country in the field of solar energy at NISE in association with partner institutes across India. The focus of these programmes is on technology development, system design, installation, commissioning, operation & maintenance and repair, etc. NISE is also organizing training programmes for start-ups, solar PV roof top projects, SPV pumps, solar thermal technologies, hydrogen energy and fuel cells. A dedicated training programme on Renewable Energy Technologies for senior defence officers is conducted every year. NISE has also started a long term programme for solar professionals for six months duration 13th August 2019 to 12th February 2020. A total of 10 training programs on various aspects of Solar Energy were conducted for imparting training to 244 participants at NISE.



*Renewable Energy Training Program for Armed Force Officials conducted at NISE*







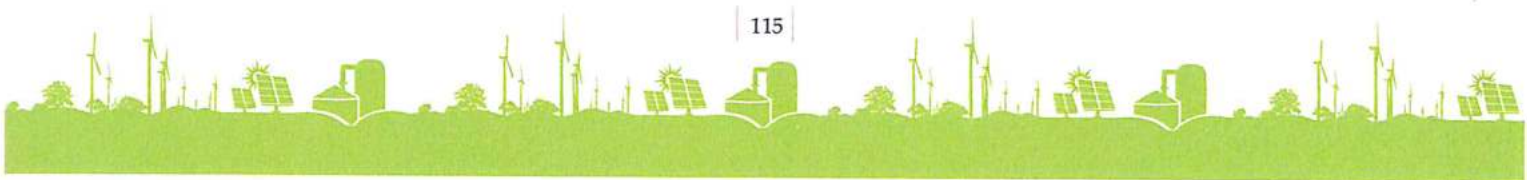
*International Training Programme on Solar Energy Technologies & Application (ITEC) conducted at NISE*

#### 10.1.19 INTERNATIONAL TRAINING PROGRAM

The Ministry of External Affairs, Govt. of India has identified NISE as a premier institute to conduct Indian Technical and Economic Cooperation (ITEC) Programme every year for international participants along with other international programmes like Indo African Forum Summit (IAFS). NISE has conducted five International Programmes in FY 2019-20. A total of 156 participants from 55 countries have participated in these International Training Programmes. These programmes are for duration of three-weeks, focused on latest Solar and Renewable Energy Technologies. NISE targets to complete three more International Training Programmes (30 participants each) in the FY 2019-20.

#### 10.1.20 SURYAMITRA TRAINING & PLACEMENT

NISE is implementing Suryamitra training program to train the ITI/diploma holders as a skilled workforce/ field technicians for installation, commissioning, operation and maintenance of solar technology to execute National Solar Mission (NSM) programme across the country. A network of institutions through Training Partners help conduct these training programmes. Since inception, a cumulative number of 1,079 programmes have been conducted by NISE and other implementing agencies approved by it and a total of 31,092 Suryamitras have been imparted trainings under this programme up to 31-03-2019. A number of 11,646 Suryamitras have been trained at 228 Training Centres (TCs) across different States during 2019-20 till 31-12-2019. The state-wise progress is given in **Table 10.1**.





**Table 10.1: Progress of Suryamitra Skill Development Programme**

Sl. No.	State/UTs	Number of Suryamitras Trained till 31.03.2019	Number of Suryamitras Trained during 01.04.2019 to 31.12.2019	Total Suryamitras trained as on 31.12.2019
1	Andhra Pradesh	1308	414	1722
2	Arunachal Pradesh	30	0	30
3	Assam	833	387	1220
4	Bihar	1139	453	1592
5	Chandigarh	148	60	208
6	Chhattisgarh	1227	526	1753
7	Delhi	432	180	612
8	Goa	174	90	264
9	Gujarat	2136	680	2816
10	Haryana	937	420	1357
11	Himachal Pradesh	324	90	414
12	Jammu & Kashmir	244	90	334
13	Jharkhand	517	179	696
14	Karnataka	1371	256	1627
15	Kerala	495	180	675
16	Lakshadweep	30	0	30
17	Madhya Pradesh	2522	1090	3612
18	Maharashtra	2933	999	3932
19	Manipur	150	0	150
20	Nagaland	60	0	60
21	Orissa	1766	270	2036
22	Puducherry	62	0	62
23	Punjab	323	30	353
24	Rajasthan	2006	826	2832
25	Tamil Nadu	2142	929	3071
26	Telangana	1914	956	2870
27	Tripura	148	30	178
28	Uttar Pradesh	2608	1084	3692
29	Uttarakhand	680	206	886
30	West Bengal	2433	1221	3654
	<b>Total</b>	<b>31,092</b>	<b>11,646</b>	<b>42,738</b>







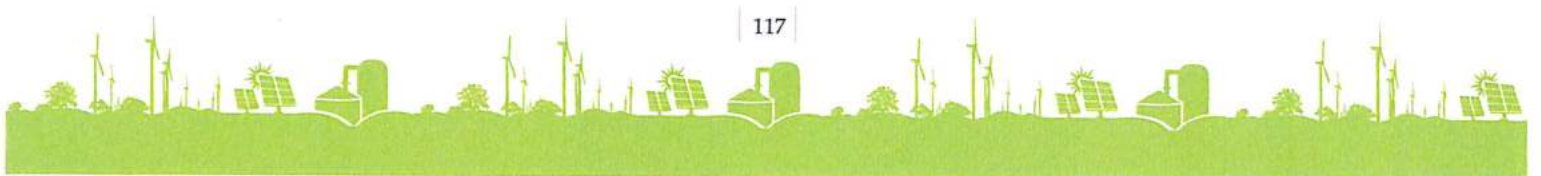
*Suryamitra Trainees at Synchro Serve Global Solutions Pvt. Ltd., Hyderabad, Telangana*



*Suryamitra Trainees at Mahindra Susten, Maharashtra*

#### **10.1.21 DESIGN, INSTALLATION & COMMISSIONING OF SOLAR WATER PUMPING SYSTEM – VARUNMITRA TRAINING PROGRAMME**

Solar Water Pumping System is anticipated to attain an impressive growth in Global market and while witnessing to its allied activities in irrigation, farming, drip irrigation, drinking, cooking, etc. NISE has aimed to impart a trained manpower for solar water pumping system. NISE, under the sponsorship of MNRE has started a solar water pumping course known as Varunmitra Training Program. The main objective of the programme is to impart knowledge in understanding of site feasibility, water table, efficiency and different types of heads, solar water pumping components such as DC- DC converter, inverter, battery, motors, pump – motor set etc. This course provides a hands on practise for Solar PV





Water Pumping System. During the year, a total of 20 programmes were started at various institutions. NISE has allocated 15 institutions in 13 states for implementation of this programme. A total of 425 participants were trained in the Varunmitra Training programme on PAN India Basis. The course shall follow SGJ/Q0112 (SGJ/N0134) Qualification Pack of SCGJ.

#### **10.1.22 SOLAR ANALYTICS SKILL DEVELOPMENT PROGRAMME**

The Solar Analytics programme aims to develop Centre of Excellence (CoE) on analytics for organization as well as developing skills for managing the same. The program encompasses the combination of solar domain with the technology like Internet of Things (IOT), Machine Learning, predictive modelling, forecasting, optimization which has to be understood by utility/solar plant engineers and decision makers to carve differentiator for their utility operations in resolving day to day problems. NISE has completed one Solar Analytics Skill Development Programme and shall complete further two more solar analytics training programme in NISE.

#### **10.1.23 ADVANCED PROFESSIONAL COURSE & ROOFTOP GRID PROGRAMME**

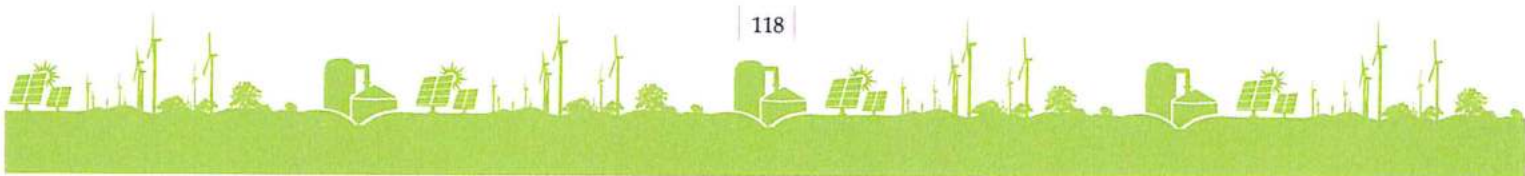
- (i) NISE is organising a flagship training program for young professionals. This advanced solar professionals course is a new job oriented and technologically advanced training program. The Advanced Solar Professional Course was launched on 6th Feb 2018. This course aims for a trained manpower readily available to the Indian Solar Power sector in line with its present and future requirements. This course profile covers the solar energy concepts for both technical and non-technical individuals (business persons). During the year, 32 participants were awarded certificates on successful completion of 2nd batch (8th October 2018- 7th April 2019) for this course. The Third Batch with 20 Participants was started on 13th August 2019 at NISE Campus in which 22 nos. of candidates have joined the course.
- (ii) During 2019-20, two Rooftop Solar Grid Engineer training programmes were organised by NISE to improve knowledge and enhance skills of professionals and businessmen in the field of Solar Rooftop Grid-tied systems which is based on National Skill Development Corporation (NSDC) approved / certified Qualification Pack (QP) SGJ/0106. In the FY 2018-19, NISE has conducted 22 Rooftop Solar Grid Engineer Training Programme across the country. These training programmes were fully funded by MNRE. A total of 923 participants were trained & imparted knowledge across different states for rooftop solar grid tied system.

