ANNUAL REPORT

2021-22

सत्यमेव जयते

Government of India

Ministry of New and Renewable Energy

CONTENTS

CHAPTER 1

OVERVIEW - A YEAR OF NOTABLE MILESTONES

1.1 TARGETS, COMMITMENTS AND ACHIEVEMENTS

The year 2021 was a landmark year for India's renewable energy sector in which significant milestones were crossed even while recovering from the Covid-19 pandemic. India achieved one of its Paris 2030 Nationally Determined Contributions (NDC) commitment 9 years in advance after crossing the 40% installed capacity target from non-fossil sources in November, 2021 itself. The country surpassed the 100 GW renewable energy installed capacity (excluding large hydro) landmark, on August 12th, 2021. India stands at 4th position in the world in terms of installed RE capacity.

The country's RE capacity stood at 104.88 GW as of December 31st, 2021, with 56.31 GW under implementation and 26.82 GW tenders issued. **Table 1** provides a sector-wise breakdown of the capacities achieved.

Table 1.1: Sector-wise targets and Cumulative Achievements (as on 31.12.2021)

Sector	Target by 2022 (GW)	Installed capacity (GW)	Under Implementation (GW)	Tendered (GW)	Total Installed/ or in the Pipeline (GW)
Solar Power*	100	49.35	40.86	20.52	110.73
Wind Power	60	40.08	9.65	1.50	51.23
Bio energy**	10	10.61	0.00	0.00	10.61
Small Hydro	5	4.84	0.36	0.00	5.20
Hybrid/Round the clock (RTC)/ Peaking Power/ Thermal + RE Bundling	0	0	5.44	4.80	10.24
Total	**175**	**104.88**	**56.31**	**26.82**	**188.01**

Note: *Includes Solar off-grid capacity of 1.46 GW
**Includes Waste to Energy capacity of 0.23 GW

Renewable energy was central to India's ambitious climate change announcements at UN 26th Conference of Parties (COP 26) at Glasgow in November, 2021. India announced plans to achieve the target of Net Zero emissions by 2070 and reduce the carbon intensity of its economy by more than 45%. India is also working towards a roadmap to implement 500 GW non-fossil energy capacity target by 2030, in line with PM's COP 26 announcement.

1.2 HIGHLIGHTS UNDER MAJOR ONGOING SCHEMES

The section outlines achievements under various schemes of the Ministry during the year.

1.2.1 Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan (PM-KUSUM) for decentralised solar

As on 31.12.2021, 25.25 MW capacity solar power plants were installed under scheme's Component-A, over 75,000 stand-alone solar pumps were installed under Component-B and over 1000 pumps were reported solarised under individual pump solarisation variant of Component-C.

1.2.2 Roof Top Solar (RTS) Programme Phase-II

Over 5.87 GW capacity of grid connected RTS plants were installed, as on 31.12.2021, against the 40 GW target.

1.2.3 Central Public Sector Undertaking (CPSU) Scheme for Grid Connected Solar Photovoltaic (PV) Power Projects

Under this scheme, around 8.2 GW of projects were sanctioned, as on 31.12.2021, against the 12 GW target.

1.2.4 Development of Solar Parks and Ultra Mega Solar Power Projects

Under this scheme, 50 solar parks with a cumulative capacity of 33.82 GW in 14 States were approved, as on 31.12.2021, against the March, 2022 target of 40 GW.

1.2.5 Domestic manufacturing

Production Linked Incentive (PLI) Scheme, 'National Programme on High Efficiency Solar PV Modules', was approved in April, 2021 with an outlay of Rs. 4500 crores for scaling up indigenous fully integrated manufacturing units. Three successful bids for setting up 8737 MW manufacturing capacity were also awarded in 2021.

1.2.6 Green Energy Corridor

As on 31.12.2021, works related to installation of transmission towers and their stringing for an aggregate approx. 8468 ckm have been completed, and substations of aggregate capacity of approx. 15268 MVA have been charged.

1.2.7 Human Resource Development Programme

Under this programme, a total number of 50,537 Suryamitras were trained till December, 2021.

1.2.8 Renewable Energy Research and Technology Development (RE-RTD) Programme

Various R&D projects were continued with emphasis on cost reduction, reliability and efficiency improvement of renewable energy systems and components.

1.3 NEW INITIATIVES

Aside from the schemes outlined in Section 1.2, the Ministry also took significant steps this year to mainstream emerging technologies and concepts to fast-track country's clean energy transition goals. Key examples are noted below :

1.3.1 Green Hydrogen

The National Hydrogen Mission was announced by the Hon'ble Prime Minister in his Independence Day speech on 15th August, 2021. The Ministry is putting together a Green Hydrogen Roadmap to action this ambition and to turn India into a Global Green Hydrogen Hub.

1.3.2 Energy Storage

The storage tenders in India have evolved from RTC, peak power and now, standalone ESS. SECI issued

tender for 1000 MWh Battery Energy Storage System (BESS) in October, 2021 to enable DISCOMS to use storage facilities on an on-demand basis.

1.3.3 Carbon-Neutral Ladakh

A combination of solar park, hydrogen, and geothermal projects are being planned to fulfill the country's vision of a carbon neutral Ladakh. India's first geothermal pilot plant will be commissioned in Ladakh. A 20 MW solar power project integrated with 50 MWh Battery Energy Storage System was initiated in Phyang, located in the Leh district of Ladakh. The Union Territory of Ladakh announced the provision of 20,000 acres of land at Pang to set up 10 GW of renewable energy projects, in November, 2021.

1.3.4 Green Energy Corridor

The second phase of Intra-State Transmission System Green Energy Corridor Scheme was approved on January 6, 2022, under which transmission infrastructure would be set up in 7 States, namely, Gujarat, Himachal Pradesh, Karnataka, Kerala, Rajasthan, Tamil Nadu, and Uttar Pradesh.

1.4 INTERNATIONAL COOPERATION

India has strengthened its existing alliance and forged new ones to harness globally available know-how on renewables. International Solar Alliance (ISA)'s 4th assembly took place on October 22, 2021. In FY 2021-22, 11 countries signed the ISA Framework Agreement taking the total membership to 86. India and International Renewable Energy Agency (IRENA) signed a strategic agreement on 16th January, 2022 to strengthen collaboration on knowledge sharing on RE including green Hydrogen. India participated in the 22nd IRENA Council meeting on October 26-27, 2021, and in the 12th General Assembly on January 14-16, 2022, at Abu Dhabi. The US Department of Energy and the MNRE launched the Hydrogen Task Force under the bilateral Clean Energy Partnership on June 17, 2021. The Centre of Excellence on Offshore Wind was launched under the India-Denmark Partnership on RE on September 9th, 2021.

CHAPTER 2

INTRODUCTION

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

2.2 ALLOCATION OF BUSINESS RULES

As per distribution of subjects among the Ministries/Departments under Allocation of Business Rules, following subjects have been allocated to the Ministry of New and Renewable Energy (Naveen aur Navikarniya Oorja Mantralaya):

i. Research and Development of Bio-gas and programmes relating to Bio-gas units.
ii. Commission for Additional Sources of Energy (CASE).
iii. Solar Energy – including Photovoltaic devices and their development, production and applications.
iv. All matters relating to small/mini/micro hydel projects of and below 25 MW capacity.
v. Programmes relating to improved Chulhas and Research and Development thereof.
vi. Indian Renewable Energy Development Agency Ltd. (IREDA).
vii. Research and Development of other non-conventional/Renewable sources of energy and programmes relating thereto.
viii. Tidal Energy.
ix. Integrated Rural Energy Programme (IREP).
x. Geothermal Energy.

2.3 STRUCTURE OF THE MINISTRY

Shri Indu Shekhar Chaturvedi is the Secretary in Ministry of New and Renewable Energy with effect from 11th May, 2020. The Ministry has one Financial Adviser, two Joint Secretaries and one Economic Adviser as on 31.12.2021. Various programmes are being implemented by the Ministry through State Nodal Agencies (SNAs) and channel partners.

2.4 INSTITUTIONS UNDER THE MINISTRY

To support the Ministry, there are five institutions consisting of three autonomous bodies i.e., National Institute of Solar Energy (NISE), National Institute of Wind Energy (NIWE) and Sardar Swarn Singh National Institute of Bio Energy (SSS-NIBE) and two Public Sector Undertakings i.e., Indian Renewable Energy Development Agency (IREDA) and Solar Energy Corporation of India (SECI). NISE is located at Gurugram, Haryana and serves as the technical focal point for Research and Development in Solar energy sector. NIWE is located at Chennai, Tamil Nadu and serves as the technical focal point for Research and Development in Wind energy sector. SSS-NIBE is located at Kapurthala, Punjab and is focusing on Research and Development in Bio- energy sector. IREDA, a Non-Banking Financial Institution under the administrative control of this Ministry, provides term-loans for renewable energy and energy efficiency projects. SECI functions as the implementing and executing arm of the Ministry for implementation of the National Solar Mission and Wind energy projects. In addition, the Department of Hydro and Renewable Energy (DHRE) formerly known as the Alternate Hydro Energy Centre (AHEC), Indian Institute of Technology, Roorkee provides technical support for small hydro

power development. However, DHRE is not an institution under the administrative control of the Ministry.

2.5 PUBLIC GRIEVANCES REDRESSAL

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

(i) Shri Anurag Sharma, Deputy Secretary has been designated as Liaison Officer for Scheduled Castes (SC)/Scheduled Tribes (ST)/Other Backward Classes (OBC) for implementation of scheme of reservation for persons of SC/ ST/OBC categories.

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

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

(iv) Time frame for redressal of the grievance/petition:

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

2.6 CITIZENS/CLIENTS CHARTER OF MNRE

In order to ensure timely delivery of services to its Clients/Citizens and redressal of their grievances in a time-bound manner, the Ministry has brought out a Citizens'/Clients' Charter (CCC) , incorporating its mission, main Services/Transactions and commitment to its clients and the people of India in general. It also aims at addressing problems of interface between the Ministry and its Clients/Citizens and also continuously improving the quality of public services for the people at large to make them responsive to their needs and wishes.

CHAPTER 3

NATIONAL SOLAR MISSION

FOCUS AREA UNDER PHASE-II OF NSM

3.1 GRID CONNECTED PROJECTS

The Government has set the target of 100 GW of installed solar power in the country by 2022 under the National Solar Mission (NSM). The target is planned to achieve through various policy decisions, enabling mechanisms, schemes, etc.

3.1.1 Achievements

As on 31.12.2021, a cumulative capacity of 48.087 GW of solar power projects have been installed in the country. In addition, tenders have been finalized and Letter of Intents (LoI) have been issued for around 40.869 GW and tenders have issued but LoI is yet to be issued for around 20.518 GW. Thus, it is expected that the target capacity of 100 GW could be fully achieved by the end of 2022. It is expected that the solar power projects of capacity around 55 GW will be commissioned by March, 2022.

Based upon availability of land and solar radiation, the potential solar power in the country has been assessed to be around 750 GWp. State-wise details of estimated solar energy potential in the country and the cumulative installed capacity (as on 31.12.2021) are given in **Table 3.1** and **Table 3.2** respectively.

Table 3.1: State-wise estimated Solar Energy Potential in the Country

Sl. No.	State/UT	Solar Potential (GWp)#
1.	Andhra Pradesh	38.44
2.	Arunachal Pradesh	8.65
3.	Assam	13.76
4.	Bihar	11.20
5.	Chhattisgarh	18.27
6.	Delhi	2.05
7.	Goa	0.88
8.	Gujarat	35.77
9.	Haryana	4.56
10.	Himachal Pradesh	33.84
11.	Jammu & Kashmir	111.05
12.	Jharkhand	18. 18
13.	Karnataka	24.70
14.	Kerala	6.11
15.	Madhya Pradesh	61.66
16.	Maharashtra	64.32
17.	Manipur	10.63

Sl. No.	State/UT	Solar Potential (GWp)#
18.	Meghalaya	5.86
19.	Mizoram	9.09
20.	Nagaland	7.29
21.	Odisha	25.78
22.	Punjab	2.81
23.	Rajasthan	142.31
24.	Sikkim	4.94
25.	Tamil Nadu	17.67
26.	Telangana	20.41
27.	Tripura	2.08
28.	Uttar Pradesh	22.83
29.	Uttarakhand	16.80
30.	West Bengal	6.26
31.	UTs	0.79
	Total	**748.98**

Assessed by National Institute of Solar Energy

Table 3.2: Status of Grid Connected Solar Projects as on 31.12.2021

Sl. No.	State/UT	Cumulative Capacity till 31.03.2021 (MW)	Capacity added in 2021-22 till 31.12.2021 (MW)	Cumulative Capacity till 31.12.2021 (MW)
1	Andaman & Nicobar	29.22	0.00	29.22
2	Andhra Pradesh	4203.00	89.37	4292.37
3	Arunachal Pradesh	5.61	0.00	5.61
4	Assam	42.99	16.16	59.15
5	Bihar	159.51	9.97	169.48
6	Chandigarh	45.16	7.48	52.64
7	Chhattisgarh	252.48	56.35	308.33
8	Dadar & Nagar	5.46	0.00	5.46
9	Daman & Diu	40.55	0.17	40.72
10	Delhi	192.97	16.69	209.66
11	Goa	7.44	10.93	18.37
12	Gujarat	4430.82	1775.52	6206.34
13	Haryana	407.83	185.37	593.20
14	Himachal Pradesh	42.73	2.31	45.04
15	Jammu & Kashmir	14.73	9.76	24.49
16	Jharkhand	52.06	1.50	53.56
17	Karnataka	7355.16	141.64	7496.80

Sl. No.	State/UT	Cumulative Capacity till 31.03.2021 (MW)	Capacity added in 2021-22 till 31.12.2021 (MW)	Cumulative Capacity till 31.12.2021 (MW)
18	Kerala	257.00	49.30	306.30
19	Ladakh	6.00	1.80	7.80
20	Lakshadweep	0.75	0.00	0.75
21	Madhya Pradesh	2463.21	128.94	2592.15
22	Maharashtra	2289.97	216.84	2506.81
23	Manipur	6.36	0.00	6.36
24	Meghalaya	0.12	0.07	0.19
25	Mizoram	1.53	0.00	1.53
26	Nagaland	1.00	0.00	1.00
27	Odisha	401.72	3.50	405.22
28	Pondicherry	9.33	2.55	11.87
29	Punjab	959.50	91.59	1051.09
30	Rajasthan	5732.58	4247.14	9979.72
31	Sikkim	0.07	2.69	2.76
32	Tamil Nadu	4475.21	282.55	4757.76
33	Telangana	3953.12	201.30	4154.42
34	Tripura	9.41	0.00	9.41
35	Uttar Pradesh	1712.50	277.78	1990.28
36	Uttarakhand	368.41	172.08	540.49
37	West Bengal	149.84	1.16	151.00
	Total	**40085.33**	**8002.51**	**48087.83**