#### **10.1.24 FIVE – DAY SKILL DEVELOPMENT PROGRAM ON SOLAR PV SYSTEM DESIGN USING PVSYST & PVSOL SOFTWARE WITH COST ECONOMICS AND POLICIES**

NISE has organized three training program (20th edition, 21st edition and 22nd edition) on Solar PV System Design Using PVSYST & PVSOL Software with Cost Economics and Policies under simulation lab. The total 60 Participants register this training program and all are successfully completed this. This program basically skill the participants in solar application and designing of solar power plant on grid as well as off grid.

#### **10.1.25 SOLAR ENERGY INTERNSHIP PROGRAM**

NISE is implementing solar energy internship program for B.Tech/M.Tech/M.Sc/Ph.D students for their research project in various Testing and R&D laboratory. A total 11 number of B.Tech/M.Tech/M.S. students were completed their thesis/project research work in various Testing and R&D laboratory at NISE in the financial year 2019-20.







### 10.1.26 COORDINATION ACTIVITIES

NISE has signed Memorandum of Understanding (MoU) with various organisations to operate a collaborative venture for development and dissemination of solar energy in the country and to ensure a clean energy environment. During 2019-20, NISE signed 11 MoUs with National Organisation/Agencies & 3 MoUs with International Organisation/Agencies. The list of MoUs are given in **Table 10.2** and **10.3**.

### 10.1.27 CONSULTANCY SERVICES

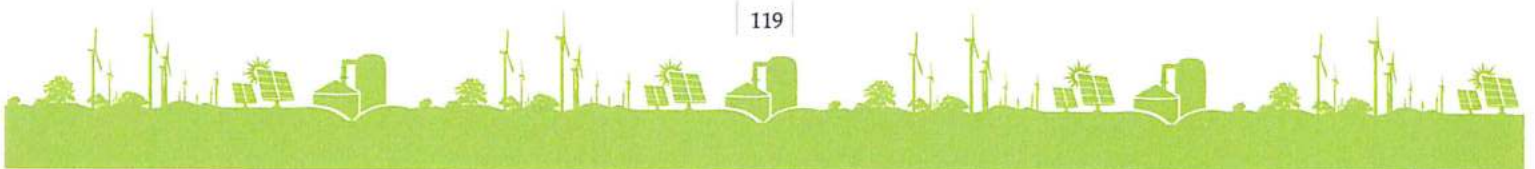
NISE is extending various consultancy services such as site survey, preparation of Detailed Project Report, Solar System Design, vetting of tender documents and specifications, Project management &

**Table 10.2: List of MoUs Signed with National Organizations/Agencies**

S. No.	MoU	Date of MoU Signed	Date of MoU valid up to
1.	NISE & GERMI, Gandhinagar	8th April, 2019	--
2.	NISE & RTPL (Ruchi Telecom Private Limited), New Delhi	15th May, 2019	14th May, 2022
3.	NISE & University of Lucknow, Lucknow	4th July, 2019	3rd July, 2024
4.	NISE & National Productivity Council (NPC), New Delhi	24th July, 2019	23rd July, 2024
5.	NISE & Ministry of New & Renewable Energy (MNRE)	25th July, 2019	31st March, 2020
6.	NISE & Shri Mata Vaishno Devi University, J&K	2nd August, 2019	1st August, 2024
7.	NISE & Gautam Buddha University, Greater Noida	29th August, 2019	28th August, 2024
8.	NISE & MSIT Kolkata (Meghnad Saha Institute of Technology, Nazirabad, Kolkata)	23rd September 2019	22nd September 2024
9.	NISE & IISc Bangalore	9th October, 2019	8th October, 2024
10.	NISE & NSDC- Schneider Electric- Power Sector Skill Council for Setting up of Centre of Excellence at NISE	6th November, 2019	5th November, 2024
11.	NISE & Department of Horticulture, J&K Government	13th November, 2019	(up to the completion of project)

**Table 10.3: List of MoUs Signed with International Organizations/Agencies**

S. No.	MoU	Date of MoU Signed	Date of MoU valid up to
1.	NISE & UNIDO, Vienna, Austria United Nations Industrial Development Organization	7th August, 2019	-----
2.	Memorandum of Agreement between NISE & CEA-INES, France on cooperation in Hydrogen Technology	22nd August, 2019	-----
3.	Implementation Agreement PTB & NISE	26th November, 2019	(up to the completion of project i.e. August 2019 to July 2022)





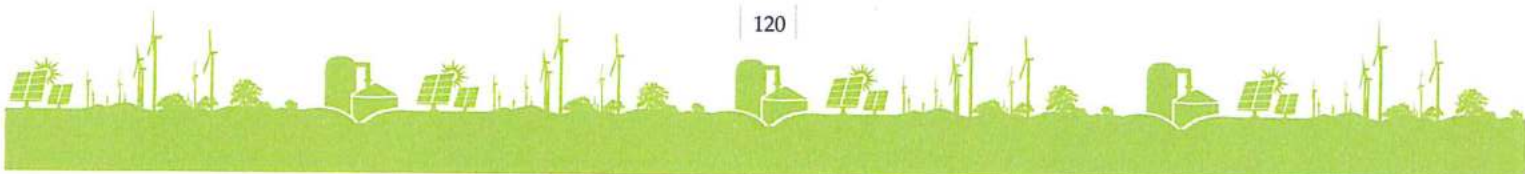
**Table 10.4: Projects completed by NISE consultancy during 2019-20**

S. No.	Vendor Name/Company Details	Description of the Project and Capacity in (MW)
1	M/s Vivaan Solar Pvt. Ltd. Garrison Engineer I, Air Force, MES Lohegaon, Pune, Maharashtra, 411032	1 MW ( MES, Nagpur Project)
2	M/s Vivaan Solar Pr.t. Ltd. Mauja Mahavan Khadar, Mauja Mahavan Khadar, Tehsil Mahavan, Mathura, Uttar Pradesh, 281001	1 MW (MES, Chakeri Project)
3	M/s Vivaan Solar Pvt. Ltd. Garrison Engineer I, Air Force, MES Lohegaon, Pune, Maharashtra, 41 1032	1 MW (MES Ojhar Project)
4	M/s Phoenix Infra No. 15B, 2nd Floor, 4th Cross T. Aswathnarayana Road Thirumala Nagar, yelahanka, Bangalore-560064	MMS Drawing for Vetting LEH Air Force Project
5	M/s Perfect House Pvt. Ltd. M-7, Addl, Midc, Satara-415004, Dist-Satara, Maharashtra	500 KW (Air Force Station, Deoli, Nagpur)
6	M/s Lumos Infra Pvt.Ltd. 44-A, Laxmi Plaza, Cantt. Road, Lucknow-226001	Design and Drawings vetting of 600 KW (AC) Solar Power plant, MES Bamrauli at Allahabad
7	M/s SM Renergy Pvt. Ltd., Flat # 4A/1, D.No.9-14-6, 3rd Floor, Balaji's Mangalagiri Chambers, VIP Road, Siripuram, Visakhapatnam-530003.	Design and Drawings vetting of 450 KW Solar Power Plant at MES Meerut
8	M/s SM Renergy Pvt. Ltd., Flat # 4A/1, D.No.9-14-6, 3rd Floor, Balaji's Mangalagiri Chambers, VIP Road, Siripuram, Visakhapatnam-530003.	Design and Drawings vetting of 100 KW Solar Power Plant at NCS Vishakhapatanam
9	M/s Lumos Infra Pvt.Ltd. 44-A, Laxmi Plaza, Cantt. Road, Lucknow-226001	Design and Drawings vetting of 2 MW Solar Power Plant at MES, Meerut
10	M/s Lumos Infra Pvt.Ltd. 44-A, Laxmi Plaza, Cantt. Road, Lucknow-226001	Design and Drawings vetting of 2 MW Solar Power Plant at MES, Meerut
11	M/s Reva Ultra Mega Solar Limited, Urja Bhawan, Link Road No. 2, Shivaji Nagar, Bhopal-462016	Consultancy Services
12	M/s Phoenix Infra No. 1, Zangskar Dambuchan, Leh Ladaka, Jammu, Jammu and Kashmir -194101	Design and Drawings vetting (1.5 MW)

EPC advisory, Solar Feasibility Report 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. The Projects completed by NISE consultancy (2019-2020) is given in **Table 10.4**.