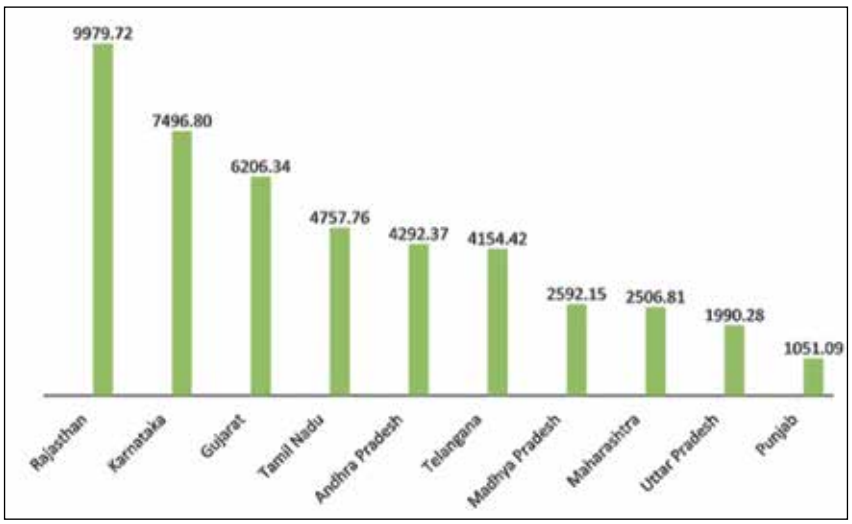

Fig. 3.1: Top 10 States in Solar Installation Capacity in MW as on 31.12.2021

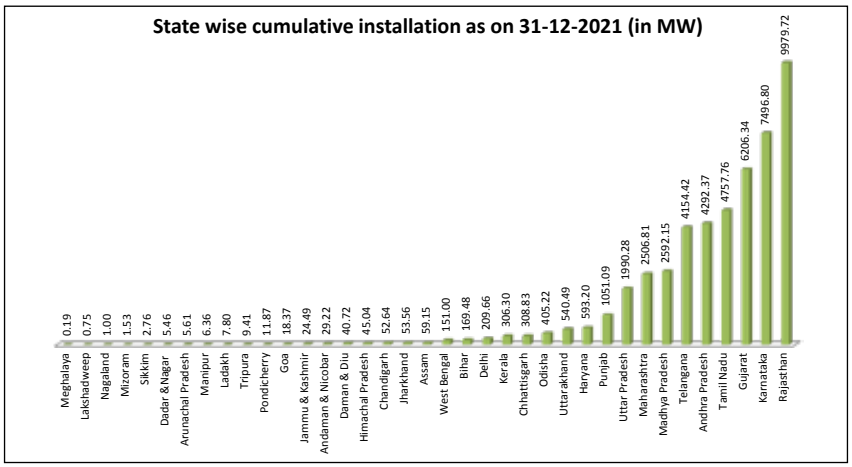

Fig. 3.2: Cumulative Capacity of Solar Power Installed till 31.12.2021

3.1.2 Expected achievements till 31.03.2022

It is expected that a capacity of around 55,000 MW will be installed under different solar programmes by end of Financial Year 2021-22.

3.2 SCHEME FOR DEVELOPMENT OF SOLAR PARKS AND ULTRA MEGA SOLAR POWER PROJECTS:

i. The Scheme for "Development of Solar Parks and Ultra Mega Solar Power Projects" was rolled out on 12-12-2014 with aggregate capacity 20,000 MW. Further, the capacity of the Solar Park Scheme was enhanced from 20,000 MW to 40,000 MW on 21-03-2017 to set up at least 50 Solar Parks. The timeline of the scheme is extended till 2023-24.

ii. Solar Park is a large chunk of land developed with all necessary infrastructure and clearances for setting up of solar projects. The capacity of the Solar Parks is generally 500 MW and above. However, smaller parks (up to 20 MW) are also considered in States or UTs where there is shortage of non-agricultural land. Approximately 4 to 5 acres per MW of land is required for setting up Solar Parks.

iii. Under the scheme, the Ministry provides Central Financial Assistance (CFA) of up to Rs. 25 lakh per solar park for preparation of Detailed Project Report (DPR). Beside this, CFA of up to Rs. 20.00 lakh per MW (Rs. 12 Lakh/MW for development of internal infrastructure of solar park and Rs. 8 Lakh/MW for development of external power evacuation infrastructure of solar park) or 30% of the project cost, including Grid-connectivity cost, whichever is lower, is also provided on achieving the milestones prescribed in the scheme. The total Central Grants approved under the Scheme is Rs. 8100.00 crore (Rupees Eight Thousand and One Hundred crore).

iv. Solar Energy Corporation of India (SECI) & Indian Renewable Energy Development Agency (IREDA) implement the scheme under the direction from MNRE and also handle the fund being made available under the scheme on behalf of Government of India.

3.2.1 Selection of Solar Power Park Developers

Solar parks are developed in collaboration with the State Governments & their agencies, CPSUs and private entrepreneurs. The solar park implementing agency is termed as Solar Power Park Developer (SPPD) and may be selected in any of the eight modes as per the Solar Park Scheme.

Table 3.3: The different Modes under which Solar Power Parks are developed

Mode	Brief Description of Mode	CFA
Mode-1	State designated nodal agency or a State Government Public Sector Undertaking (PSU) or a Special Purpose Vehicle (SPV) of the State Government.	Rs 12 lakh/MW for internal infrastructure & Rs 8 lakh/MW for external infrastructure Or 30% of the project cost, whichever is lower.
Mode-2	Joint Venture Company of State designated nodal agency and Solar Energy Corporation of India Ltd (SECI).	
Mode- 3	The State designates SECI as the nodal agency	
Mode- 4	(i) Private entrepreneurs with/without equity participation from the State Government (ii) Selection of private entrepreneurs based on open transparent bidding process.	
Mode- 5	Central Public Undertakings (CPSUs) like SECI, NTPC, etc.	
Mode- 6	Private entrepreneurs without any Central Financial Assistance from MNRE	No CFA
Mode- 7	SECI will act as a Solar Power Park Developer (SPPD) for Renewable Energy Parks	Rs 20 lakh/MW for external infrastructure only Or 30% of the project cost, whichever is lower.
Mode- 8	CPSU/ State PSU/ Government organization/ their subsidiaries or JV of the above entities can act as SPPD	Rs 20 lakh/MW for internal infrastructure only Or 30% of the project cost, whichever is lower.

3.2.2 Progress of Solar Park Scheme

The progress of Solar Park Scheme as on 30.12.2021 is given below:

i **Capacity approved:** Based on the proposals received from the States, 50 Solar Parks of aggregate capacity 33,821 MW has been approved to 14 States. These solar parks are at different stage of development. Few solar parks have been cancelled either due to slow progress or on the basis of request from the State. The list of parks is given at **Table 3.4**.

ii **Detailed Project Report (DPR) submitted:** Out of the approved capacity, DPRs of around 27,696 MW has been submitted.

iii **Land identified & acquired:** In the approved parks, land has been identified for around 33,821 MW out of which land has already been acquired for the capacity of around 26,496 MW.

iv **Internal and External Infrastructure developed:** Solar Park infrastructure almost fully developed in 10 number of parks of aggregate capacity 8285 MW. The infrastructure for remaining capacity is at various stages of development.

v **Commissioned capacity of solar projects inside Solar Parks:** During 2021-22 (as on 31.12.2021), solar projects of capacity 798 MW have been commissioned inside various solar parks. The aggregate capacity 9,195 MW of solar projects have been commissioned inside various solar parks as given in **Fig. 3.3**.

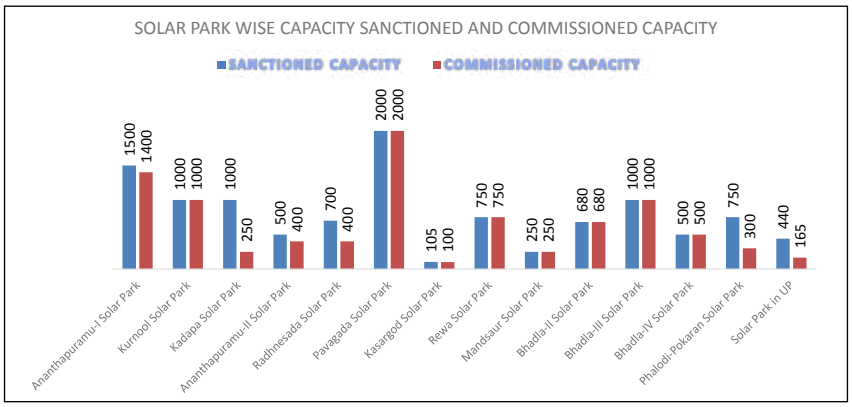

Fig. 3.3: Solar Parks- Capacity approved and capacity commissioned

Table 3.4: List of Parks as on 31.12.2021

Sl. No.	State	Solar Park	Sanctioned Capacity of Park (MW)
1	Andhra Pradesh	Ananthapuramu-I Solar Park	1500
2		Kurnool Solar Park	1000
3		Kadapa Solar Park	1000
4		Ananthapuramu-II Solar Park	500
5		Solar Wind Hybrid Park	200
6	Gujarat	Radhnesada Solar Park	700
7		Dholera Solar Park Ph-I	1000
8		NTPC RE Park	4750
9		GSECL RE Park	3325
10		GIPCL RE Park	600
11	Himachal Pradesh	Kaza Solar Park	880
12	Jharkhand	Floating Solar Park	100
13		Deogarh Solar Park	20
14		Palamu Solar Park	20
15		Garwha Solar Park	20
16		Simdega Solar Park	20
17	Karnataka	Pavagada Solar Park	2000
18		Kalaburgi Solar Park	500
19	Kerala	Kasargod Solar Park	105
20		Floating Solar Park	50
21	Madhya Pradesh	Rewa Solar Park	750
22		Mandsaur Solar Park	250

Sl. No.	State	Solar Park	Sanctioned Capacity of Park (MW)
23	Madhya Pradesh	Neemuch Solar Park	500
24		Agar Solar Park	550
25		Shajapur Solar Park	450
26		Omkareswar Floating Solar Park	600
27		Chhattarpur Solar Park	950
28		Morena Solar Park	1400
29		Barethi Solar Park	550
30	Maharashtra	Sai Guru Solar Park	500
31		Patoda Solar Park	500
32		Dondaicha Solar Park	250
33	Manipur	Bukpi Solar Park	20
34	Meghalaya	Solar park in Meghalaya	20
35	Mizoram	Vankal Solar Park	20
36	Odisha	Solar Park in Odisha	40
37		Floating Solar Park	100
38	Rajasthan	Bhadla-II Solar Park	680
39		Bhadla-III Solar Park	1000
40		Bhadla-IV Solar Park	500
41		Phalodi-Pokaran Solar Park	750
42		Fatehgarh Phase-1B Solar Park	421
43		Nokh Solar Park	925
44	Uttar Pradesh	Solar Park in UP	440
45		Jalaun Solar Park	1200
46		Mirzapur Solar Park	100
47		Parasan Kalpi Solar Park	65
48		Lalitpur Solar Park	600
49		Jhansi Solar Park	600
50		Chitrakoot Solar Park	800
Total			**33821**

3.2.3 Expected Achievement till 31.03.2022

It is expected that a cumulative solar projects capacity of more than 10,000 MW will be installed and cumulatively more than 12 solar parks will be completed with respect to park infrastructure by end of Financial Year 2021-22 under the Scheme. It is also expected that a capacity of around 40,000 MW will be approved under this scheme by end of Financial Year 2021-22.

3.3 SCHEME FOR INSTALLATION OF GRID-CONNECTED SOLAR PROJECT AND VARIOUS OFF-GRID APPLICATIONS FOR 100% SOLARIZATION OF KONARK SUN TEMPLE AND KONARK TOWN

The administrative guidelines of the Scheme for solarisation of Konark sun-temple and Konark city has been issued on 19.05.2020 with support of total CFA of around Rs. 25.00 crore as a high visibility project.

A 10 MW grid connected Solar Project and different Off -grid applications are to be installed in the Konark city. Odisha Renewable Energy Development Agency (OREDA) being the implementing agency is in the process of finalising the developers through competitive bidding.

The 10 MW grid connected Solar Project was awarded with zero VGF at a tariff of Rs. 2.77 per unit. The project is expected to be completed by next F.Y. The following Off-grid applications components were implemented with a total financial support of Rs. 13.17 crore under this project:

i. Solar Trees: 50 Nos.
ii. Street Lights: 200 Nos.
iii. Solar powered Drinking Water Kiosks: 40 Nos.
iv. Rooftop Solar power plants in Hybrid mode: 250 kWp
v. Rooftop Solar power plant in Off-grid Mode: 50 kWp
vi. Electrical Vehicles and Charging Stations: 20 Nos.
vii. Charging Stations: 2 Nos.

Fig. 3.4: Solar Powered Drinking Water Kiosk

Fig. 3.5: Solar Tree and Street Lighting System

Fig. 3.6: Rooftop Solar Power Plant

Fig. 3.7: Off-Gid Solar Power Plant for Temple Illumination

Fig. 3.8: Electric Vehicle and Charging Station

3.4 SOLAR POWER PROJECT OF 20 MWac/ 50 MWp AT PHYANG, LEH UNDER PMDP

A Scheme for setting up of solar PV capacity of 20 MWac/ 50 MWp with battery storage of 50 MWh at Phyang, Leh under J&K Prime Minister Development Package (PMDP) – 2015 was announced vide order No. 322/12/2017-NSM dated 08.11.2021 with a maximum financial support of Rs. 250 crore from Govt. of India.

SECI will be implementing the project on EPC mode and will be maintaining the project for the entire 25 years of its life. The project has been awarded to M/s Tata Power Solar Systems Limited through competitive bidding. The tariff for the project was fixed at Rs. 2.22/unit.

3.5 CPSU SCHEME PHASE-II FOR SETTING UP 12,000 MW GRID-CONNECTED SOLAR PHOTOVOLTAIC (PV) POWER PROJECTS BY CENTRAL AND STATE PSUS, GOVERNMENT ORGANISATIONS, WITH VIABILITY GAP FUNDING (VGF) SUPPORT FOR SELF-USE OR USE BY GOVERNMENT ENTITIES, EITHER DIRECTLY OR THROUGH DISTRIBUTION COMPANIES (DISCOMS)

(i) Government of India, through Ministry of New & Renewable Energy (MNRE), on 05.03.2019, has approved implementation of CPSU Scheme Phase-II for setting up 12,000 MW grid-connected Solar Photovoltaic (PV) Power Projects by Central and State PSUs, Government Organisations, with Viability Gap Funding (VGF) support over 4 years 2019-20 to 2022-23 for self-use or use by Government/ Government entities, either directly or through Distribution Companies (DISCOMs).