## 10.2 NATIONAL INSTITUTE OF WIND ENERGY (NIWE)

10.2.1 NIWE's main activities include Wind & Solar Radiation Resource Assessment; preparation of standards for wind turbines; testing and certification of wind turbine and associated systems; information dissemination; human resource development; and offer various consultancy services to customers. The major activities of NIWE during this period are given below:







### 10.2.2 WIND SOLAR & OFFSHORE RESOURCE MEASUREMENTS DIVISION

- (i) Wind Resource Assessment (WRA) programme data is being used widely to establish wind farms in the country. The wind farms established in the country is generally based on the reference data collected under the WRA programme. Under this program of the Ministry, 889 dedicated wind monitoring stations have been established with the support of State Nodal Agencies. In addition, the division has initiated Wind Resource Assessment studies using 90 nos. of existing telecom towers of M/s. Airtel & M/s. BSNL in the North Eastern region and data collection from these towers are under progress. As on date, 133 Wind monitoring stations are under operation. In the current year, 14 nos. of 50 m wind monitoring Stations, 12 nos. of 100 m wind monitoring stations were established and 72 nos. of telecom towers in NE region are mounted with wind sensors and data loggers for collecting the wind data.
- (ii) Further, during this year, 18 sites have been registered for wind measurement by private sector from various States in India. The wind data from over 14 private Wind Monitoring stations have been analysed. Three consultancy projects focused in various wind farm developmental needs were undertaken for a variety of clients from public/government/private sector during this period.

### 10.2.3 GEO-TAGGING OF WIND TURBINES INSTALLED ACROSS THE COUNTRY

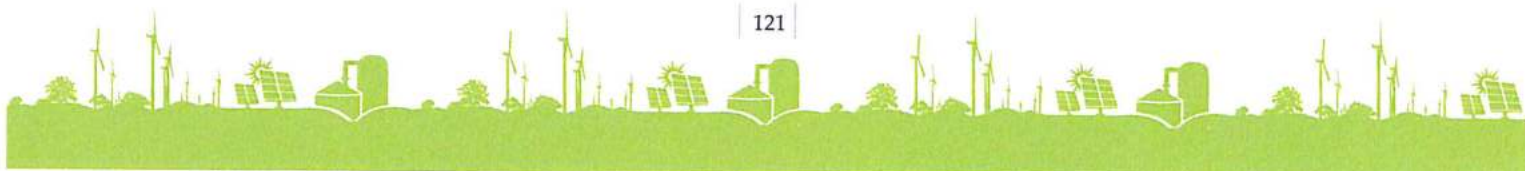
At present, the installed capacity of wind generation in India stands at about 37000 MW with equivalent number of wind turbines. However, there was no centralized system for maintaining this vast database. Considering the requirements of the centralized system, under the directions of MNRE, NIWE has developed a geo-tagged data base / online registry web portal of wind turbines already installed and proposed to be installed across the country with the support of central and state agencies. With the continuous efforts, NIWE has collated wind turbine details to the tune of 34 GW (which includes both full data, partial data and the double entries) as on date. NIWE has also developed a web portal for data management and the collected data is quality controlled and loaded into the portal.

### 10.2.4 120M WIND POTENTIAL MAP

Wind Turbine technology has evolved significantly over the last decade with emphasis on greater energy capture and improved capacity utilization factor. Modern turbines have larger rotor diameter and higher hub heights. Hence, it became necessary to identify areas which have wind potential at higher heights. Considering this and using advancements of mapping techniques, wind potential assessment of the country at 120m hub height was undertaken by NIWE under the directions of MNRE. Based on the analysis, the indicative wind potential of India is estimated as 695 GW at 120m agl. The high wind potential regions with better CUF is distributed in the States of Andhra Pradesh, Gujarat, Karnataka, Maharashtra and Tamil Nadu and scattered potential areas are observed to be in Kerala, Madhya Pradesh, Telangana and Rajasthan.

### 10.2.5 OFFSHORE MEASUREMENTS OFF GUJARAT COAST

- (i) LiDAR based measurements for 2 year have been completed at Gulf of Khambhat off Gujarat coast. Raw data files (time series) of LiDAR measurement carried out at Gulf of Khambhat has been uploaded in NIWE website. NIWE has completed Geo-physical investigation (single beam bathymetry survey, side scan sonar, sub-bottom profiling, magnetometer survey and sediment sampling) covering the entire area 369 Sq km for developing 1GW offshore project at Gulf of Khambhat off Gujarat Coast and the final report is under process. Based on the Geo-physical results, the recommended five bore-hole locations for geotechnical studies have been finalized.







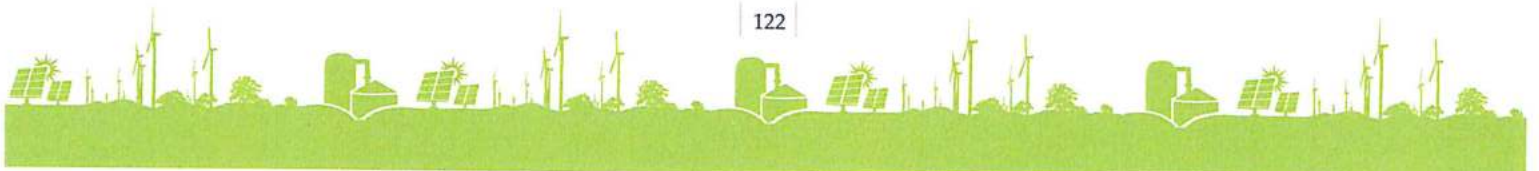
- (ii) Rapid Environmental Impact Assessment for developing 1 GW offshore wind farm project at Gulf of Khambhat is being carried out by NIWE through National Institute of Oceanography (NIO). Field data collection was completed by July 2019 and draft report has been submitted and comments are sought from the stakeholders for the finalization of the report.

### 10.2.6 WIND TURBINE TEST STATION (WTTS)

Wind Turbine Research Station is having cumulative installed capacity of 6400 kW wind turbine for conducting various R&D related activities in addition to type testing facilities of large WEG and Small Wind Turbine performance testing facilities at the Test Beds created with all infrastructure facilities at the Research Station. The testing facilities are certified as per the requirements of ISO 9001:2015 and accredited as per the requirements of ISO / IEC 17025:2017. During the year, WTTS was reaccredited by NABL per the requirements of ISO/IEC 17025:2017 for both Electrical and Mechanical parameters with validity from 07.03.2019 to 06.03.2021. Further during the year, Power curve measurements of two numbers of 2000 kW WTG, two numbers of power performance test, type testing of a 750 kW was completed. Type testing of a 5.5 kW Small wind turbine was also carried out during this year.

### 10.2.7 RESEARCH & DEVELOPMENT

- (i) NIWE carries out in-house R&D through networking in research relevant areas with a mutually beneficial interdisciplinary approach for most of the projects. Strategic collaboration that could assist in most suitable technological developments for our country is nurtured by funding and technical support. During the year, NIWE has taken three in-house R&D projects namely Design and Development of Indigenous Grid Emulator and LVRT Facilities, IoT Based Smart wind farm to enable the real-time remote monitoring and control and Development of Long-term Wind Speed Forecasting using Hybrid Model. In addition, research proposals are solicited from various research / academic institutions, universities, industries, research scholars and consultancy organizations to support Research and development programs by promoting the reliable and novel cost-effective technologies in wind power systems. 14 Research proposals received during this financial year. Based on the novelty executed by the PI the project will be funded based on the NIWE's research council's recommendations.
- (ii) During 2019-20, 132 graduate and post graduate students/faculties have completed their internship / project work and twenty graduate and post-graduate students are presently pursuing Internship and project work at NIWE in the field of Wind and Solar energy mentored by various subject matter experts. As per the Research Council guidelines, NIWE had initiated a sustained discussion with various industry and premier academia groups for conducting workshop to identify R&D Areas and to create the hub of synergy for all wind related research in India. In order to establish this amalgamation and have a good number of collaborative R&D funded projects, the 2nd PAN India research meet was conducted during 6th January, 2020 at MNIT Jaipur.
- (iii) The activities for Hybridize, a research project approved by DST-IFD (Department of Science and Technology and Innovation Fund Denmark) a kick off meeting has been completed. The activities as per schedule of the project are under progress. The draft MOU with IIT-KGP is under preparation.
- (iv) The Ministry of Foreign Affairs of Denmark (MFA) has awarded a project Maintenance and Repair Strategy for Wind Energy Development with a grant of Danish Kroner 4,682,078 from DANIDA/ Danish Development Foundation under Danish-Indian joint development projects, wherein NIWE is collaborating with DANIDA for the said project. Signing of collaboration agreement between NIWE and DANIDA will be carried out during 2020.







### 10.2.8 WIND AND SOLAR FORECASTING

NIWE has developed indigenous wind and solar power forecasting model along with in-house Data management system, Monitoring System, Web portal, forecast simulation tools and security system. NIWE has created an operational forecast system with simulation tools, to predict the wind power up to 7 days ahead. In order to improve the forecasting model, NIWE has signed MoU with ISRO SAC for Development of Wind and Solar Power Forecasting using High Resolution Numerical Model. Currently, NIWE has developed the indigenous Intra-day forecasting model and also carrying out various activities to improve/fine-tune the day ahead model from the inputs received during the delivery of pilot operational forecasts to RE SLDCs. NIWE has signed MoUs with SLDC's of Tamilnadu, Gujarat, Andhra Pradesh, Karnataka, Maharashtra & SRLDC for providing wind/solar power forecasting services. The Pilot Wind/Solar power forecasting services have been initiated for Tamilnadu, Gujarat, Karnataka, Andhra Pradesh, Maharashtra and SRLDC (NP Kunta Solar Park & Chandragiri wind farm).

### 10.2.9 SOLAR RADIATION RESOURCE ASSESSMENT

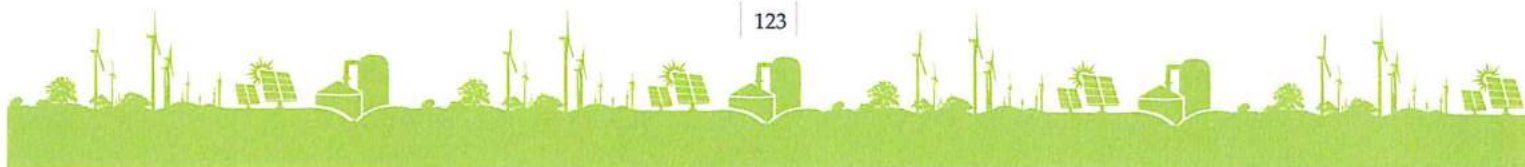
As part of SRRA program of the Ministry for solar radiation assessment in the country 125 SRRA stations are set-up. Under this program, NIWE had earlier prepared the Solar Radiation Atlas, a first of its kind combining satellite-derived data and the world's largest high quality network of simultaneously measured solar ground data. During the year, NIWE had developed a mobile app SWurja featuring the Wind, Solar and Hybrid maps of India with relevant wind and solar data in each map. By selecting a location on the map, wind and solar data can be retrieved and viewed. The app also features a solar AEP calculator. The app is a green energy tool which provides information to the user on the Wind, Solar & Hybrid (wind & solar) resource data of any given location including roof top across the country. During the year, NIWE has carried out calibration of 30 Pyranometers and 15 Pyrheliometer under SRRA mode and 31 Pyranometers under commercial mode.

### 10.2.10 CERTIFICATION & IT DIVISION

- (i) During the year, NIWE has successfully submitted application along with requisite documentation as per IS/IEC 17065 standard requirement with National Accreditation Board for Certification (NABCB), Quality Council of India in connection with obtaining accreditation for the certification services. Interactions with M/s. TUV Rheinland Industrie Service GmbH and M/s. TUV Rheinland (India) Private Ltd. in connection with the cooperation agreement have been completed and the activities are under progress.
- (ii) Establishment of new IT infrastructure such as N-computing, Desktops & Workstations, Servers, Networks, Storage, Data Centre, Disaster Recovery System, Biometric System and upgradation of fire wall have been completed. The IT infrastructure monitoring tool and IT policy are under progress.

### 10.2.11 STANDARDS AND REGULATION DIVISION

- (i) NIWE is entrusted with the preparation of Indian Standards on wind turbines under the Committee, viz., Wind Turbines Sectional Committee (ETD 42) and NIWE, which is a part of BIS ETD 42 committee, provides the technical support to BIS in all the standards related work. Based on the contribution, nine Indian standards on wind turbines have already been finalized, so far. During the year (April to November 2019), one Indian standard has been finalized. Further, NIWE provides the technical support to BIS regularly on the works related to International Electrotechnical Commission (IEC) standards including voting for draft IEC standards at IEC TC 88 Committee. IEC has formulated a separate system for the



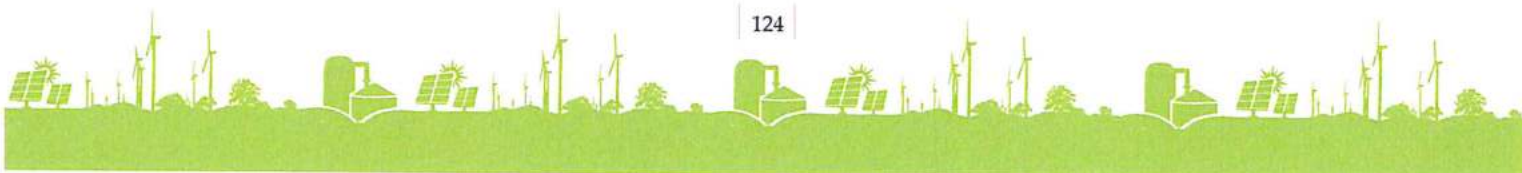


renewable energy sector viz., IEC System for Certification to Standards relating to Equipment for use in Renewable energy Applications (IECRE system). Based on the efforts taken by NIWE and MNRE, BIS has already obtained the membership for India in IECRE system. NIWE is providing the technical support regularly to Central Marks Department (CMD) of BIS on IECRE related works.

- (ii) Considering the need to formulate a new certification scheme for India which takes into account of the latest standards etc., as per the directions of the Ministry, NIWE has prepared an Indian Wind Turbine Certification Scheme. A comprehensive certification scheme viz., Indian Wind Turbine Certification Scheme (IWTCS), which is the first of its kind covering various aspects of certification till the disposal of wind turbines. The scheme covers Prototype Certification & Type Certification for wind turbines; Project Certification, Failure reporting of installed wind turbines, Safety and Performance assessment and De-commissioning. The draft document has been submitted to MNRE.
- (iii) During the year, NIWE has successfully undergone the recertification audit of quality management system as per ISO 9001:2015 and the ISO certificate for NIWE has been issued with the extended validity. Further, during the year, S&R division has issued recommendation letters in connection with grid synchronization for four (4) prototype wind turbine models for the purpose of Type Testing with the rated capacity from 750 kW to 2600 kW. NIWE will be hosting IEC TC 88 and IECRE meetings during 16-17 March 2020 and 18-20 March 2020 respectively.

#### **10.2.12 SKILL DEVELOPMENT AND TRAINING DIVISION**

- (i) During the year 2019, the following training courses have been conducted successfully.
- 04th Special International Training course on Wind Resource Assessment and Wind Farm Planning for ITEC countries held from 28.08.2019 to 20.09.2019 with 16 participants from nine countries.
  - 03rd Special International Training Course on Design Installation & Maintenance of Small Wind Turbine held from 28.08.2019 to 24.09.2019 with 26 participants from nine countries.
  - 24th International Training Course on Wind Turbine Technology and Applications for ITEC Countries scheduled from 23.10.2019 to 19.11.2019 with 28 participants from 18 countries.
  - 07th Special international training course on Wind Turbine Technology and Applications especially for African Countries held from 24.10.2019 to 21.11.2019 with 26 participants from 16 countries.
  - Special International Training Course on Solar Resource Assessment and Development of Solar Power Plant under ITEC programme from ISA Member Countries held from 27.11.2019 to 20.12.2019 with 21 participants from 20 countries.
  - 25th International Training Course on Wind Turbine Technology and Applications for ITEC partner countries under ITEC program with 30 participants.
  - Scaling up of Renewables (Wind and Solar) Generation with Focus on Policy Initiatives specially for BIMSTEC Countries under ITEC program with 25 participants.
- (ii) The third IREDA-NIWE Annual Award ceremony for wind energy will be conducted during March, 2020. The award is to promote innovation, research & development, manufacturing, developing & harnessing wind energy at the State and National levels and to motivate individuals, stakeholders to strive for the best in the field.







### 10.2.13 GLOBAL WIND DAY CELEBRATIONS 2019

Global Wind Day is a worldwide event that is supported by Global Wind Energy Council (GWEC) jointly with the European Wind Energy Association (EWEA) on June 15 every year. It is a day for discovering wind, its power and the possibilities it holds to change our world. On 15th June, hundreds of public events are organized all over the world, to create awareness on Wind Power. Similarly, the Global Wind Day 2019 was celebrated at NIWE. As part of the Celebration, NIWE has announced competitions for School Students and also a capacity building workshop for School Teachers towards creating awareness among school level. Accordingly, the following events were conducted on 12th June 2019 at NIWE with support of National Green Corps (NGC), Chennai.

- **Drawing** competition on the title Use of Renewable Energy Sources for Sustainable Environment.
- **Elocution** competition on the title: Wind Energy Development in India.
- **Capacity building Workshop** on Wind Energy Technology for School Teachers.

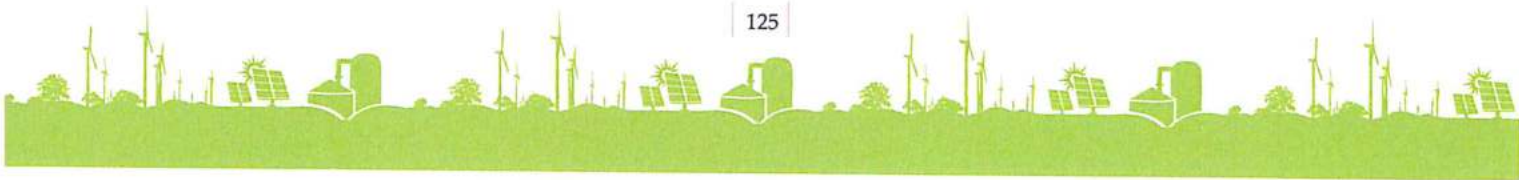
### 10.3 SARDAR SWARAN SINGH NATIONAL INSTITUTE OF BIO-ENERGY (SSS-NIBE)

10.3.1 Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE) earlier known as SSS-NIRE, Kapurthala (Punjab), an autonomous Institution of the Ministry of New and Renewable Energy, Govt. of India, is a centre of excellence in the field of bio energy. The objectives of the Institute is to carry out and facilitate research, design, development, testing, standardization & technology demonstration eventually leading to commercialization of RD&D output with a focus on bioenergy, biofuels & synthetic fuels in solid, liquid and gaseous forms for transportation, portable & stationary applications, development of hybrid/integrated energy systems, to undertake & facilitate human resource development and training in the area of bioenergy. The Institute has drafted a vision plan for next 10-years and submitted a comprehensive project proposal Establishing pilot scale testing facility in the broad spectrum of bioenergy to emerge as Global Centre of Excellence in Bioenergy.