(ii) The Scheme is under implementation.

(iii) The VGF fund requirement over the four years 2019-20 to 2022-23 is estimated to be Rs. 8,580 crore, subject to a maximum of Rs. 0.7 crore/MW, to be decided through bidding amongst Government organizations. The VGF content will be reviewed by MNRE, for downward revision if required. The savings thereby achieved is to be used for additional capacity.

(iv) **Domestic Content Requirement (DCR):** The scheme mandates usage of domestically manufactured solar PV cells and modules.

(v) **Total Investment envisaged:** Rs. 48,000 crore for 12,000 MW capacity, @ Rs. 4 crore/MW.

(vi) **Implementation Agency:** (i) For first two tranches bid out till 31.12.2020: Solar Energy Corporation of India Limited (SECI); (ii) For subsequent tranches: Indian Renewable Energy Development Agency Limited (IREDA).

(vii) **Role of Implementing Agency (SECI / IREDA):** Implementing Agency will handle the Scheme, on behalf of MNRE, by way of Bidding on VGF among prospective Government Producers; Scrutiny of project proposals for WTO compliance; Project progress monitoring including site inspection; Ensuring compliance of Domestic Content Requirement (DCR) by way of site inspection/ field visits; and handling of funds under the Scheme. For these activities, SECI will be given a fee of 1% of VGF disbursed.

(viii) **Status of implementation:** Under CPSU Scheme Phase-II, following capacities have been allotted till 31.01.2022 **(Table 3.5)**.

Table 3.5: Capacities allotted till 31.01.2022 under CPSU Scheme Phase – II

Name of Government entity	Capacity of Solar PV power plants allotted under CPSU Scheme Phase-II (MW)	Scheduled Commissioning Date
NTPC Ltd.	3682	28/08/2022 for 769 MW in Tranche-I,
		25/10/2022 for 923 MW in Tranche-II,
		03/04/2024 for 1990 MW in Tranche-III
The Singareni Collieries Company Limited	171	28/08/2022 for 90 MW in Tranche-I and 09/01/2023 for 80.5 MW in Tranche-II
Delhi Metro Rail Corporation Limited	3	28/08/2022
Assam Power Distribution Company Ltd.	30	12/11/2022
NHDC Ltd.	25*	-
Nalanda University	5	12/11/2022
Indore Municipal Corporation	100	25/10/2022
SJVN Ltd.	1000	03/04/2024
NLC India Limited	510	03/04/2024
NHPC Limited	1000	03/04/2024
IRCON International Ltd.	500	03/04/2024
Solar Energy Corporation of India Ltd.	1200	06/06/2024
Total	**8226***	

*25 MW capacity allotted to NHDC Ltd. has been cancelled by SECI.

3.6 SOLARISATION OF SUN TEMPLE TOWN OF MODHERA IN MEHSANA DISTRICT, GUJARAT

(i) With an objective of solarisation of Sun-temple town of Modhera in District – Mehsana, Gujarat, and fulfilling the domestic and agricultural electricity needs of all the households of Modhera with solar energy, MNRE, Government of India has launched a Scheme on 19th March, 2020, for a pilot demonstration project for setting up various renewable energy installations like solar PV power plants, rooftop solar PV power plants, Battery Energy Storage System, smart energy meters, solar EV charging stations, smart load monitoring and data centre with weather station, smart street lights near Modhera sun temple, etc. in Modhera, with an investment of around Rs. 65 crore, with up to 50% central financial assistance (max. Rs. 32.50 crore) from Government of India through Ministry of New & Renewable Energy (MNRE) and balance 50% coming from Government of Gujarat. The Scheme is being implemented by MNRE and Government of Gujarat, through Gujarat Power Corporation Limited (GPCL).

(ii) MNRE has released Rs. 16.25 crore as Central Financial Assistance (CFA) for this project.

(iii) Gujarat Power Corporation Limited (GPCL) has awarded Letter of Intent (LoI)/ Letter of Award (LoA) for this project on 5th August, 2020. As on 19.01.2022, the project is commissioned.

(iv) Additional 500 nos. of 1kW solar PV rooftop projects, costing about Rs. 2.70 crore (including MNRE's CFA of around Rs.1.35 crore) have been sanctioned under the scheme. The additional solar PV rooftop projects are likely to get commissioned by end of year 2022.

3.7 GRID-CONNECTED ROOFTOP AND SMALL SOLAR POWER PLANTS PROGRAMME

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 February, 2019. Operational guidelines were issued on 20th August, 2019.

Under the Phase II of the Grid connected rooftop solar programme Central Financial Assistance (CFA) up-to 40% of the benchmark cost is provided for RTS projects up to 3 kW capacity and 20% for RTS system capacity beyond 3 kW and up to 10 kW in residential sectors. For Group Housing Societies/ Residential Welfare Associations (GHS/RWA), CFA is limited to 20% for RTS plants for supply of power to common facilities maximum upto 500 kW capacity. The programme is being implemented through power distribution companies (DISCOMs)/Electricity Department of States and UTs.

The Phase II of the programme has provision of incentives to DISCOMs. As per scheme, DISCOMs will get the incentive for addition of capacity achieving in the financial year above the baseline capacity as on 31st March of the previous year. No incentives for capacity addition up to 10% of base capacity 5% incentives for addition beyond 10% and up to 15% of base capacity and 10% incentives for addition beyond 15% of base capacity.

- Aggregate capacity of 3.34 GW **(Table 3.6)** has been allocated to Electricity Departments/ DISCOMs of various States and UTs, under the Phase-II programme out of which 1.18 GW has been installed as on 31.12.2021.
- Online portal has been developed in 31 States and UTs (as on 31.12.2021).
- An amount of Rs. 1134.47 crore (i.e. Rs.1009.87 crore as CFA and Rs. 124.60 crore as incentives) has been released to DISCOMs of various States and UTs in FY 2021-22 (as on 31.12.2021).

Table 3.6: Capacity Allocated under Phase-II

S. No.	States/UTs	DISCOM Full name	Aggregate allocated capacity in (MW)
1	Andaman & Nicobar	Electricity Department of Andaman & Nicobar	1.00
2	Andhra Pradesh	Andhra Pradesh Eastern Power Distribution Company Ltd.	8.00
		Andhra Pradesh Southern Power Distribution Company Ltd.	17.00
	Sub total		25.00
3	Arunachal Pradesh	No proposal received	0.00
4	Assam	Assam Power Distribution Company Limited	2.00
5	Bihar	North Bihar Power Distribution Company Limited	12.00
		South Bihar Power Distribution Company Limited	13.00
	Sub Total		25.00
6	Chandigarh	Chandigarh Electricity Department	85.00
7	Chhattisgarh	Chhattisgarh State Power Distributing Company Ltd	10.00
8	Dadara & Nagar Haveli and Daman & Diu	No proposal received	0.00

S. No.	States/UTs	DISCOM Full name	Aggregate allocated capacity in (MW)
9	Goa	Electricity Department Goa	80.00
10	Gujarat	Dakshin Gujarat Vij Company Ltd.	226.90
		Madhya Gujarat Vij Company Ltd.	290.27
		Pashim Gujarat Vij Company Ltd.	309.90
		Uttar Gujarat Vij Company Ltd.	151.86
		Torrent Power Ltd., Ahmedabad	167.95
		Torrent Power Ltd., Surat	41.98
	Sub Total		1,188.86
11	Haryana	Uttar Haryana Bijali Vitran Nigam Ltd	16.50
		Dakshin Haryana Bijli Vitran Nigam Ltd	30.00
	Sub Total		46.50
12	Himachal Pradesh	Himachal Pradesh State Electricity Board	15.00
13	J&K	Jammu and Kashmir Energy Development Agency	20.00
14	Jharkhand	Tata Steel licensee, Jamshedpur	0.60
		Tata Steel Utilities and Infrastructure Services Limited, Jusco Licensee, Saraikela Kharasawan	0.10
		Jharkhand Bijli Vitran Nigam Limited	60.00
	Sub total		60.70
15	Karnataka	Bangalore Electricity Supply Company Ltd	330.00
		Hubli Electricity Supply Company Limited	20.00
		Chamundeshwari Electricity Supply Corporation Limited	10.00
		Gulbarga Electricity Supply Company Limited	10.00
		Mangalore Electricity Supply Company Limited	2.00
	Sub Total		372.00
16	Kerala	Kerala State Electricity Board	250.00
17	Ladakh	No proposal received	0.00
18	Lakshadweep	Lakshadweep Electricity Department	10.00
19	Madhya Pradesh	Madhya Pradesh Madhya Kshetra Vidyut Vitaran Co. Ltd	20.00
		Madhya Pradesh Paschim Kshetra Vidyut Vitaran Co. Ltd	15.00
		Madhya Pradesh Poorva Kshetra Vidyut Vitaran Co. Ltd	10.00
	Sub Total		45.00

S. No.	States/UTs	DISCOM Full name	Aggregate allocated capacity in (MW)
20	Maharashtra	Tata Power Co. Ltd	2.40
		Brihanmumbai Electric Supply & Transport Undertaking	0.58
		Adani Electricity Mumbai Limited	3.50
		Maharashtra State Electricity Distribution Co. Ltd	525.00
		Sub Total	531.48
21	Manipur	Manipur State Power Distribution Company Limited	1.00
22	Meghalaya	Meghalaya Power Distribution Corporation Limited	70.00
23	Mizoram	Electricity Department, Mizoram	1.50
24	Nagaland	Electricity Department	4.80
25	NCT of Delhi	Tata Power Delhi Distribution Limited	10.00
		BSES Rajdhani Power Ltd	15.00
		New Delhi Municipal Council	1.50
		BSES Yamuna Power Ltd	13.00
		Sub Total	39.50
26	Odisha	TP Central Odisha Distribution Limited	1.00
		TP Southern Odisha Distribution Limited	1.00
		TP Western Odisha Distribution Limited	1.00
		TP Northern Odisha Distribution Limited	1.00
		Sub Total	4.00
27	Puduchery	Electricity Department, Puduchery	30.00
28	Punjab	Punjab State Power Corporation Ltd	80.00
29	Rajasthan	Jaipur Vidyut Vitran Nigam Ltd	50.00
		Ajmer Vidyut Vitran Nigam Ltd	5.00
		Jodhpur Vidyut Vitran Nigam Ltd	15.00
		Sub Total	70.00
30	Sikkim	Energy and Power Department, Sikkim	2.00
31	Tamil nadu	Tamil Nadu Generation and Distribution Corporation Limited	55.00
32	Telangana	Southern Power Distribution Company of Telangana Limited	30.78
		Northern Power Distribution Company of Telangana Limited	6.50
		Sub Total	37.28
33	Tripura	Tripura State Electricity Corporation Limited	1.00
34	Uttarakhand	Uttarakhand Power Corporation Limited	28.00

S. No.	States/UTs	DISCOM Full name	Aggregate allocated capacity in (MW)
35	Uttar Pradesh	Madhyanchal Vidyut Vitran Nigam Limited	39.00
		Pooravanchal Vidyut Vitran Nigam Limited	15.00
		Paschimanchal Anchal Vidyut Vitran Nigam Limited	17.00
		Dakshinanachal Vidyut Vitran Nigam Limited	16.00
		Kanpur Electric Supply Corporation	4.50
		Noida Power Company Limited	2.50
		Torrent Power	4.00
	Sub Total		98.00
36	West Bengal	West Bengal State ElectricityDistribution Company Limited	50.00
Total			**3,339.62**

3.8 GRID-CONNECTED ROOFTOP AND SMALL SOLAR POWER PLANTS PROGRAMME PHASE-I

Earlier, Ministry has been implementing Grid Connected Rooftop and Small Solar Power Plants Programme which was providing subsidy up to 30% of benchmark cost for the general category states and up to 70 % of benchmark cost for special category states, i.e. North Eastern States including Sikkim, Uttarakhand, Himachal Pradesh, Jammu & Kashmir and Lakshadweep, Andaman & Nicobar Islands for installation of grid connected rooftop solar power plants in building of residential, institutional and social sector for the sanctioned projects under phase-I. For Government sector achievement linked incentives up to 25% of the benchmark cost in general category States and UTs and 60% of the benchmark cost for special category States and UTs has been provided for the sanctioned projects under Phase-I.

An amount of Rs. 93.45 crore has been released to various agencies towards full or / partial settlement of projects in FY 2021-22.

As reported by DISCOMs, overall, 5.87 GW capacity of grid connected rooftop solar plant has been installed in the country as on 31.12.2021 **(Table 3.7)**.