10.3.2 Several projects on different R&D processes for biofuels and bioenergy are in progress in different divisions:

#### 10.3.3 THERMOCHEMICAL CONVERSION DIVISION

- (i) The Institute has developed the biomass cookstove testing laboratory as per revised BIS@2013 and testing of commercial cookstove is ongoing as per request from different commercial entity. Biomass cookstove testing centre is equipped for testing of different parameters such as  $\text{CH}_4$ ,  $\text{NO}$ ,  $\text{SO}_2$ ,  $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{O}_2$ , particulate matter, temperature, etc. The testing of Biomass Cookstove is carried out as per BIS Standards.
- (ii) During FY 2019-20, an improved biomass cookstove (IBC) was designed and tested out by using woody fuel to reduce carbon emissions with higher efficiency. The performance of IBC was evaluated in terms of energy efficiency, power output and emission reduction potential. For the experimentation, two different designs of IBC were taken with varying insulation material (one using Plaster of Paris and the other using glass wool) in between. It was concluded that the glass wool based IBC performed better in terms of efficiency and emissions. An article based on the research work was presented in International Conference on Advances in Energy Research, held in IIT Bombay during December 2019.







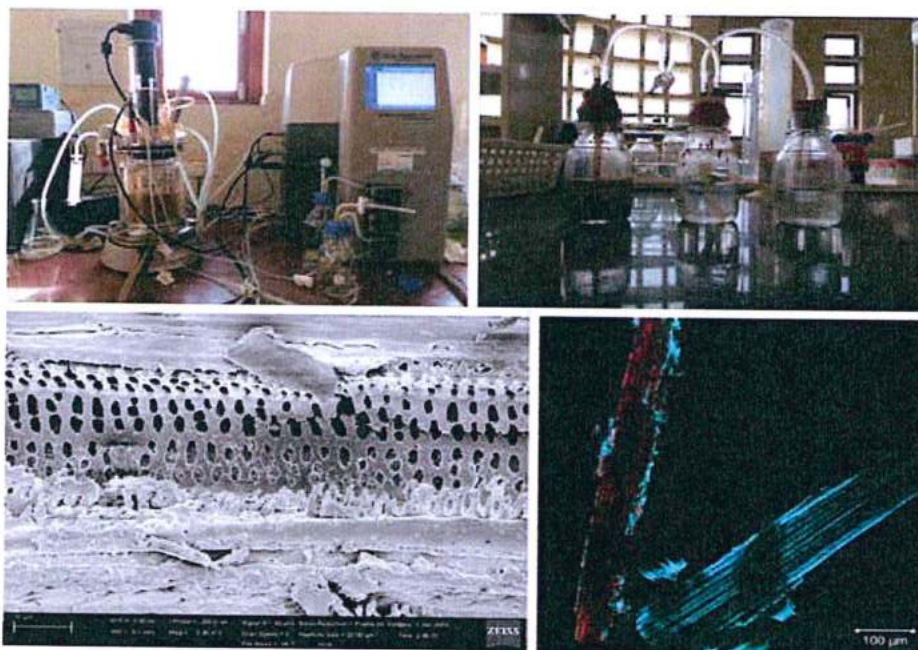
*Working at biomass cookstove testing lab at National Institute of Bio-Energy*

#### 10.3.4 BIOCHEMICAL CONVERSION DIVISION

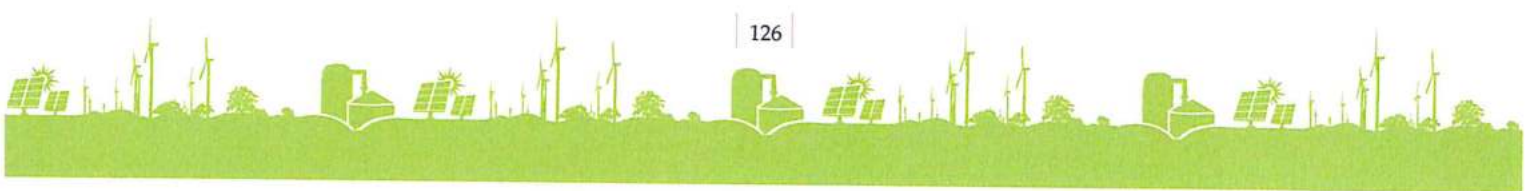
Biochemical Conversion Division has various research projects funded by the Department of Biotechnology that are going on:

#### 10.3.5 BIOREFINING OF SUGARCANE BAGASSE FOR PRODUCTION OF BIOETHANOL AND VALUE-ADDED PRODUCTS

A project entitled 'Biorefining of sugarcane bagasse for production of bioethanol and value-added products' under Indo-Brazil bilateral collaboration with IFSC/USP, Brazil and GNDU, Amritsar, funded by the Department of Biotechnology (DBT), Ministry of Science and Technology is going on since May 2016. The project cost from Indian side is INR 129.264 lakhs. Till now, optimized pretreatment studies of SCB have been conducted successfully followed by enhanced production of bioethanol via optimized



*Bio-refinery Laboratory at National Institute of Bio-Energy*







conventional and developed fermentation (SHF & SSF) processes. Biophysical characterization had been conducted successfully in our collaborator's lab at IFSC/USP, Brazil during the 18 months visit of research fellow (May 10, 2018-November 9, 2019). During the same visit, process of simultaneous isomerisation and fermentation (SIF) was also developed for enhanced pentose (xylose) utilization by external xylose isomerase to the fermentation medium rather than complicated, time and energy consuming pre-isomerisation followed by fermentation.

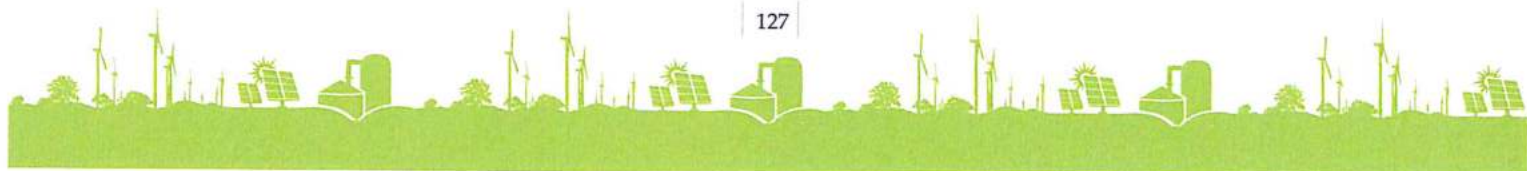
### 10.3.6 BIOREFINERY APPROACH FOR GENERATION OF PLATFORM CHEMICALS AND BIOETHANOL FROM INDIGENOUS LIGNOCELLULOSIC AGROWASTE BIORESOURCES

- (i) A project entitled 'Biorefinery approach for generation of platform chemicals and bioethanol from indigenous lignocellulosic agrowaste bioresources' has been sanctioned by DBT. The project cost is INR 69.60 lakhs. The project was taken up with effect from Oct 26, 2017.
- (ii) The objective of project is to process lignocellulosic waste specially grown in North East region i.e. *Saccharum spontaneum* (Kans) grass and banana pseudostem for bioethanol and platform chemicals. This project is to be performed in collaboration with Tezpur University, Assam. Our institute has to take care of bioethanol production from lignocellulosic wastes and characterization of end products. The pre-treatment of kans grass using different chemicals acid or alkali has been optimized. Further, the pre-treated biomass under optimized conditions will be used for ethanol production by simultaneous saccharification and fermentation (SSF) method using in-house thermos-tolerant yeast and commercial cellulases enzymes.

### 10.3.7 CHEMICAL CONVERSION DIVISION

Many possibilities have been explored so far for replacing petro-diesel with biodiesel and hybrid fuel, but none of these bio-fuels could completely substitute the petro-diesel with or without modification in the CI engine. Keeping all the alternative options open following R &D studies were conducted during the year in Chemical Conversion laboratory.

- (1) An investigation was carried out for the production of green diesel from waste cooking oil (WCO) by hydro-processing and TBP distillation. The fuel properties of the green diesel thus produced were estimated using ASTM/EN standards and thereafter green diesel (G100) and its blends (G10, G20, G30 & G50) were used as fuel in a CI engine to analyze the effect on engine combustion, performance and emission characteristics. The results obtained were compared with petro-diesel, optimized biodiesel blend B30 and hybrid fuel (HB-1) to explore its efficacy under same experimental test rig and operating conditions.
- (2) A comparative analysis of production, chemical structure, fuel properties, and cost estimation of waste cooking oil-based bio-diesel, hybrid fuel, and hydro-processed fuels was carried out. Biodiesel was produced by transesterification process; hybrid fuel was prepared by three-phase micro-emulsion process, while hydro-processed fuels were produced via hydro-processing followed by true boiling point distillation as per ASTM D2892 and ASTM D5236 specifications.
- (3) An experimental investigation on production of biodiesel and hybrid fuels from waste cooking oil and analysis of its behavior in an existing CI engine without the alteration of fuel injection settings was carried out. Biodiesel blend B30 showed higher brake thermal efficiency, lower brake specific energy consumption, and lower exhaust emissions (except NO<sub>x</sub> level), whereas, hybrid fuels showed a significant reduction in NO<sub>x</sub> level and comparable other exhaust emissions (except unburnt hydrocarbon) at the cost of lower brake thermal efficiency when compared with diesel.