Table 3.7: Overall installed capacity (with or without CFA) as on 31.12.2021

S. No.	States/UTs	DISCOM Full name	Capacity installed (MW) in residential sector under phase II with CFA	Overall installed capacity in all sectors (with or without CFA) as on 31.12.2021
1	Andaman & Nicobar	Electricity Department of Andaman & Nicobar	0	4.59
2	Andhra Pradesh	Andhra Pradesh Eastern Power Distribution Company Ltd.	0.514	67.338
		Andhra Pradesh Southern Power Distribution Company Limited	0	81.477
	Sub total		0.514	148.815

S. No.	States/UTs	DISCOM Full name	Capacity installed (MW) in residential sector under phase II with CFA	Overall installed capacity in all sectors (with or without CFA) as on 31.12.2021
3	Arunachal Pradesh			0.22
4	Assam	Assam Power Distribution Company Limited	0	29.8771
5	Bihar	North Bihar Power Distribution Company Limited	0.473	10.283
		South Bihar Power Distribution Company Limited	1.202	10.95
		Sub Total	1.675	21.233
6	Chandigarh	Chandigarh Electricity Department	3.239	46.2
7	Chhattisgarh	Chhattisgarh State Power Distributing Company Ltd	0.466	35.769
8	Dadara & Nagar Haveli and Daman & Diu			0.39
9	Goa	Electricity Department Goa	0	17.935
10	Gujarat	Dakshin Gujarat Vij Company Ltd.	195.240	304.560
		Madhya Gujarat Vij Company Ltd.	248.760	398.186
		Pashim Gujarat Vij Company Ltd.	269.920	368.150
		Uttar Gujarat Vij Company Ltd.	131.520	274.992
		Torrent Power Ltd., Ahmedabad	146.350	230.846
		Torrent Power Ltd., Surat	36.980	51.210
		Sub Total	1028.770	1627.944
11	Haryana	Uttar Haryana Bijali Vitran Nigam Ltd	6.185	157.232
		Dakshin Haryana Bijli Vitran Nigam Ltd	15.735	162.38
		Sub Total	21.92	319.612
12	Himachal Pradesh	Himachal Pradesh State Electricity Board	0.78	19.31
13	J&K			15.02
14	Jharkhand	Tata Steel licensee, Jamshedpur	0.013	7.561
		Tata Steel Utilities and Infrastructure Services Limited, Jusco Licensee, Saraikela Kharasawan	0	1.534
		Jharkhand Bijli Vitran Nigam Limited	0.17	25.419
		Sub total	0.183	34.514

S. No.	States/UTs	DISCOM Full name	Capacity installed (MW) in residential sector under phase II with CFA	Overall installed capacity in all sectors (with or without CFA) as on 31.12.2021
15	Karnataka	Bangalore Electricity Supply Company Ltd	0	177.74
		Hubli Electricity Supply Company Limited	0	44.966
		Chamundeshwari Electricity Supply Corporation Limited	0	16.769
		Gulbarga Electricity Supply Company Limited	0	22.194
		Mangalore Electricity Supply Company Limited	0	37.882
	Sub Total		0	299.551
16	Kerala	Kerala State Electricity Board	2.366	174.687
17	Ladakh		0	0
18	Lakshadweep	Lakshadweep Electricity Department	0	0
19	Madhya Pradesh	Madhya Pradesh Madhya Kshetra Vidyut Vitaran Co. Ltd	6.887	63.585
		Madhya Pradesh Paschim Kshetra Vidyut Vitaran Co. Ltd	5.312	50.446
		Madhya Pradesh Poorva Kshetra Vidyut Vitaran Co. Ltd	1.523	58.91
	Sub Total		13.722	172.941
20	Maharashtra	Tata Power Co. Ltd	0.005	13.65
		Brihanmumbai Electric Supply & Transport Undertaking	0.003	11.243
		Adani Electricity Mumbai Limited	0.14396	23
		Maharashtra State Electricity Distribution Co. Ltd	1.603	873.42
	Sub Total		1.75496	921.313
21	Manipur	Manipur State Power Distribution Company Limited	0.069	4.765
22	Meghalaya	Meghalaya Power Distribution Corporation Limited	0	0.214
23	Mizoram	Power & Electricity Department Mizoram	0	1.365
24	Nagaland	Electricity Department Nagaland	0	0.1

S. No.	States/UTs	DISCOM Full name	Capacity installed (MW) in residential sector under phase II with CFA	Overall installed capacity in all sectors (with or without CFA) as on 31.12.2021
25	NCT of Delhi	Tata Power Delhi Distribution Limited	0.335	46.32
		BSES Rajdhani Power Ltd	1.644	87.22
		New Delhi Municipal Council		10.556
		BSES Yamuna Power Ltd	0.14	28.8
	Sub Total		2.119	172.896
26	Odisha	TP Central Odisha Distribution Limited	0	16.685
		TP Southern Odisha Distribution Limited	0	0.8755
		TP Western Odisha Distribution Limited	0	0.952
		TP Northern Odisha Distribution Limited	0.0025	1.30312
	Sub Total		0.0025	19.81562
27	Puduchery	Electricity Department Puduchery	0	9.3
28	Punjab	Punjab State Power Corporation Ltd	14.314	165.723
29	Rajasthan	Jaipur Vidyut Vitran Nigam Ltd	20.378	315.207
		Ajmer Vidyut Vitran Nigam Ltd	3.997	231.372
		Jodhpur Vidyut Vitran Nigam Ltd	10.97	143.08
	Sub Total		35.345	689.659
30	Sikkim	Energy and Power Department Sikkim	0	2.673
31	Tamil Nadu	Tamil Nadu Generation and Distribution Corporation Limited	0	241.815
32	Telangana	Southern Power Distribution Company of Telangana Limited	13.682	195.79
		Northern Power Distribution Company of Telangana Limited	1.813	20.765
	Sub Total		15.495	216.555
33	Tripura	Tripura State Electricity Corporation Limited	0	3.13
34	Uttarakhand	Uttarakhand Power Corporation Limited	10.29	262.708
35	Uttar pradesh	Madhyanchal Vidyut Vitran Nigam Limited	17.088	67.54
		Pooravanchal Vidyut Vitran Nigam Limited	1.904	11.958

S. No.	States/UTs	DISCOM Full name	Capacity installed (MW) in residential sector under phase II with CFA	Overall installed capacity in all sectors (with or without CFA) as on 31.12.2021
	Uttar pradesh	Paschimanchal Vidyut Vitran Nigam Limited	1.01	4.184
		Dakshinanachal Vidyut Vitran Nigam Limited	0.74398	1.45187
		Kanpur Electric Supply Corporation	1.021	17.51
		Noida Power Company Limited	0.201	24.053
		Torrent Power	1.502	8.959
	Sub Total		23.46998	135.655
36	West Bengal	West Bengal State Electricity Distribution Company Limited		53.04
Total			**1176.49444**	**5869.33**

3.9 OFF GRID AND DECENTRALISED SOLAR PV APPLICATIONS PROGRAMME

(i) Under Off -Grid and Decentralized Solar PV Applications Programme, Ministry has been providing Central Financial Assistance (CFA) for deployment of Solar Street lights, Solar Study Lamps and Solar Power Packs to meet out the electricity and lighting needs of the local communities/institutions/ individuals in the rural areas. Programme is being implemented mainly through State Nodal Agencies (SNAs). Further, installation of standalone solar pumps, solarization of existing agricultural pumps and installation of grid-connected solar power plants up to 2 MW is being done under PM-KUSUM Scheme.

(ii) 217 MW capacity solar PV off -grid power packs / power plants have been installed till 31.12.2021.

(iii) Some major Off Grid Solar PV projects under implementation during FY 2021-22 are as follows:

a. Over 3.9 lakh Solar Study Lamps have been distributed to school going children, in North Eastern States and LWE affected districts.

b. Over 79 thousand solar street lights have been installed, particularly in North Eastern and Hill States/ UTs.

c. Under Atal Jyoti Yojana: Phase-II, cumulatively 1.23 lakh Solar Street Lights have been installed till 31.12.2021.

d. Solar Off-grid power plants of capacity 190 kWp have been installed at Public Service Institutionsin the State of Kerala.

e. Solar Off-grid power plants of capacity 130 kWp have been installed at Public Service Institutions in the State of Odisha.

f. Solar Off-grid power plants of capacity 105 kWp have been installed at Public Service Institutions in the State of Bihar.

(iv) Cumulative numbers/capacity of the off-grid solar applications installed in various States as on 31.12.2021 is given in **Table 3.8**.

Table 3.8: Cumulative systems installed up to 31.12.2021

SPV Systems	Cumulative up to 31.12.2021
Lanterns and Study Lamps (No.)	84,02,449
Home Lights (No.)	17,23,479
Street Lights (No.)	9,29,537
Solar Pumps (No.)	3,34,886
SPV Plants (MWp)	217

(v) State-wise details of the solar off-grid applications installed till 31.12.2021 are given in **Table 3.9**.

Table 3.9: State-wise Cumulative Capacity installed under Off-grid SPV Programme

S. No.	Agencies	Solar Home Light (Nos)	Solar lamp (Nos)	Solar Street Light (Nos)	Solar Pump (Nos)	Solar Power Plant (kW)	Grid-connected solar power plants under PM-KUSUM (MW)
1	Andhra Pradesh	22972	77803	16460	34045	3815.595	0
2	Arunachal Pradesh	35065	218551	25008	22	963.2	0
3	Assam	46879	647761	29248	45	1605	0
4	Bihar	12303	1735227	51400	2813	6905	0
5	Chhattisgarh	42232	3311	4442	61970	31372.9	0
6	Delhi	0	4807	301	90	1269	0
7	Goa	393	1093	707	45	32.72	0
8	Gujarat	9253	31603	5004	11979	13576.6	0
9	Haryana	56727	93853	34625	25994	2321.25	0
10	Himachal Pradesh	22592	33909	98500	186	1905.5	12.75
11	Jammu & Kashmir	144316	51224	38249	39	8129.85	0
12	Jharkhand	9450	790515	14294	11381	3769.9	0
13	Karnataka	52638	7781	5694	7734	7854.01	0
14	Kerala	41912	54367	1735	818	16268.39	0
15	Madhya Pradesh	7920	529101	16443	25047	3654	0
16	Maharashtra	3497	239297	10420	11315	3857.7	0
17	Manipur	24583	69722	32292	54	1580.5	0
18	Meghalaya	14874	96140	5800	54	2004	0
19	Mizoram	12060	155217	20325	37	3894.6	0
20	Nagaland	1045	30766	16045	3	1506	0
21	Odisha	5274	99843	18450	10292	2321.515	0
22	Punjab	8626	17495	43448	10596	2066	0
23	Rajasthan	187968	225851	8544	72059	30449	12.50
24	Sikkim	15059	30200	504	0	850	0

S. No.	Agencies	Solar Home Light (Nos)	Solar lamp (Nos)	Solar Street Light (Nos)	Solar Pump (Nos)	Solar Power Plant (kW)	Grid-connected solar power plants under PM-KUSUM (MW)
25	Tamil Nadu	298641	16818	41067	6646	13052.6	0
26	Telangana	0	101550	2458	424	7450	0
27	Tripura	32723	364012	14948	572	867	0
28	Uttar Pradesh	235909	2351205	96834	35288	10638.31	0
29	Uttarakhand	91595	165071	42119	26	4059.53	0
30	West Bengal	145332	17662	17750	653	1730	0
31	Andaman & Nicobar	468	6296	1490	5	167	0
32	Chandigarh	275	1675	901	12	730	0
33	Lakshadweep	600	5289	4465	0	2190	0
34	Puducherry	25	1637	417	21	121	0
35	Others	24047	125797	9150	609	23885	0
36	NABARD (2015 onwards)	116226	0	0	4012	0	0
	Total	**1723479**	**8402449**	**929537**	**334886**	**216862.67**	**25.25**

(vi) The Capacity installed in various States during FY 2021-22 (as on 31.12.2021) is given in the **Table 3.10**.

Table 3.10: Capacity installed under Off-grid SPV Programme during FY 2021-22

S. No.	Agencies	Solar Home Light (Nos)	Solar lamp (Nos)	Solar Street Light (Nos)	Solar Pump (Nos)	Solar Power Plant (kW)	Grid connected solar power plants under PM-KUSUM (MW)
1	Andhra Pradesh	0	0	0	0	0	0
2	Arunachal Pradesh	0	92970	11267	0	0	0
3	Assam	0	0	11289	0	0	0
4	Bihar	0	0	3207	0	105	0
5	Chhattisgarh	0	0	343	0	0	0
6	Gujarat	0	0	0	0	0	0
7	Goa	0	0	0	364		0
8	Haryana	0	0	0	15891	0	0
9	Himachal Pradesh	0	0	6000	140	0	12.75
10	Jammu & Kashmir	0	0	13220	0	0	0
11	Jharkhand	0	0	210	6330	0	0

S. No.	Agencies	Solar Home Light (Nos)	Solar lamp (Nos)	Solar Street Light (Nos)	Solar Pump (Nos)	Solar Power Plant (kW)	Grid connected solar power plants under PM-KUSUM (MW)
12	Karnataka	0	0	0	238	0	0
13	Kerala	0	0	0	0	190	0
14	Madhya Pradesh	0	0	1795	0	0	0
15	Manipur	0	10025	9900	14	0	0
16	Meghalaya	0	55390	0	35		0
17	Mizoram	0	48000	10208	0	20	0
18	Nagaland	0	24000	920	0	0	0
19	Odisha	0	0	345	631	130	0
20	Punjab	0	0	0	4907	0	0
21	Rajasthan	0	0	1167	16446	0	12.50
22	Sikkim	0	6900	0	0		0
23	Tamil Nadu	0	0	550	199	0	0
24	Telangana	0	76550	0	0		0
25	Tripura	0	75071	8061	358	0	0
26	Uttar Pradesh	0	1685	4689	3679	0	0
27	Uttarakhand	0	0	7901	0	0	0
28	West Bengal	0	0	1932	0	0	0
29	Andaman & Nicobar	0	0	355	0	0	0
Total		**0**	**390591**	**93359**	**48056**	**445**	**25.25**

3.10 PRADHAN MANTRI KISAN URJA SURAKSHA EVAM UTTHAAN MAHABHIYAAN (PM-KUSUM) SCHEME

i The Cabinet Committee on Economic Affairs approved PM-KUSUM scheme in its meeting held on 19.2.2019. Subsequently, expansion of Scheme was announced in the Budget for 2020-21, which was later approved by Ministry of Finance. The Scheme consists of three components:

Component-A: 10,000 MW of Decentralized Ground Mounted Grid Connected Solar Power Plants.

Component-B: Installation of 20 lakh Standalone Solar Powered Agriculture Pumps.

Component-C: Solarisation of 15 Lakh existing Grid-connected Solar Powered Agriculture Pumps.

ii The Scheme has been expanded during FY 2020-21 with an increase targeted solar capacity addition of 30.8 GW by 2022. The total central financial support provided under the scheme would be Rs. 34,035 crore including service charges of 2% on eligible CFA to implementing agencies. Revised physical and financial targets are given in **Table 3.11**.

Table 3.11: PM- KUSUM Programme Components

Component	Approved capacity	Creation of RE Capacity targeted (GW)	CFA including service charges (Rs. in crore)
Component-A	10 GW	10	3,325
Component-B	20 lakh pumps	9.6	15,912
Component-C	15 lakh pumps	11.2	14,798
Total		**30.8**	**34,035**

iii Under **Component A**, renewable power plants of capacity 500 KW to 2 MW will be setup by individual farmers/ cooperatives/panchayats /farmer producer organisations (FPO) on their barren or cultivable lands. The power generated will be purchased by the DISCOMs at tariff determined by respective State Electricity Regulatory Commission (SERC). The scheme will open a stable and continuous source of income to the rural land owners. Performance Based Incentives @ Rs. 0.40 per unit purchased or Rs. 6.6 lakh per MW of capacity installed, whichever is less, is provided to the Distribution Company for a period of five years from the Commercial Operation Date.

iv Under **Component B**, individual farmers are supported to install standalone solar pumps of capacity up to 7.5 HP. Under **Component C** of the scheme, individual farmers will be supported to solarise pumps of capacity up to 7.5 HP. Solar PV capacity up to two times of pump capacity in kW is allowed under the Component-C. The farmer will be able to use the generated energy to meet the irrigation needs and the excess available energy will be sold to the Distribution Company. This will help to create an avenue for extra income to the farmers, and for the States to meet their RPO targets. States can also opt for feeder level solarisation, where single solar plant can be installed through RESCO/CAPEX mode for feeding power to single or multiple agriculture feeders.

v For both Component-B and Component-C, (Individual Pump Solarisation) Central Financial Assistance (CFA) of 30% of the benchmark cost or the tender cost, whichever is lower, will be provided. The State Government will give a subsidy of 30%; and the remaining 40% will be provided by the farmer. Bank finance may be made available for meeting 30% of the cost. The remaining 10% will be provided by the farmer. Higher CFA of 50% will be provided for North Eastern States, Sikkim, Jammu & Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Lakshadweep and A&N Islands.

vi Under feeder level solarization, CFA @ 30% of the estimated cost of installation of solar power plant subject to a ceiling of Rs. 1.05 Cr/MW will be provided by MNRE and balance will be invested by the State Government (in Capex mode) or developer (in RESCO mode).

vii The Scheme will have substantial environment impact in terms of savings of CO_2 emissions. All three components of the Scheme combined together are likely to result in saving of about 32 million tonnes of CO_2 emission per annum. Further, Component-B of the Scheme on standalone solar pumps may result in saving of 1.4 billion litres of diesel per annum and associated saving in the foreign exchange due to reduction of import of crude oil.

viii Under Component-B and Component-C, it is mandatory to use indigenously manufactured solar modules with indigenously manufactured solar cell and therefore, the scheme will open-up opportunities for local manufacturing of solar cells and modules to the tune of 20.8 GW.

ix Implementation Status: The MNRE issued implementation guidelines/modalities on 22.7.2019. Based on the demand received from the States, capacities were sanctioned to them under the three components during FY 2019-20 and FY 2020-21. The capacity sanctioned to the states under the three components of the scheme till 31.12.2021 is given in **Table 3.12**.