- (4) An investigation was carried out to study the effects of cetane improver (2-Ethylhexyl nitrate) (2-EHN) on performance, combustion and emission characteristics of a constant speed, single cylinder CI engine fuelled with E20 (bioethanol (20%) – petrodiesel (80%)). A cetane improver, 2-EHN was used at concentration of 1000 ppm and 2000 ppm with the test fuel (E20) and the results were compared to petrodiesel. From the results, it is clearly unveiled that E20 with 1000 ppm of 2-EHN showed better results than E20, E20EHN2000 and petrodiesel.

### 10.3.8 PUBLICATIONS

During 2019-20, 16 publications across various journals, conferences, books, etc. were brought out by scientists from the three divisions of the Institute.

### 10.3.9 VISIT OF FOREIGN DELEGATION

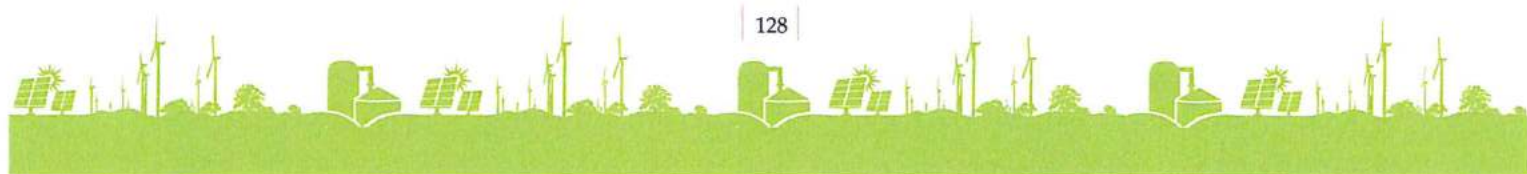
A delegation of Brazilian collaborators including Prof. Igor Polikarpov, PI of the project from Brazilian side along with group members of Prof. Francisco Eduardo Gontijo Guimares and Dr. Vanessa Arnoldi, Postdoc Fellow, visited the Institute during Jul 22-26, 2019 and discussed continuation of our on-going collaboration in biomass enzymatic deconstruction and valorisation of the obtained products. They also used this opportunity to discuss future collaboration between the SSS-NIBE, and the University of São Paulo (USP) in biotechnology and bioproducts aiming to explore synergies between Brazil and India and discussed concrete steps towards submission of joint grant applications, and students and researchers exchanges.

### 10.3.10 TRAINING PROGRAMMES

SSS-NIBE has organized training and skill development programmes to impart knowledge and skills on biogas technologies, a four days National Training Programme on Biogas Technology: Demonstration and its Implementation was organized at the institute during November 5 - 8, 2019. Training covered several areas related to biogas technology and basics of anaerobic digestion, production of bio CNG, problems faced by investors, in-situ and ex-situ management of biogas and various other aspects. A total of 22 participants including entrepreneurs, academicians, research scholars and master's students from all over the country actively participated in the training program.



*Interactive session with foreign delegation regarding on-going collaboration at SSS-NIBE*







*Group photograph during the national training program on 'Biogas Technology' at SSS-NIBE*

#### **10.4 SOLAR ENERGY CORPORATION OF INDIA LIMITED (SECI)**

10.4.1 Solar Energy Corporation of India Ltd. (SECI) is a 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).

10.4.2 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.

10.4.3 During FY 2018-19, it registered a total revenue of Rs.3264.26 crore and profit after tax (PAT) of Rs.129.40 crore.

#### **10.4.4 BUSINESS ACTIVITIES**

#### **10.4.5 IMPLEMENTATION OF SOLAR TENDERS UNDER NATIONAL SOLAR MISSION**

- (i) SECI is the MNRE's implementing agency for promotion of solar projects under the National Solar Mission (NSM). In this role, SECI floats tenders on pan-India/state-specific basis for selection of developers for setting up of solar projects, who are selected through a transparent tariff-based e-bidding and e-reverse auction process.
- (ii) SECI also signs long term power purchase agreements (PPA) with the developers for the selected projects and long term power sale agreements (PSA) with various DISCOMs for offtake of power, as a trading intermediary.





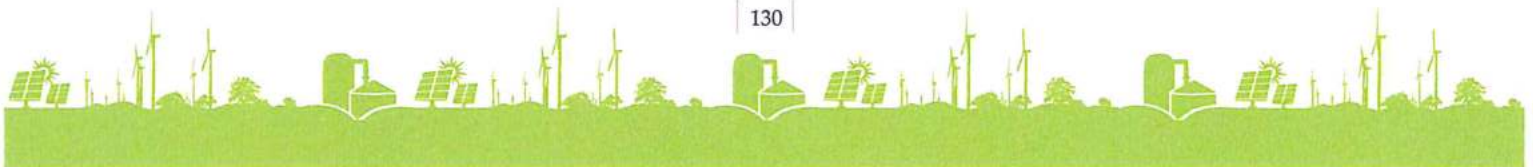


*250 MW solar project in Rajasthan commissioned in FY 2019-20 (I)*

- (iii) As on 31.12.2019, SECI has cumulatively awarded capacities of 20331 MW, of which 5305 MW capacity of projects have been commissioned.
- (iv) During FY 2019-20, SECI has issued tenders for 11675 MW capacity and projects totaling 750 MW capacity were commissioned in Rajasthan and Karnataka (till 31.12.2019). Notice inviting tender (NIT) for 1200 MW ISTS connected solar power projects in India (ISTS VIII) has been issued.



*250 MW solar project in Rajasthan commissioned in FY 2019-20 (II)*







#### 10.4.6 MANUFACTURING LINKED SOLAR

With the objective to strengthen India's domestic manufacturing base in solar photovoltaic (PV) technology, SECI has brought out tender for selection of developers for setting up of 7 GW of solar projects combined with 2 GW solar manufacturing facilities. Under the tender, capacity of 4 GW of solar projects with 1 GW of manufacturing plant has been awarded.

#### 10.4.7 IMPLEMENTATION OF ISTS-CONNECTED WIND POWER TENDERS

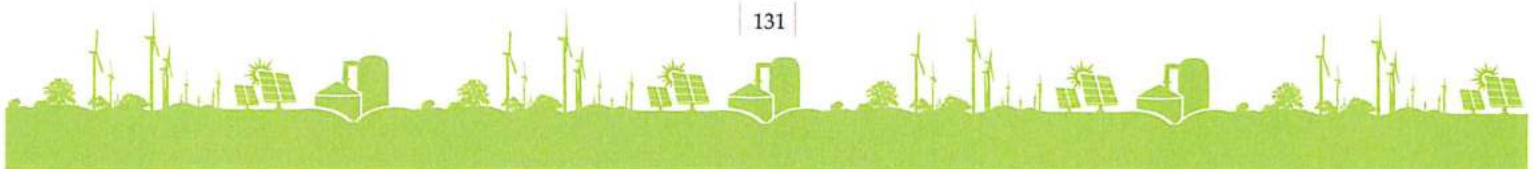
- (i) SECI is MNRE's nodal agency for implementing large-scale wind power projects in the country. On cumulative basis, SECI has awarded capacities of 9360.54 MW in eight tranches, of which about 1791.6 MW has been commissioned and balance capacities are under various stages of implementation (till 31.12.2019).
- (ii) During the FY 2019-20, two tenders have been issued (tranches-VIII & IX) for setting up of 3000 MW capacity. Total awarded capacity is 2120.64 MW during the year (including from previous tenders).

#### 10.4.8 SCHEME FOR SETTING UP OF GRID CONNECTED ROOF-TOP SOLAR PROJECTS

- (i) SECI implements MNRE's schemes for setting up of grid-connected rooftop solar projects in the country. Under this segment, various tenders brought out by SECI in previous years in CAPEX (investment by roof owner) and RESCO (PPA with roof owner) models have resulted in competitive procurement mechanisms and rapid expansion of the sector.
- (ii) During FY 2019-20, SECI has launched a tender under the Achievement Linked Incentive Scheme of MNRE for setting up 97.5 MW grid connected rooftop solar projects on buildings of Central/State Government ministries, departments etc. Under this scheme, there is provision for incentives of up to Rs. 12,000/- per kW (for general category states) and up to Rs. 31,800/- per kW (for special category states).



*Wind Turbine in SECI tendered project in Tamil Nadu*







#### 10.4.9 SOLAR PARKS SCHEME

SECI is the implementation agency for the scheme for development of solar parks, for providing infrastructural support, viz. developed land and power evacuation facilities, to solar project developers. Under the scheme, 39 solar parks have been sanctioned by MNRE in 17 states with total capacity of 22,879 MW till 31.12.2019.

#### 10.4.10 CPSU SCHEME

Under the scheme (phase-I) being implemented by SECI, projects of 881.76 MW were commissioned (till 31.03.2019). Under phase-II of the scheme, SECI has floated tenders for 2000 MW and 1500 MW capacity of solar projects (Tranches I and II respectively), of which 2026 MW have been awarded (as on 31.12.2019).

#### 10.4.11 SCHEME FOR DEFENCE ESTABLISHMENTS

Under the scheme for setting up of over 300 MW of grid connected and off grid solar PV projects by defence establishments, 117 MW has been commissioned (as on 31.12.2019).