Table 3.12: State-wise and Component-wise Implementation of PM KUSUM Scheme

S. No.	State	Component-A (MW)	Component-B (Numbers)	Component-C (Numbers)	
				Individual Pumps Solarization	Feeder Level Solarization
1	Andhra Pradesh	0	0	0	50000
2	Arunachal Pradesh	0	50	0	0
3	Assam	50	1000	500	0
4	Chhattisgarh	30	20000	0	0
5	Delhi	62	0	550	0
6	Gujarat	500	3424	7000	500
7	Goa	50	200	11000	0
8	Haryana	65	37000	0	32927
9	Himachal Pradesh	20	950	0	0
10	Jammu and Kashmir	5	5000	0	0
11	Jharkhand	50	11000	500	10000
12	Karnataka	500	10500	0	250000
13	Kerala	40	100	100	2000
14	Ladakh	0	600	0	0
15	Madhya Pradesh	300	57000	20000	175000
16	Maharashtra	500	100000	0	250000
17	Manipur	40	150	0	0
18	Meghalaya	5	200	0	10000
19	Nagaland	0	50	0	0
20	Odisha	500	5700	0	0
21	Puducherry	7	0	0	0
22	Punjab	220	12000	0	25000
23	Rajasthan	1200	65000	12500	25000
24	Tamil Nadu	75	6100	20000	0
25	Telangana	500	0	0	65000
26	Tripura	5	3100	2600	0
27	Uttar Pradesh	225	20000	0	30000
28	Uttarakhand	0	338	200	0
29	West Bengal	0	0	700	0
Total		**4909**	**359462**	**75650**	**925427**

Note: No demand was received from States not shown above, in any of the three components.

x Out of the sanctioned capacities shown above till 31.12.2021, under Component-B, 77,099 standalone solar pumps have been installed in various States. Under Component-C, 1,026 nos. of individual pumps have been solarized by Distribution Companies in the State of Rajasthan. Under Component-A, 25.25 MW Grid-Connected solar power plants have been installed in the states of Himachal Pradesh and Rajasthan.

3.11 OFF-GRID & DECENTRALISED SOLAR PV APPLICATIONS SCHEME: PHASE-III

i Phase-III of Off-grid and Decentralised Solar PV Applications Programme was launched in August, 2018 with target of 3,00,000 solar street lights, 25,00,000 solar study lamps and 100 MW capacity of off-grid solar power plants. Scheme was available till 31.03.2021.

ii Under the scheme, CFA of 30% of the benchmark cost or tender cost, whichever is lower, of the system is available for General category States and 90% of the benchmark cost or tender cost, whichever is lower, of the system is available for NE States, Hilly States/UTs and Island UTs. Solar study lamps for students are being provided in North-Eastern States and Left-Wing Extremism (LWE) affected areas with 85% financial support from the Central Government.

iii Status of sanctions and installations as on 31.12.2021 are given in **Table 3.13**.

Table 3.13: Status of Off -Grid & Decentralised Solar PV Applications Programme

S. No.	States/Union Territories	Solar Street Lights (Nos.)		Solar Study Lamps (Nos.)		Solar Power Packs (kWp)	
		Sanctioned Quantity	Installed Quantity	Sanctioned Quantity	Installed Quantity	Sanctioned Quantity	Installed Quantity
1	Andhra Pradesh	12,000	1,968	-	-	-	-
2	Andaman & Nicobar	1,100	1,100	-	-	-	-
3	Arunachal Pradesh	20,000	20,000	2,00,000	2,00,000	-	-
4	Assam	20,000	13,949	-	-	-	-
5	Bihar	-	-	-	-	240	135
6	Himachal Pradesh	20,000	20,000	-	-	-	-
7	Jammu & Kashmir	20,000	19,000	-	-	-	-
8	Kerala	-	-	-	-	2,000	400
9	Manipur	20,000	19,550	75,000	60,664	25	25
10	Meghalaya	-	-	1,02,000	55,390	-	-
11	Mizoram	20,000	15,000	1,50,000	1,44,705	939	939
12	Nagaland	9,810	9,810	24,000	24,000	-	-
13	Odisha	-	-	-	-	1,000	1,000
14	Sikkim	-	-	43,034	6,900	-	-
15	Telangana	-	-	2,00,000	1,01,550	-	-
16	Tripura	12,000	11,000	3,00,000	3,00,000	-	-
17	Uttarakhand	19,665	13,800	-	-	-	-
18	Uttar Pradesh	-	-	21,122	21,122	-	-
	Total	**1,74,575**	**1,45,177**	**11,15,156**	**9,14,331**	**4,204**	**2,499**

Note: No demand was received from States not shown above, in any of the three components.

iv Projects are being implemented by State Nodal Agencies. Centralised tendering was done through Energy Efficiency Services Ltd. (EESL), for procurement of solar streetlights and solar study lamps.

3.12 ATAL JYOTI YOJANA (AJAY): PHASE-II

i Considering the success of the AJAY Phase-I scheme, coverage of the scheme in Phase-II launched in December, 2018 was expanded for implementation in North Eastern States including Sikkim and hilly States/UTs of Jammu & Kashmir, Ladakh, Himachal Pradesh and Uttarakhand and Island UTs and also in the aspirational districts of other States. A total of 3,04,500 Solar Street Lights (SSLs) were proposed to be installed.

ii Under Phase-II, 2000 numbers of SSLs are provided in the Parliamentary Constituencies of NE States, Hilly States/UTs and Island UTs. In the five States covered under AJAY Phase-I, 1000 numbers of SSLs will be provided in each of the Parliamentary Constituencies, which are irrespective of number of SSLs already installed in Phase-I of AJAY scheme. Further, out of total 115 aspirational districts, 67 districts are lying in the states/UTs mentioned above and hence are automatically covered. Parliamentary constituencies lying in uncovered balance 48 aspirational districts not covered in above mentioned States/UTs, are provided with up to 2000 numbers of SSLs based on the extent the Parliamentary Constituency lies in the aspirational district.

iii Due to stoppage of funds under MPLADS for two years on account of challenges due to COVID-19 pandemic, the Scheme was closed for new sanctions w.e.f. 01.04.2020. However, already sanctioned lights are being installed subject to availability of funds from MPLADS.

iv Till 31.03.2020, sanctions were issued by District Administrations for 1.48 lakh solar street lights. Out of this, 1,23,050 nos. of solar street lights have been installed till 31.12.2021.

3.13 SOLAR OFF-GRID PROGRAMME IN LADAKH

350 nos. of off-grid solar power plants of 5 kWp each have been installed in Kargil under Prime Minister Development Package announced in the year 2015 with financial support by MNRE.

3.14 GREEN ENERGY CORRIDOR

i. In order to facilitate integration of large-scale renewable generation capacity addition, the Cabinet Committee of Economic Affairs (CCEA) in FY 2015-16, approved the creation of Intra-State Transmission System Green Energy Corridor scheme in the Renewable Energy rich states of Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Tamil Nadu.

ii. The scheme includes establishment of grid sub-stations at different voltage levels with aggregate transformation capacity of approx. 22600 Mega Volt Ampere (MVA) and installation of approx. 9700 circuit kilometers (ckm) of transmission lines in these eight Renewable Energy rich states. The creation of the Intra-State Transmission System under the scheme will facilitate the evacuation of approx. 24 GW of power from renewable energy generation stations to load centers. The project is anticipated to be completed by June, 2022.

iii. The funding of the GEC scheme consists of 40% Central Grant, 40% KfW loan (EUR 500 million) and the remaining 20 percent as equity of implementing agencies. The scheme has an estimated cost of Rs. 10,141.68 crore including central grant of Rs.4056.67 crore from Government of India. As on 31.12.2021, a total grant of approx. Rs. 2151 crore has been disbursed to the States.

iv. As on 31.12.2021, works related to installation of transmission towers and their stringing for an aggregate approx. 8468 ckm have been completed, and substations of aggregate capacity of approx. 15268 MVA have been charged.

Green Energy Corridor Phase-II

v. In addition to the above, the second phase of Intra-State Transmission System Green Energy Corridor scheme was approved by the Cabinet Committee on Economic Affairs (CCEA) on 06.01.2022.

vi. The scheme includes establishment of grid sub-stations at different voltage levels with aggregate transformation capacity of approx. 27500 Mega Volt Ampere (MVA) and installation of approx. 10750 circuit kilometres (ckm) of transmission lines in seven States, namely Gujarat, Himachal Pradesh, Karnataka, Kerala, Rajasthan, Tamil Nadu and Uttar Pradesh.

vii. The creation of the Intra-State Transmission System under the scheme will facilitate the evacuation of approx. 20 GW of power from renewable energy generation stations to load centres.

viii. The scheme is targeted to be set up by FY 2025-26 with total estimated cost of Rs.12,031.33 crore and Central grant @ 33 percent of the project cost i.e., Rs. 3970.34 crore. The Central grant will help in offsetting the Intra-State transmission charges and thus keep the power costs down.

CHAPTER 4

POWER FROM OTHER RENEWABLES

4.1 WIND ENERGY

4.1.1 **Introduction:** India's wind energy sector is led by indigenous wind power industry and has shown consistent progress. The expansion of the wind industry has resulted in a strong ecosystem, project operation capabilities and manufacturing base of around 12,000 MW per annum. The country currently has the fourth highest wind installed capacity in the world with total installed capacity of 40.08 GW (as on 31st December, 2021) of which 1.46 GW was added during January to December 2021. The number of units generated from wind power projects during January to December, 2021 were 68.08 billion units.

4.1.2 Potential of Wind Energy in India

Wind is an intermittent and site-specific source of energy and therefore, an extensive Wind Resource Assessment is essential for these lection of potential sites. Over a period, the Ministry, through National Institute of Wind Energy (NIWE), has installed 967 wind-monitoring stations all over the country and issued wind potential maps at 50 m, 80 m, 100 m and 120 m above ground level. The latest assessment indicates gross wind power potential of 302.25 GW and 695.50 GW in the country at 100 meter and 120 meters respectively, above ground level. Most of this potential exists in seven windy States as given in **Table 4.1**.

Table 4.1: Wind Power Potential in India at 120 meters, above ground level

S. No.	State	Wind Power Potential at 120 mtr agl (GW)
1	Andhra Pradesh	74.90
2	Gujarat	142.56
3	Karnataka	124.15
4	Madhya Pradesh	15.40
5	Maharashtra	98.21
6	Rajasthan	127.75
7	Tamil Nadu	68.75
	Total (7 windy States)	651.72
	Other States	43.78
	All India Total	**695.50**

The wind atlas is available on the NIWE's website http://www.niwe.res.in and wind potential map at 120m above ground level is given in **Fig. 4.1**.

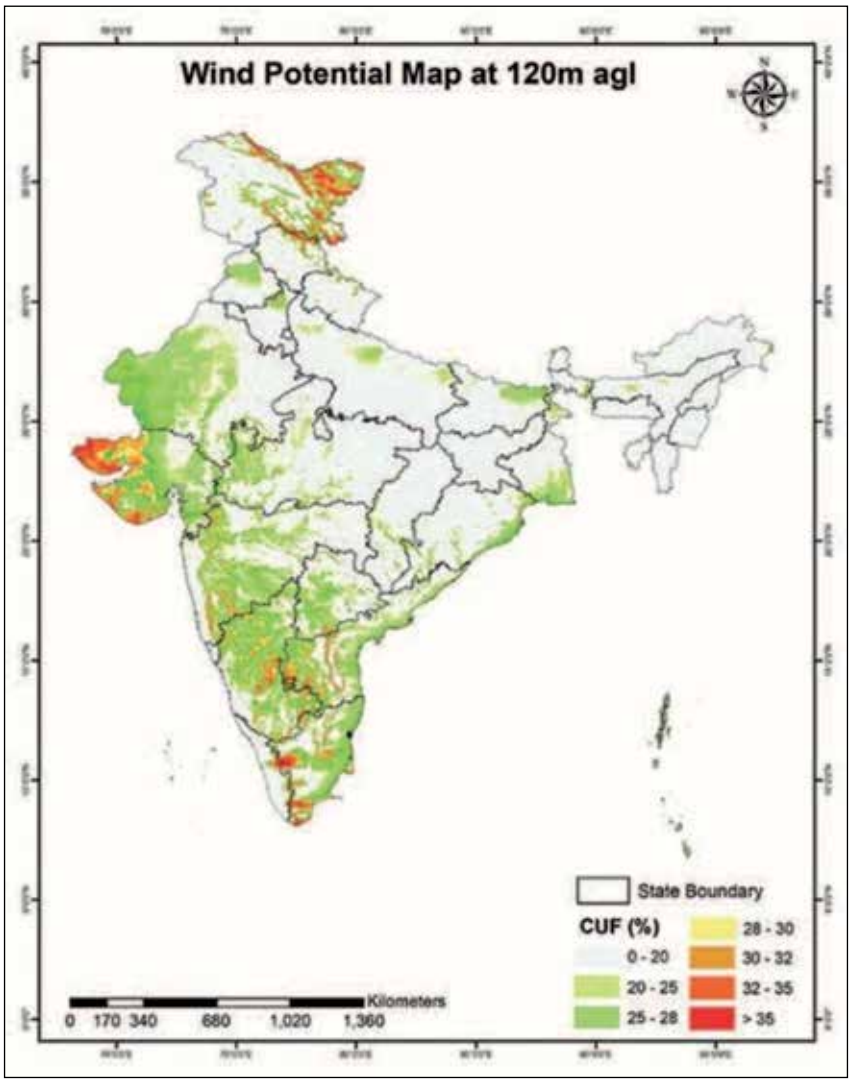

Fig. 4.1: Wind Potential Map at 120 Meters above ground level

4.1.3 Installed capacity of Wind Power in the country

The installed capacity of grid-interactive wind power in the country as on 31.12.2021 is 40.08 GW and state-wise installed capacity (in MW) is shown in **Table 4.2**.