#### 10.4.12 EMERGING TECHNOLOGY AREAS

**10.4.13 Floating Solar-** During FY 2019-20, SECI has awarded capacity of 150 MW floating solar project to be set up in Rihand dam, Uttar Pradesh. SECI has signed PSA with Uttar Pradesh Power Corporation Limited (UPPCL) and PPA with the successful bidders.

SECI is also planning to develop floating solar projects with own investment in Lakshadweep, Uttarakhand and Jharkhand. Technical and environmental due-diligence are in progress.

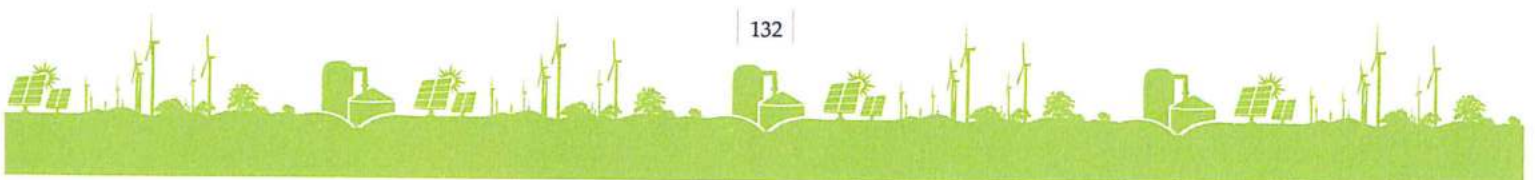
**10.4.14 Solar wind hybrid-** Under tenders for selection of developers for setting up solar-wind hybrid projects issued by SECI in previous year, 600 MW capacity has been awarded during FY 2019-20, thereby bringing cumulative awarded capacity to 1440 MW. NIT for 1200 MW Connected Wind-Solar Hybrid Power Projects Tranche-III has been issued.

**10.4.15 RE with Energy storage-** SECI is planning to deploy several energy storage systems to address the challenges of grid stability due to increasing penetration of intermittent RE generation. Several systems are being planned under CAPEX projects, and tenders for setting up of RE projects, incorporating energy storage systems, have also been issued:

- **Round the Clock (RTC) RE-** SECI has issued tender for supply of 400 MW Round the Clock (RTC) RE Power to New Delhi Municipal Council (NDMC) & Dadra and Nagar Haveli (DNH) in October, 2019. These tenders are expected to address the base-load requirements of the off-takers through RE, as well as providing generation flexibility to meet the peak demand.
- **RE with peak power supply-** SECI has floated a tender for selection of developers for setting up of 1200 MW ISTS-connected renewable energy (RE) projects with assured peak power supply. This is expected to enable Discoms to meet their peak energy demand at economical rates.

#### 10.4.16 PROJECT DEVELOPMENT

Apart from creating large scale solar and wind capacities of BOO basis through tenders, SECI also engages in development of solar and wind capacities through its own investment and as a project management consultant (PMC). Some of the initiatives are listed below:

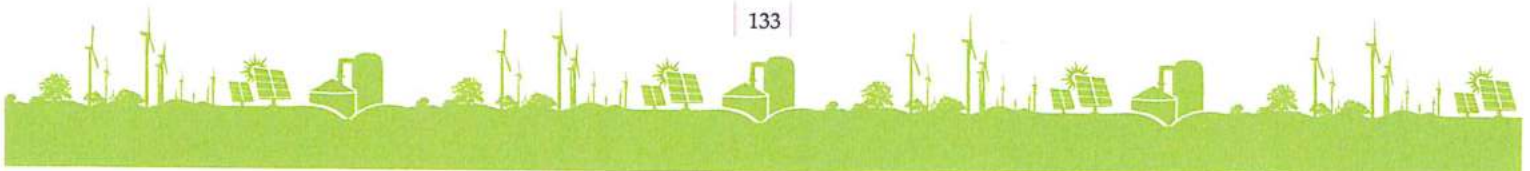






5 MW Solar PV Project in Ibrahimpatnam

- (i) **Projects under PMC-** SECI is implementing about 350 MW of projects for various entities under PMC mode, of which over 90 MW has been commissioned. Some of the major projects under execution during FY 2019-20 are as follows:
- **300 MW for SCCL-** SECI is undertaking PMC of 300 MW aggregate capacity of solar projects in different locations of Telangana, on behalf of Singareni Collieries Company Ltd. (SCCL). The power plants are being developed in spare land in coal mines for their captive use. The projects of capacity 219 MW are under execution, and for balance 81 MW capacity, detailed project report (DPR) is being prepared.
  - **5 MW for BDL, Ibrahimpatnam** – A 5 MW solar project at Bharat Dynamics Limited (BDL), Ibrahimpatnam has been successfully commissioned by SECI in April, 2019.
  - **6.2 MW for BHU-** SECI is undertaking development of 6.2 MW rooftop solar projects at Banaras Hindu University (BHU), Varanasi. The project is under execution.
  - **50 MW Solar project for THDC-** A 50 MW solar project is being developed in Kasargod, Kerala. The project is under execution.





- (ii) **CAPEX Projects-** SECI has operational projects of 11 MW capacity under its ownership and the company is looking to expand its portfolio in renewable energy. Details of existing and ongoing projects are as follows:
- **10 MW Badi Sid, Rajasthan-** The first solar PV project of 10 MW capacity of SECI was commissioned in Badi Sid, Jodhpur district of Rajasthan on 31.03.2016. The plant has generated about 12.6 MU in FY 2019-20 (till 30.11.2019).
  - **1 MW Andaman & Nicobar (A&N)-** SECI has installed 1 MW rooftop solar power projects in Andaman & Nicobar Islands. The project was commissioned in June, 2017 and is under operation.
  - **160 MW Solar-wind hybrid Project at Ramagiri, Andhra Pradesh-** SECI is planning to develop a 160 MW solar-wind hybrid project with 20 MWh battery storage system (BESS) with World Bank funding. Investment approval of the Government has been obtained. Discussions with the state government for offtake of power are underway.
  - **10 MW Solar PV Project at Karnataka (DRDO) –** A 10 MW solar project is being set up at DRDO, Kolar (Karnataka) for meeting their internal demand. The project is under execution.
  - **Solarization of Lakshadweep islands:** As an initiative towards diesel replacement in island regions, SECI has floated tender for setting up 1.95 MW Solar PV Power Plants with 2.15 MWh BESS. Bidding is in progress. Technical feasibility studies and Environmental and social impact studies (ESIA) are under progress for 20 MW floating solar project with 60 MWh battery storage system.
  - **150 MW Floating solar project in Jharkhand-** SECI is proposing to develop a 150 MW floating solar plant in Getalsud Dam, Jharkhand. Project is under feasibility assessments.
  - **200 MW Floating solar project in Uttarakhand-** SECI is planning to develop a 200 MW floating solar plant in Baur dam in Uttarakhand. DPR and ESIA are under progress.
  - **100 MW Solar PV Project with BESS 150 MWh in Chhattisgarh-** SECI is proposing to develop a 100 MW solar plant with 150 MWh BESS in Rajnandgam, Chhattisgarh. DPR is being finalized.
  - **10 MW Solar PV Project at Hyderabad (DRDO) –** A 10 MW solar PV project is planned to be set up at DRDO, Hyderabad. Feasibility studies are under progress.
  - **20 MW BESS projects in Delhi:** SECI has signed a MoU with BSES Rajadhani Power Limited for developing a 20 MW BESS project in Delhi.
  - **100 MW BESS projects in Delhi:** SECI is planning to develop a 100 MW BESS project in Delhi for improving the grid stability.

#### 10.4.17 POWER TRADING

- (i) SECI is mandated to purchase power from projects set up under RE tenders issued by the company, as a power trading intermediary, and in-turn supplying it to various DISCOMs through long term PPAs/ PSAs.
- (ii) For this role, SECI has a Category-I interstate power trading license from Central Electricity Regulatory Commission (CERC) and is actively trading RE power on both intra-state and inter-state levels.





- (iii) In FY 2019-20, 8049 million units (MU) of electricity have been traded across states and union territories (till 31.12.2019).

## 10.5 INDIAN RENEWABLE ENERGY DEVELOPMENT AGENCY LIMITED

10.5.1 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.

### 10.5.2 LENDING OPERATIONS

- (i) During the Financial Year 2018-19, IREDA has sanctioned loans to the tune of Rs. 11941.87 crore (corresponding previous year Rs. 12130.01 crore) and disbursed Rs. 9385.37 crore (corresponding previous year Rs. 8328.38 crore) against the annual target of Rs.15000 crore and Rs. 9315 crore for sanction & disbursements respectively. The above said sanctioned loan (includes co-financed projects/ takeover loans) would support capacity addition of 3266.37 MW. The sector wise breakup of sanctions and disbursements for the said period and the calendar year 2019 are given below in **Table 10.5**.
- (ii) The sector-wise break-up of cumulative sanctions and disbursements up to 31.12.2019 and projected sanctions and disbursements for the period from 01.01.2020 to 31.03.2020 are given in **Table 10.6**.

### 10.5.3 MOU WITH MNRE

Based on the audited accounts of financial year 2018-19, the Memorandum of Understanding (MoU) rating is Very Good. IREDA has also signed MoU with the MNRE for the year 2019-20.