Table 4.2: State wise Wind Power installed as on 31.12.2021

S. No.	STATE	Installed Capacity (MW)
1	Andhra Pradesh	4096.65
2	Gujarat	9007.72
3	Karnataka	5077.20
9	Kerala	62.50
4	Madhya Pradesh	2519.89
5	Maharashtra	5012.83
6	Rajasthan	4326.82

S. No.	STATE	Installed Capacity (MW)
7	Tamil Nadu	9846.69
9	Telangana	128.10
10	Others	4.30
	Total (MW)	**40082.7**

The year-wise electricity generation from wind energy source is shown in **Table 4.3**.

Table 4.3: Year wise Electricity Generation from Wind Energy Sources

S.No.	Year	Generation(MU)
1	2014-15	33768
2	2015-16	33029
3	2016-17	46004
4	2017-18	52666
5	2018-19	62036
6	2019-20	64639
7	2020-21	60149
8	2021-22 (upto December, 2021)	58127

4.1.4 Technology development and manufacturing base for Wind Power

The Wind Turbine Generator technology has evolved, and state-of-the-art technologies are available in the country for the manufacture of wind turbines. Around 75% localization has been achieved with strong domestic manufacturing capacity for wind energy turbines and its components in the country. All the major global players in this field have their presence in the country and over 37 different models of wind turbines are being manufactured by more than 14 different companies, through (i) joint ventures under licensed production (ii) subsidiaries off oreign companies, and (iii) Indian companies with their own technology. The unit size of the largest machine has gone upto 3.60 MW.

Wind turbines and components manufactured in India are also being exported to various countries. The current annual production capacity of wind turbines in the country is about 12,000 MW.

4.1.5 Tender/bidding in Wind Energy sector

Government issued Guidelines for Tariff Based Competitive Bidding Process for Procurement of Power from Grid Connected Wind Power Projects vide resolution notified on 8th December, 2017. This was done with an objective to provide a framework for procurement of wind power through a transparent process of bidding including standardization of the process and defining of roles and responsibilities of various stakeholders. These Guidelines aim to enable the Distribution Licensees to procure wind power at competitive rates in a cost-effective manner.

Based on past bidding experience and after consultation with stakeholders, the standard bidding guidelines for wind power projects were amended on 16th July, 2019 to reduce the investment risks related to the land acquisition and Capacity Utilization Factor (CUF). Incentives were also provided for early part commissioning of project. The subjectivity in penalty provisions was removed and the penalty rate was fixed. The risk of wind power developers in case of delay in signing of Power Sale Agreement (PSA) has been mitigated by starting timeline of execution of project from date of signing of Power Purchase Agreement (PPA) or Power Sale Agreement (PSA), whichever is later.

The Scheme for procurement of blended wind power from 2,500 MW ISTS connected projects was introduced. The objective of the Scheme is to provide a framework for procurement of electricity from 2,500 MW Interstate Transmission System (ISTS) Grid Connected Wind Power Projects with up to 20% blending with Solar PV Power through a transparent process of bidding. Solar Energy Corporation of India Ltd. (SECI) is the nodal agency for implementation of the Scheme. It has provisions for payment security mechanism, commission schedule, power offtake constraints, power purchase agreement, among others. SECI has awarded 970 MW of projects under this scheme at discovered tariff of Rs. 2.99 - 3.00 per unit.

4.1.6 Status of tenders for Wind Power Projects

To enable DISCOMs of the non-windy States to fulfill their non-solar Renewable Purchase Obligation (RPO), through purchase of wind power at a tariff determined by transparent bidding process, MNRE through SECI has auctioned wind power capacity in eleven tranches. Further, NTPC and the states of Gujarat, Maharashtra and Tamil Nadu have also auctioned wind power capacities.

i. Cumulative commissioned capacity till 31.12.21: 40.08 GW

ii. Capacity under implementation: 9.65 GW

iii. Total ongoing bids: 1.5 GW

Total [(i) + (ii) + (iii)]: 51.23 GW

The details of tender sauctioned for Wind Power are shown in **Table 4.4**.

Table 4.4: Details of Tenders Auctioned for Wind Power

Sl. No.	Bidding Agency	Capacity awarded (MW) (A)	Capacity cancelled (MW) (B)	Net capacity (MW) (C=A-B)	Capacity Commissioned (MW)	Bidding Agency Type	Min. Tariff (Rs./kwh)
1.	SECI-I	1049.9	50	999.9	999.9	Central	3.46
2.	SECI-II	1000	19.9	980.1	740.1	Central	2.64
3.	SECI-III	2000	0	2000	950.2	Central	2.44
4.	SECI-IV	2000	0	2000	528	Central	2.51
5.	Tamil Nadu (TANGEDCO)	450	0	450	49.5	State	3.42
6.	Gujarat (GUVNL)	500	30	470	470	State	2.43
7.	Maharashtra (MSEDCL)	500	0	500	277	State	2.85
8.	SECI-V	1190	0	1190	0	Central	2.76
9.	NTPC	1150	1150	0	0	Central	2.77
10.	SECI – VI	1200	0	1200	386.5	Central	2.82
11.	SECI – VII	480	0	480	90.3	Central	2.79
12.	GUVNL Ph.-II	202.6	0	202.6	138.6	State	2.80
13.	SECI – VIII	440	0	440	0	Central	2.83
14.	SECI IX	970	0	970	0	Central	2.99
15.	SECI X	1200	0	1200	0	Central	2.77
16.	SECI XI	1200	0	1200	0	Central	2.69
	Total	**15532.5**	**1249.9**	**14282.6**	**4630.1**		

4.1.7 Incentives available for Wind sector

The Government has taken several steps to promote renewable energy, including wind energy, in the country. These include:

- Permitting Foreign Direct Investment (FDI) up to 100 percent under the automatic route,
- Waiver of Inter State Transmission System (ISTS) charges for inter-state sale of solar and wind power for projects to be commissioned by 30th June, 2025,
- Declaration of trajectory for Renewable Purchase Obligation (RPO) up to the year 2022,
- Setting up of Ultra Mega Renewable Energy Parks to provide land and transmission to RE developers on a plug and play basis,
- Laying of new transmission lines and creating new sub-station capacity for evacuation of renewable power,
- Setting up of Project Development Cell for attracting and facilitating investments,
- Standard Bidding Guidelines for tariff based competitive bidding process for procurement of Power from Grid Connected Solar PV and Wind Projects.
- Government has issued orders that power shall be dispatched against Letter of Credit (LC) or advance payment to ensure timely payment by distribution licensees to RE generators.
- Conducting skill development programmes to create a pool of skilled manpower for implementation, operation and maintenance of RE projects.

In addition to the above, the following steps have been taken specifically for promoting wind energy:

- Concessional custom duty exemption on certain components required for manufacturing of wind electric generators.
- Generation Based Incentive (GBI) is being provided to the wind projects commissioned on or before 31st March, 2017.
- Technical support including wind resource assessment and identification of potential sites through the National Institute of Wind Energy, Chennai.

4.1.8 Offshore Wind development in India

India is blessed with a coastline of about 7600 kms surrounded by seawater on three sides and has tremendous power generation potential from offshore wind energy. Considering this, the Government had notified the National Offshore Wind Energy Policy as per the Gazette Notification dated 6th October, 2015. As per the policy, Ministry of New and Renewable Energy will act as the nodal ministry for development of Offshore Wind Energy in India and work in close coordination with other government entities for Development and Use of Maritime Space within the Exclusive Economic Zone (EEZ) of the country in an effective manner for production of enormous quantity grid quality electrical power for national consumption.

National Institute of Wind Energy (NIWE), Chennai has been designated as the nodal agency to execute various pre-feasibility activities relating to resource assessment, surveys and studies within EEZ (Exclusive Economic Zone), demarcation of offshore potential blocks and facilitating offshore wind energy project developers for setting up offshore wind energy farms.

4.1.9 Present status

➢ Based on the preliminary assessment from satellite data and data available from other sources, 8 (eight) zones each in Gujarat and Tamil Nadu have been identified as potential zones for exploitation of offshore wind energy. Initial assessment of offshore wind energy potential within the identified zones has been estimated to be about 70 GW off the coast of Gujarat & Tamil Nadu only. (**Fig. 4.2** and **Fig. 4.3**).

- In order to attract the large investment needed/required for development of the sector in India, Government of India has already announced its intention of developing 30 GW of offshore wind energy project by 2030.
- Data collection (wind, geophysical, geotechnical, oceanographic) for 1.0 GW project capacity equivalent area off Gujarat coast has been completed and the rapid environmental impact assessment studies are also completed.

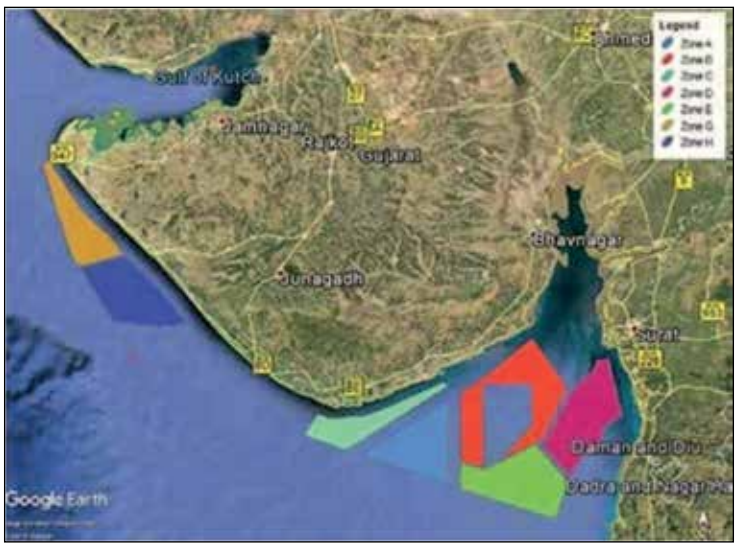

Fig. 4.2 Gujarat Offshore Wind Potential Zone

Fig. 4.3 Tamil Nadu Offshore Wind Potential Zone

4.1.10 Studies to Assess the Potential on the Gujarat Coast

(1) Offshore measurements off Gujarat coast:

LiDAR based offshore wind potential measurements for 2 years have been completed at Gulf of Khambhat off Gujarat coast. The offshore LiDAR wind data measurement report for the first and second years have been published for benefit of stakeholder. Four more LiDARs have been procured by NIWE for carrying out offshore wind resource assessment off Gujarat and Tamil Nadu coast. The LiDARs have already been validated in the WTRS test station, Kayathar, Tamilnadu. Considering the geotechnical profile of sea bed and depth of Tamil Nadu Offshore wind areas, it is decided to go for Floating LiDAR based measurements and accordingly, NIWE is in the process of procurement of floating structures for carrying out the offshore wind measurement along with other oceanographic measurements.

(2) Geophysical investigation at Gulf of Khambhat off Gujarat coast:

In order to ascertain the nature of sub sea surface and soil profile available at recommended depths for the design of foundation for offshore structures, a detailed geophysical survey is required to be carried out. Onsite Geo-physical investigation (single beam bathymetry survey, side scan sonar, sub- bottom profiling, and magnetometer survey and sediment samples) covering an area of 365 sq. km for 1GW offshore project in Gulf of Khambhat off Gujarat Coast has been completed.

(3) Geotechnical Investigation at Gulf of Khambat and Gulf of Mannar off Tamilnadu Coast:

In order to understand the subsoil profile and load bearing capacity of the seabed geotechnical studies were carried out at five locations off the coast of Gujarat. The geotechnical investigations at three locations off the coast of Tamil Nadu have been completed. Based on the results of the geotechnical investigations offshore structure (LiDAR platform) was designed and tendered. However, there was only one bidder and the cost was very high. Therefore it was decided to go for floating LiDAR based measurement.

(4) Offshore Wind Turbine Research and Test Centre at Dhanushkodi, Tamil Nadu:

In order to strengthen the domestic capacity for design and development of new offshore wind energy turbines, a testing cum research facility was necessary and NIWE has already identified the suitable site at Dhanushkodi, Tamil Nadu for establishment of the testing cum research centre. The required land for the purpose has been allotted by Govt. of Tamil Nadu. NIWE has submitted a project proposal for the test cum research centre. The generated power from this centre can also enable the Rameswaram city to get clean power. A committee has been constituted with members from Govt. of Tamil Nadu to examine the project report and finalize the various implementation issues and requirements of the State.

(5) Strategy for Offshore Wind Energy Development in India:

Ministry is preparing a strategy and roadmap for development of offshore wind projects, including the optimal capacity for the first project, adequate project pipeline, development models and financing mechanisms etc. The strategy paper once approved will open the offshore wind energy sector in India for development of projects through various modes such as centralized procurement, open access, captive etc.

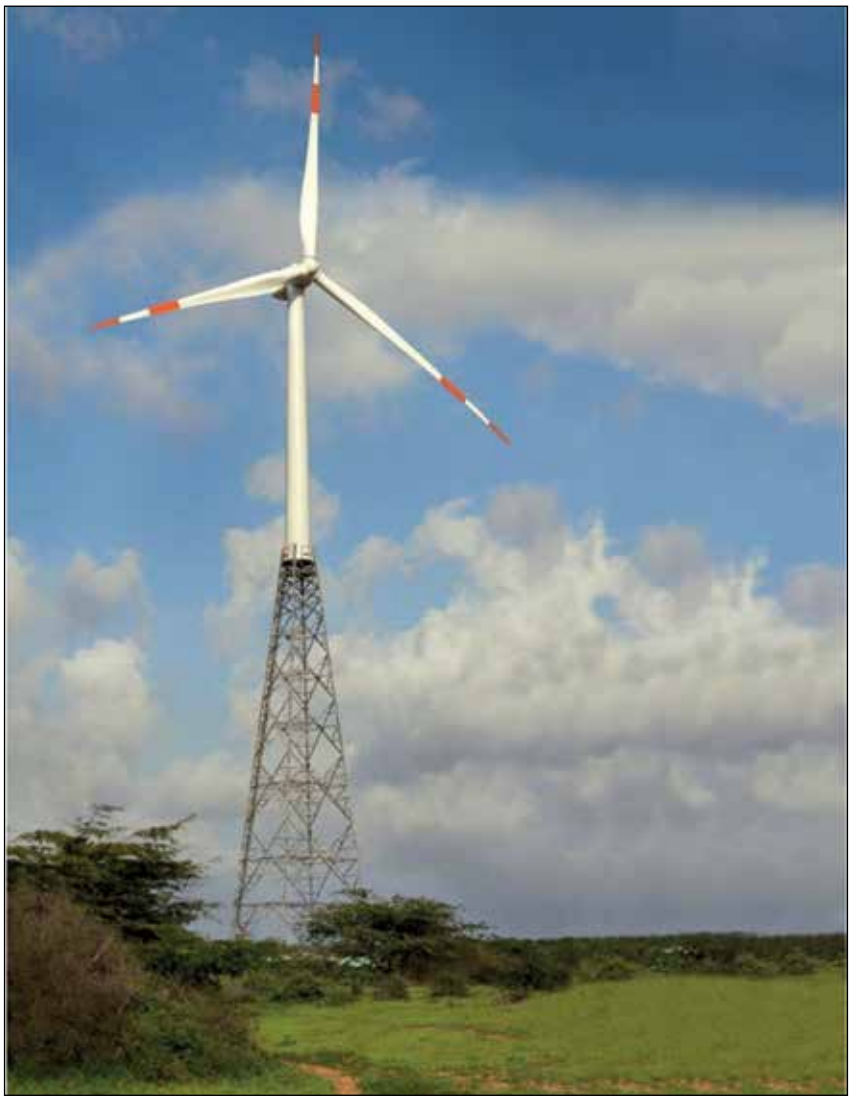

Fig. 4.3 Naniber (Golay) , Kutch Gujarat

Fig. 4.4 Suzlon Vayor, Kutch Gujarat

4.2 ENERGY FROM WIND-SOLAR HYBRID

4.2.1 **National Wind-Solar Hybrid Policy:** The Ministry issued National Wind-Solar Hybrid Policy on 14th May, 2018. The main objective of the policy is to provide a framework for promotion of large- scale grid connected wind-solar PV hybrid systems for optimal and efficient utilization of wind and solar resources, transmission infrastructure and land. The wind-solar PV hybrid systems will help in reducing the variability in renewable power generation and achieving better grid stability. The policy also aims to encourage new technologies, methods and way-outs involving combined operation of wind and solar PV plants.

4.2.2 The Major Highlights of the Policy are as under:

i. A wind-solar plant will be recognized as hybrid plant if the rated power capacity of one resource is at least 25% of the rated power capacity of other resource.

ii. Both AC and DC integration of wind-solar hybrid project are allowed.

iii. The power procured from the hybrid project may be used for fulfillment of solar RPO and non-solar RPO in the proportion of rated capacity of solar and wind power in the hybrid plant respectively.

iv. Existing wind or solar power projects, willing to install solar PV plant or Wind Turbine Generators (WTGs) respectively, to avail benefit of hybrid project, may be allowed.

v. All fiscal and financial incentives available to wind and solar power projects will also be made available to hybrid projects.

vi. The Central Electricity Authority (CEA) and Central Electricity Regulatory Commission (CERC) shall formulate necessary standards and regulations including metering methodology and standards, forecasting and scheduling regulations, REC mechanism, grant of connectivity and sharing of transmission lines, etc., for wind-solar hybrid systems.

vii. Storage may be added to the hybrid project to ensure availability of firm power for a particular period.

4.2.3 Wind-Solar Hybrid Projects

The following are the Projects under the Wind-Solar Hybrid Programme:

i. In order to implement the National Wind-Solar Hybrid Policy, a scheme for setting up of 2500 MW Inter State Transmission System (ISTS) connected wind-solar hybrid projects was sanctioned on 25.05.2018. The Solar Energy Corporation of India (SECI) was the nodal agency for implementation of the scheme through tariff based transparent competitive bidding process.

ii. Guidelines for Tariff Based Competitive Bidding Process for procurement of power from Grid Connected Wind Solar Hybrid Projects were issued on 14.10.2020 and amended on 23.07.2021. The objective is to provide a framework for procurement of electricity from ISTS Grid Connected Wind-Solar Hybrid Power Projects through a transparent process of bidding. Individual minimum size of project allowed is 50 MW at one site and a single bidder cannot bid for less than 50 MW. The rated power capacity of one resource (wind or solar) shall be at least 33% of the total contracted capacity. It has provisions for payment security mechanism, commission schedule, power offtake constraints, power purchase agreement, etc.

iii. Wind-solar hybrid projects of 4250 MW capacity have been awarded through e- reverse auction (as shown in **Table 4.5**) of which 201.18 MW has been commissioned till December, 2021.

Table 4.5: Details of tender sauctioned for Wind-Solar Hybrid Power Projects

Sl. No.	Bid	Capacity Awarded (MW)	Capacity Commissioned (MW)	Min. Tariff (Rs./kwh)
1.	SECI Hybrid–I	840	100	2.67
2.	SECI Hybrid-II	600	101.18	2.69
3.	SECI Hybrid-III	1110	0	2.41
4.	SECI Hybrid -IV	1200	0	2.34
5.	MSEDCL Maharashtra	500	0	2.62
	Total	**4250**	**201.18**	

4.2.4 Issuance of Concessional Custom Duty Exemption Certificates for manufacturing of Wind Turbines

Ministry is issuing concessional custom duty exemption certificates (CCDCs) to the manufacturers of wind operated electricity generators as per Ministry of Finance tariff notification no. 50/2017-customs dated 30.06.2017 and as amended vide Notification No. 2/2021-Customs dated 1.2.2021. To avail concessional custom duty benefits for essential imports of major components/sub-components/ part/sub-parts of all such components/sub-components for such manufacturing in India, the eligible turbine and component manufacturers listed in RLMM (Registered list of Models & Manufacturers) are required to get the bill of material for turbine models approved and then apply in prescribed application formats to this Ministry for issue of CCDC (Concessional Custom Duty Certificates) for their import consignments. In order to make the entire process fast and transparent, an online portal was developed and is active since Oct, 2019. A total 354 nos. of CCDC have been issued during 1.1.2021 to 31.12.2021.

4.3 BIOMASS POWER: BAGASSE (GRID CONNECTED) /NON-BAGASSE (OFF GRID) - CO-GENERATION

4.3.1

Ministry has been promoting Biomass Power and Bagasse Co-generation Programme with the aim to recover energy from biomass including bagasse, agricultural residues such as shells, husks, de-oiled cakes and wood from dedicated energy plantations for power generation. A scheme to support promotion of biomass-based cogeneration in sugar mills and other industries was notified on 11.05.2018 and was valid till 31.03.2021. As of now the Bio-energy Programme of MNRE has been continued for the period of FY 2021-22 to FY 2025-26 to only meet the already created liabilities and no new projects are being sanctioned.

The potential for power generation from agricultural and agro-industrial residues is estimated at about 28446 MW based on 228 MMT of surplus biomass which is generated annually. With progressive higher steam temperature and pressure and efficient project configuration in new sugar mills and modernization of existing ones, the potential of surplus power generation through bagasse cogeneration in sugar mills is estimated at around 13866 MW. Thus the total estimated potential for biomass power is about 42312 MW.

4.3.2 Recent Initiatives

A study to assess the Biomass Power and Bagasse Co-generation Potential in India was initiated by MNRE. The study was carried out by Administrative Staff College of India, Hyderabad. As per the final report submitted in March, 2021, Biomass and bagasse cogeneration power potential in the country is about 42 GW.

4.3.3 Achievements

Around 800 Nos of Biomass IPP and Bagasse/non bagasse cogeneration-based power plants with aggregate capacity of 10175 MW have been installed in the country. These plants have been installed mainly in the States of Maharashtra, Uttar Pradesh, Karnataka, Tamil Nadu, Andhra Pradesh, Chhattisgarh, West Bengal and Punjab upto December, 2021. This includes 7562 MW from Bagasse Cogeneration Sector and 1841 MW from Biomass IPP Sector.

i India has more than 540 Nos of sugar mills, out of which around 370 sugar mills have installed cogeneration power plant capacity of 7562 MW till December, 2021.

ii Over 200 biomass (non-bagasse) cogeneration plants with aggregate capacity of 772 MW have been installed in the country till December, 2021.

4.4 SMALL HYDRO POWER

4.4.1 The Ministry of New and Renewable Energy (MNRE) is vested with the responsibility of developing hydro power projects of capacity upto 25MW, categorized as Small Hydro Power (SHP) Projects. These projects have the potential to meet power requirements of remote and isolated areas in a decentralized manner besides providing employment opportunity to local people. Small Hydro Power projects are further categorized into small, mini and micro hydel projects based on their capacity as follows:

Micro Hydel ≤ 0.1 MW

Mini Hydel> 0.10 MW to ≤ 2.00 MW

Small Hydel> 2.00 MW to ≤ 25.00 MW

Fig. 4.5: Saptadhara Small Hydroelectric Power Project (3x6 MW) at Malkangiri, Odisha

4.4.2 The estimated potential of small/mini/micro Hydel projects in the country is 21133.65 MW from 7133 sites located in different States of India. The SHP projects in the country are being set-up both in public and private sectors. Setting up of SHP projects normally require about 3-4 years depending upon its size and location. The national target for SHP is to achieve a cumulative capacity of 5000 MW by 2022, under overall targets of achieving a cumulative grid connected Renewable Energy Power Projects of 175,000 MW. Against this target of achieving an aggregate capacity of 5000 MW by the year 2022, an aggregate capacity of 4839.40 MW been achieved as on 31st December, 2021 through 1150 Small Hydro Power projects. In addition, 71 projects of about 358 MW are at various stages of implementation. **Table 4.6** provides state-wise details of identified potential, projects completed and those under execution.

Table 4.6: State wise list of potential sites, installed projects and on-going projects in SHP sector (as on 31.12.2021)

Sl. No.	State	Total Potential		Projects Installed						Projects under Implementation	
		Nos.	Total Capacity (MW)	Upto 2020-21		2021-22		Total		Nos.	Capacity (MW)
				Nos.	Capacity (MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)		
1	Andhra Pradesh	359	409.32	44	162.11	0	0	44	162.11	0	0
2	Arunachal Pradesh	800	2064.92	156	131.11	0	0	156	131.11	4	5
3	Assam	106	201.99	6	34.11	0	0	6	34.11	1	2
4	Bihar	139	526.98	29	70.7	0	0	29	70.7	0	0
5	Chhattisgarh	199	1098.2	10	76	0	0	10	76	0	0
6	Goa	7	4.7	1	0.05	0	0	1	0.05	0	0
7	Gujarat	292	201.97	17	82.69	2	2.2	19	84.89	5	28.41
8	Haryana	33	107.4	9	73.5	0	0	9	73.5	0	0
9	Himachal Pradesh	1049	3460.34	197	936.11	2	18	199	954.11	12	90.44
10	UT of Jammu & Kashmir	103	1311.79	19	144.68	0	0	19	144.68	4	20.15
11	UT of Laddakh	199	395.65	28	39.64	0	0	28	39.64	8	9.25
12	Jharkhand	121	227.96	6	4.05	0	0	6	4.05	0	0
13	Karnataka	618	3726.49	170	1280.73	0	0	170	1280.73	6	16.45
14	Kerala	238	647.15	35	230.02	3	12.5	38	242.52	4	61.5
15	Madhya Pradesh	299	820.44	13	99.71	0	0	13	99.71	2	7.6
16	Maharashtra	270	786.46	70	379.58	1	1	71	380.58	8	8.85
17	Manipur	110	99.95	8	5.45	0	0	8	5.45	0	0
18	Meghalaya	97	230.05	5	32.53	0	0	5	32.53	2	25.5
19	Mizoram	72	168.9	18	36.47	0	0	18	36.47	2	8.5
20	Nagaland	98	182.18	12	30.67	0	0	12	30.67	2	2
21	Odisha	220	286.22	11	88.63	1	18	12	106.63	1	15
22	Punjab	375	578.28	56	173.55	3	2.55	59	176.10	3	1.75
23	Rajasthan	64	51.67	10	23.85	0	0	10	23.85	0	0

Sl. No.	State	Total Potential		Projects Installed						Projects under Implementation	
		Nos.	Total Capacity (MW)	Upto 2020-21		2021-22		Total		Nos.	Capacity (MW)
				Nos.	Capacity (MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)		
24	Sikkim	88	266.64	17	52.11	0	0	17	52.11	1	3
25	Tamil Nadu	191	604.46	21	123.05	0	0	21	123.05	0	0
26	Telangana	94	102.25	30	90.87	0	0	30	90.87	0	0
27	Tripura	13	46.86	3	16.01	0	0	3	16.01	0	0
28	A&N Islands	7	7.27	1	5.25	0	0	1	5.25	0	0
29	Uttar Pradesh	251	460.75	10	49.1	0	0	10	49.1	1	1.5
30	Uttarakhand	442	1664.31	102	214.32	0	0	102	214.32	5	51.5
31	West Bengal	179	392.06	24	98.5	0	0	24	98.5	0	0
	Total	**7133**	**21133.61**	**1138**	**4785.15**	**12**	**54.25**	**1150**	**4839.40**	**71**	**358.40**

4.4.3 For the year 2021-22, a target of commissioning of 120 MW small hydro projects was set, against which 05 projects of aggregate capacity of 54.25 MW have been synchronized to the grid by 31st December 2021 (**Table 4.7**). Actual physical achievement from 01.01.2021 to 31.12.2021 and estimated physical achievement from 01.01.2022 to 31.03.2022 is given in **Table 4.8**.

4.4.4 Under the 'Ladakh Renewable Energy Initiative (LREI)', Kargil Renewable Energy Development Agency (KREDA) and Ladakh Renewable Energy Development Agency (LREDA) are implementing Small/ Mini hydro projects in their respective regions. A total of 7 Hydro projects with aggregate capacity of 10.55 MW are being implemented by KREDA, out of which 4 projects with aggregate capacity of 5.05 MW has been commissioned by KREDA till date. LREDA is implementing 06 nos. of projects with aggregate capacity of 3.65 MW, out of which 02 projects with aggregate capacity of 0.95 MW has been commissioned by LREDA till date.