### 10.5.4 RESOURCE MOBILIZATION

Paid up capital of IREDA is Rs. 784.60 crore with a net worth of Rs. 2563.77 crore based on the financial results for the period ended March 31, 2019. During 2018-19, IREDA has raised Rs. 2256.01 crore through International lines of credit.

### 10.5.5 DISSEMINATION OF INFORMATION

IREDA has continued to create awareness of Renewable Energy Technologies, Energy Efficiency & Conservation (EEC) and also its financial assistance schemes by hosting all its publications on its website.

### 10.5.6 HUMAN RESOURCE DEVELOPMENT

- (i) Human Resource is the most important asset of an organization. IREDA gives utmost importance to capacity building and well-being of its employees. In this direction, Training and HR policy of the Company aims to strengthen the business skills and competence of the employees for better performance and productivity. For FY 2019-20, IREDA has achieved 266 training man-days up to 31.12.2019. The MoU target of One week training in premier institutions within India to 15% Executives has been achieved. Also, the web learning programs (15 Nos.) have been rolled out to 15 employees. IREDA has also taken a number of measures to improve performance culture in the Company through policy interventions and improvement of systems and processes. In this regard, Career Path for all employees has been drawn ensuring the career growth of each employee upto E-5 level; IREDA has introduced periodical review of





<b>Table 10.5: IREDA – Sector-Wise Break-up of Loan Sanctions and Disbursements During FY 2018-19</b>				
<b>IREDA – Sector-Wise Break-up of Loan Sanctions and Disbursements During FY 2018-19</b>			<b>Sector-Wise Break-up of Loan Sanctions and Disbursements from 01.01.2019 to 31.12.2019</b>	
<b>(Rs. in crore)</b>				
<b>Sector</b>	<b>Sanction</b>	<b>Disbursement</b>	<b>Sanction</b>	<b>Disbursement</b>
Wind Power	1524.94	1557.16	1841.60	1440.14
Hydro Power	134.36	352.65	328.07	251.28
Biomass and Cogeneration	24.87	46.83	53.87	61.69
Energy Efficiency & Conservation	0	2.47	0	2.00
Solar Energy	5748.62	3828.47	5572.35	3624.11
Waste to Energy	327.14	143.79	376.97	109.38
Biomethanation from Industrial Effluents	0	0	0	0
Biomass Briquetting	0	0	0	0
Biomass Gasification	0	0	0	0
National Clean Energy Fund (NCEF)	0	0	0	0
Bill Discounting	102.35	92.03	32.53	32.53
Bridge Loan	4.79	4.78	90.29	10.61
Lines of Credit and Short Term Loan	3830.00	3327.54	5630.00	3959.09
Miscellaneous (Guarantee Scheme + Energy Access + Manufacturing +Ethanol)	244.80*	29.65**	821.71***	79.70****
<b>TOTAL</b>	<b>11941.87</b>	<b>9385.37</b>	<b>14747.39</b>	<b>9570.53</b>

\* Miscellaneous (Guarantee Scheme + Energy Access + Ethanol)

\*\* Miscellaneous (Manufacturing +Ethanol)

\*\*\* Miscellaneous (Guarantee Scheme + Energy Access + Manufacturing)

\*\*\*\* Miscellaneous (Manufacturing +Guarantee Scheme+ Ethanol)

employee performance under FR-56(j) in its Service Rules, and; compliance of DPE guidelines regarding SPARROW system introduced for performance appraisal of Board Level Executives has been done.

- (ii) In addition to the above, total number of employees, as on 31st December, 2019 is 161 excluding Board Level Executives.

#### **10.5.7 CORPORATE SOCIAL RESPONSIBILITY/ SUSTAINABLE DEVELOPMENT/ R&D ACTIVITIES**

- (i) The Company spent Rs.4.22 crore during the FY 2019-20 (till 31.12.2019) on CSR activities for the project which were completed/ongoing during the year (including Rs.2.00 Crore paid for the projects

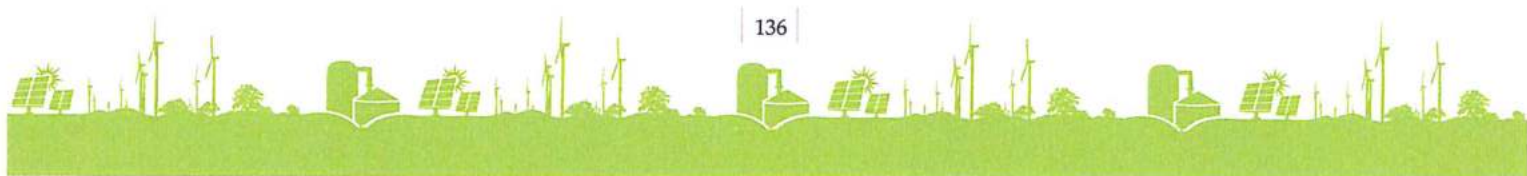




Table 10.6: IREDA Sector-Wise Break-up of Cumulative Loan Sanctions and Disbursements up to 31.12.2019				
IREDA – Sector-Wise Break-up of Cumulative Loan Sanctions and Disbursements up to 31.12.2019			Projected Sanctions and disbursements from 01.01.2020 to 31.03.2020	
(Rs. in crore)				
Sector	Cumulative Sanction	Cumulative Disbursement	Sanction	Disbursement
Wind Power	25497.22	17250.36	650.00	500.00
Hydro Power	8423.78	4807.26	50.00	80.00
Biomass Power and Cogeneration	5336.76	3414.99	125.00	14.00
Energy Efficiency & Conservation	1271.10	342.50	0	0
Solar Energy	24693.15	13129.50	600.00	1730.00
Waste to Energy	868.28	257.96	20.00	50.00
Biomethanation from Industrial Effluents	19.47	57.60	0	0
Biomass Briquetting	12.43	9.99	0	0
Biomass Gasification	72.47	5.12	0	0
National Clean Energy Fund (NCEF)	156.57	127.14	0	0
Bill Discounting	181.97	161.76	0	0
Lines of Credit & Short Term Loan	14706.39	11148.09	1150.00	1600.00
Bridge Loan	213.05	152.14	0	0
Miscellaneous	1321.94*	188.53**	0	0
<b>TOTAL</b>	<b>82774.58</b>	<b>51052.94</b>	<b>2595.00</b>	<b>3974.00</b>

\* Miscellaneous (Guarantee Scheme + Energy Access + Ethanol + Manufacturing)

\*\* Miscellaneous (Manufacturing + Ethanol)

which were sanctioned during the year 2019-20). Projects aggregating to Rs.14.43 Crore were sanctioned during the year and were in progress and few completed at the end of the year. The unspent amount on CSR initiative shall be spent upon the completion of the project. As a socially responsible corporate, IREDA is committed to increase its CSR impact and spend over the coming years, with its aim of playing a large role in India's sustainable development by embedding wider economic, social and environmental objectives.

- (ii) During the period April 2019 – December 2019, following activities/projects were undertaken by the Company under its CSR initiatives as shown in **Table 10.7**.

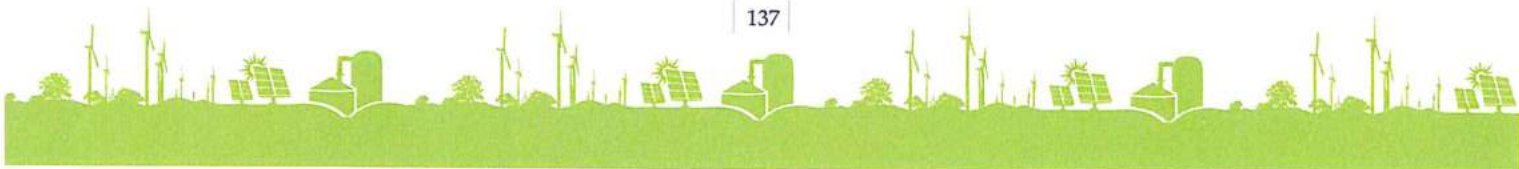






Table 10.7: CSR Initiatives undertaken by IREDA during 2019-20		
S. No.	Description	Rs. (Lakhs)
1.	Contribution to Swachh Bharat Kosh and Clean Ganga Fund	200.00
2.	Supply & Installation of 350 No. Solar PV Based Induction Cook-stoves for Providing Clean Cooking to Households / Consumers in Aspirational Districts	262.50
3.	Transformation of the Aspirational Districts Balrampur and Chandauli in Uttar Pradesh by providing Solar PV Systems, 50 LPH RO Water System and Medical Equipment for Government Schools and Primary Health Centers.	804.00
4.	Providing Solar Powered Equipment (Home Lighting Systems, Street Lighting Systems, RO Water Systems and SPV Plants on Schools / Primary Health Centers) for Transformation of Yadgir Aspirational District in Karnataka	96.52
5.	Providing Solar Water Heating Systems in Govt. Residential Schools towards Development of Raichur Aspirational District in Karnataka	80.60
<b>Total Sanctioned Amount in FY 2019-20</b>		<b>1443.62</b>

Projected Sanction for CSR from 01.01.2020 to 31.03.2020 : Rs. 5.00 Crores

Projected Disbursement for CSR from 01.01.2020 to 31.03.2020 : Rs. 11.50 Crores