Table 4.7: List of SHP projects commissioned during FY 2021-22 (till 31.12.2021)

S. No.	State	Name of the project	Capacity (MW)	Name of the Agency/ Developer
1	Kerala	Chathankottunada	6.0	Kerala State Electricity Board Limited
2	Maharashtra	Morna (Gureghar)	1.0	M/s Ashok Sthapatya Pvt. Ltd.
3	Punjab	Kalabala	0.80	M/s Preetech Power Pvt. Ltd.
4	Himachal Pradesh	Chanju-II (out of 19.80 MW)	13.2	M/s Cosmos Hydro Power Pvt. Ltd.
5	Kerala	Upper kallar	2.0	Kerala State Electricity Board Limited
6	Odisha	Saptadhara	18.0	M/s Sri Avantika Power Projects Pvt. Ltd.
7	Punjab	Changali Khurd, Ferozepur Feeder Lower	1.50	M/s. Salasar Hydro Urja Pvt. Ltd., Punjab

S. No.	State	Name of the project	Capacity (MW)	Name of the Agency/ Developer
8	Punjab	Bhikhi Distribut or yoff taking at RD 214440 of Kotla Branch Canal (Barnala)	0.25	M/s. Hydro Energy & Infrastructure, Punjab
9	Himachal Pradesh	Kareri SHP, Shimla	4.80	Sai Engineering, Himachal Pradesh
10	Gujarat	Vadoadara Branch canal SHP 2	0.7	SSNNL, Gujarat
11	Gujarat	Vadoadara Branch canal SHP 5	1.5	SSNNL, Gujarat
12	Kerala	Aripara SHP	4.50	CIAL Infrastructure Limited, Kerala

Table 4.8: Actual physical achievement from 01.01.2021 to 31.12.2021 and estimated physical achievement from 01.01.2022 to 31.03.2022

Actual physical achievement from 01.01.2021 to 31.12.2021	Estimated physical achievement from 01.01.2022 to 31.03.2022
90.60 MW	65.75 MW

4.5 WASTE TO ENERGY

4.5.1 Programme on Energy from Urban, Industrial, Agricultural Wastes and Residues

The Ministry has been implementing the scheme "Programme on Energy from Urban, Industrial and Agricultural Waste/Residues" aimed at generation of biogas, BioCNG and Power from different wastes, such as Municipal Solid Waste, vegetable and other market wastes, slaughterhouse waste, agricultural residues and industrial wastes & effluents. In addition to Bio-CNG/Biogas, biogas plants generate organic fertilizer as a by-product which is valuable for agricultural fields.

The scheme was valid upto 31st March, 2021. As of now, the Bio-energy Programme of MNRE has been continued for the period of FY 2021-22 to FY 2025-26 to only meet the already created liabilities and no new projects are being sanctioned.

4.5.2 Progress during the Calendar year 2021

i. Physical Achievement: As on 31.12.2021, during the calendar year 2021, the capacities added in respect of various output products are given in **Table 4.9**.

Table 4.9: Progress of product out put and capacity addition during calendar year 2021

Sl. No.	Output Product	No. of plants	Capacity Addition in calendar year 2021	States
1	Biogas	4	40,500 m^3 per day	Telangana, Gujarat
2	Bio-CNG/CBG	9	30430 kg/day	Andhra Pradesh, Karnataka, Haryana, Tamilnadu and Telangana
3	Power	13	50.85 MWeq	Haryana, Andhra Pradesh, Gujarat, Uttar Pradesh, Madhya Pradesh, West Bengal and Telangana

ii. In 2021, Ministry granted sanction of total Central Financial Assistance (CFA) amounting Rs 253 crore including Rs. 250 crore to five MSW to Power projects under the "Programme on Energy from Urban, Industrial and Agricultural Waste/Residues and Municipal Solid Waste".

4.5.3 **Cumulative Physical Achievement:** As on 31.12.2021, the total installed capacity is 434.11 MWeq including 199.14 MW capacity of Grid-interactive Waste to Power projects, 234.97 MWeq capacity Off-grid Waste-to-Energy projects. The generation details as well as the output till 31.12.2021 are given in **Table 4.10**.

Table 4.10: The Product Output and Cumulative Capacity of Waste-to-Energy Projects

Sl. No.	Output product	Cumulative capacity
1	Biogas	7,71,008 m^3 per day
2	Bio-CNG/CBG	1,39,319 kg per day
3	Power (Grid & Offgrid)	340.92 MWeq

4.5.4 Estimated achievement for the period January-March, 2022:

During January-March, 2022, total capacity of 16.74 MWeq is expected to be installed from Waste to Energy and Power Generation plants.

4.5.5 **Concessional Custom Duty Certificates (CCDC):** Ministry on 25.01.2021 notified guidelines for issuance of certificates for availing concessional custom duty for import of machinery and components which are required for initial setting up of projects for generation of Bio-CNG from non-conventional materials namely agricultural, forestry, agro-industrial, industrial, municipal and urban waste, bio waste or poultry litter. During calendar year 2021, total 7 nos. of Concessional Custom Duty Certificates have been issued for setting up of Bio-CNG and Power generation plants.

Fig. 4.6: 7.5 MW Power Plant based on Municipal Solid Waste in Jamnagar, Gujarat

4.6 OFF-GRID RENEWABLE POWER

4.6.1 Biogas Power

Power Generation from Biogas offers a good potential in rural areas especially if they are far from the grid.

4.6.2 Biogas Power (Off-Grid) Generation and Thermal application Programme (BPGTP)

Upto 31.03.2021, the Ministry has implemented the Biogas-based Scheme for promoting biogas generation for Off-grid/distributed and decentralized Renewable Power applications in the capacity range of 3 kW to 250 kW and also for thermal energy applications having biogas generation capacity in the corresponding matching size range of 30 M^3 to 2,500 M^3 per day. The organic bio-degradable wastes from various sources such as cattle dung/animal wastes, food and kitchen waste, poultry dropping and agro-industry waste etc., are the feed stock for Biogas plants.

4.6.3 Implementation of BPGTP

Upto 31.03.2021, the Biogas based Power Generation and Thermal Application Programme (BPGTP) has been implemented through the Agriculture and Rural Development Departments of the States, Dairy Co-operatives, State Nodal Agencies (SNAs), Biogas Development and Training Centres (BDTCs), Khadi and Village Industries Commission (KVIC) and National Dairy Development Board (NDDB).

4.6.4 Central Financial Assistance (CFA) For BPGTP

The CFA was being provided (up to 31.03.2021) from Rs.25,000 per kW to Rs.40,000 per kW for power generation as per the generation capacity slabs and Rs.12,500 per kW to Rs.20,000 per kW for thermal applications respectively.

4.6.5 Achievements

During the year 2021-22, 3 projects have been commissioned with power generation capacity of 173 kW and corresponding biogas generation capacity of 1400 M^3 per day. With this, the cumulative total of 328 biogas based projects with a total power generation capacity of 7.76 MW with a cumulative total biogas generation of 73,751 M^3 per day have been set up in the country, up to 31.12.2021. The BPGTP Scheme has been continued beyond 31.03.2021 for clearing the past liabilities only. Therefore, no new projects were sanctioned up to 31.12.2021 for the year 2021-22.

CHAPTER 5

RENEWABLE ENERGY FOR RURAL APPLICATIONS

5.0 The MNRE has been implementing and supporting Biogas Schemes for dissemination and deployment of biogas plants in remote, rural and semi- urban areas of the country upto 31.03.2021.

5.1 NEW NATIONAL BIOGAS AND ORGANIC MANURE PROGRAMME (NNBOMP)

Up to 31.03.2021, the NNBOMP scheme, a central sector scheme was implemented for setting up small Biogas Plants in the size range varying from 1 M3 to 25 M3 with the objectives to provide green and clean renewable gaseous fuel for cooking, lighting and small power needs of the potential farmers, cattle farmers/users including individual households and to facilitate management and utilization of biogas plant produced slurry as an organic enriched Solid Biogas Fertilize.

5.2 ACHIEVEMENTS UNDER THE NATIONAL BIOGAS PROGRAMME

A target of setting up 60000 small Biogas Plants has been allocated to the States/ UTs for the year 2020-21. The progress under the New National Biogas and Organic Manure Programme (NNBOMP) is given in **Table 5.1**.

Table 5.1: State/ UT wise achievements for family type/ small biogas plants from 1981-82 to 2020-21 under the National Biogas Programme.

State/ UT	During FY 2020-21 upto 31.03.2021	Cumulative small Biogas plants up to 31.03.2021* under NBMMP/NNBOMP
Andhra Pradesh	1854	268598
Arunachal Pradesh	12	3621
Assam	931	139414
Bihar	147	130072
Chhattisgarh	550	60250
Goa	8	4234
Gujarat	351	435638
Haryana	577	64013
Himachal Pradesh	12	47718
Jammu & Kashmir	1	3201
Jharkhand	35	7890
Karnataka	1813	512755
Kerala	895	153666
Madhya Pradesh	2933	379154
Maharashtra	7221	931313
Manipur	0	2128
Meghalaya	0	11156
Mizoram	1	5857
Nagaland	0	7953
Odisha	62	271752

State/ UT	During FY 2020-21 upto 31.03.2021	Cumulative small Biogas plants up to 31.03.2021* under NBMMP/NNBOMP
Punjab	1562	187145
Rajasthan	389	72886
Sikkim	0	9044
Tamil Nadu	143	224037
Telangana	62	316727
Tripura	34	3744
Uttar Pradesh	231	441180
Uttarakhand	606	365188
West Bengal	144	1216
Andaman & Nicobar	0	97
Chandigarh	0	169
Dadar & Nagar Haveli	0	681
Daman & Diu	0	0
Delhi	0	578
Lakshadweep	0	0
Puducherry	0	17541
Total	**20574**	**5080616**

*The scheme of NNBOMP is valid only upto 31.03.2021

5.3 IMPLEMENTATION OF NNBOMP

Up to 31.03.2021, the NNBOMP scheme has been implemented through the Agriculture and Rural Development Departments of the States, Dairy Co-operatives, State Nodal Agencies (SNAs), Biogas Development and Training Centres (BDTCs), Khadi and Village Industries Commission (KVIC) and National Dairy Development Board (NDDB).

5.4 SUBSIDY AND OTHER CENTRAL FINANCIAL ASSISTANCE FOR SETTING UP BIOGAS PLANTS UNDER NEW NATIONAL BIOGAS AND ORGANIC MANURE PROGRAMME (NNBOMP)

Under the NNBOMP, upto 31.03.2021 the Central Subsidy has been provided for installing biogas plants of size 1 M^3 to 25 M^3, which varies from Rs. 7500 per plant of 1 M^3 to Rs. 35,000 per plant of size 20-25 M^3.

Fig. 5.1 Poultry dropping based Biogas plant

CHAPTER 6

MNRE PARTICIPATION IN WORLD EXPO 2020 AT DUBAI

6.1 DUBAI EXPO 2021

6.1.1 Theme

The Ministry of New & Renewable Energy (MNRE) in partnership with FICCI, organised a series of events, from October 6th - 8th, 2021 during the Climate and Biodiversity Week at Expo 2020 Dubai. The events covered the themes of India's Renewable Energy Achievements and Ambitions, Emerging Areas and Opportunities for Renewable Energy in India, and also focussed events anchored by the Solar Energy Corporation of India (SECI) and Indian Renewable Energy Development Agency (IREDA). The MNRE events organised were addressed by Shri R.K Singh, Hon'ble Cabinet Minister for Power and New and Renewable Energy, Shri Bhagwanth Khuba, Hon'ble Minister of State for New and Renewable Energy, Secretary MNRE and senior officials of MNRE, SECI and IREDA. The events organised also included various panel discussions where panelist from Government, Industry, Thinktanks, financial institutions and investors participated and discussed the current and future development of renewable energy sector in India.

India has emerged as one of the leaders in global energy transition. With the recent massive achievement of touching 158 Gigawatt (GW) of installed capacity, (including large hydro) the country boasts of being 4th largest renewable energy giant in the world. The nation has also embarked on implementing the world's largest renewable energy expansion plan, that is installed capacity of 175 GW by 2022 and 450 GW by 2030. This is a testimony to India's commitment to propagate clean energy sources since the early days of sustainable development and is backed by a series of targeted and strategic initiatives by the Government of India to promote generation and adoption of RE to fuel the country's growth and development.

The Dubai Expo 2020 was a key platform for the Government of India and MNRE to showcase India's achievements in renewable energy (RE) capacity enhancement and future plans for scaling up capacity in existing RE sectors, as well as, initiating and inviting capacity addition in new and emerging areas like green hydrogen, battery storage, electric mobility, to name a few. The events held by MNRE in this week were a valuable opportunity for investors, industry leaders and the Government to mutually explore the potential of renewable energy in India and build on the strong foundation created for this sector through the Government's commitment to climate change mitigation.

6.1.2 INDIA's ORGANISING PARTNER

The various events organised at Dubai Expo were the following:

I. MNRE-FICCI Conference on India's Renewable Energy Achievements and Ambitions (October 6, 2021)

II. MNRE-FICCI Conference on Renewable Energy in India: Emerging Areas and Opportunities (October 7, 2021)

III. ISA Event on One Sun One World One Grid (OSOWOG), October 7, 2021

IV. SECI Conference on 'Amalgamation of Future Technologies in the Journey towards 450 GW RE by 2030' (October 8, 2021)

V. IREDA Conference in Expo 2020 Dubai (October 8, 2021)

6.1.3 COVERAGE

The details of various Conferences organised at the World Expo Dubai are as follows:

I. MNRE-FICCI Conference on India's Renewable Energy Achievements and Ambitions (October 6th, 2021)

The MNRE-FICCI Conference on India's Renewable Energy Achievements and Ambitions hosted virtually on 6th October 2021 during the Climate and Biodiversity Week at the Dubai Expo 2020 celebrated India's accomplishments in renewable energy capacity and the roadmap to meet the ambitious targets of the milestone years of 2022 and 2030. The event witnessed an enriching opening session with insights from Secretary MNRE, Hon'ble Minister of State for New & Renewable Energy and Chair, FICCI Renewable Energy CEOs Council and CEO Azure Power. This was followed by three panel discussions focused on:

Panel I: Indian Renewable Energy Sector: Current Scenario, Potential and Ambitions

This panel discussed the current scenario of the Indian renewable energy sector in the context of India's achievements in scaling up renewable energy generation capacity, access to renewables in the grid, and off-grid coverage and the policy and programmes implemented by the Government of India to enhance and ease the transition to renewable power generation across the country. The panel also reflected on India's future ambitions on renewable energy capacity increase, and on new and emerging clean energy solutions and technologies for this decade. The organizations in this panel included CEEW, IRENA, Suzlon, PRESPL, Vikram Solar, Abellon Clean Energy Ltd.

Panel II: Renewable Energy: Meeting Dual Goals of Energy Transition and Climate Mitigation

This panel discussed the path to climate mitigation with energy transition away from fossil fuels as a complementary goal that will be achieved within the broader context of mitigation and climate action plans. The features of India's energy transition with respect to its global obligations and climate commitments were also be contextualised against focal national development areas. Additionally, the session explored how energy transition can be designed such that it is beneficial for all stakeholders while striving for greenhouse gas emission reduction. The organisations in this panel included CVC Biorefineries, NTPC, GOGLA, L&T, Avaada.

Panel III: The Business Case for Renewable Energy: Success Stories, Experience Sharing and Opportunities

This panel focused on making the business case for renewable energy and the relative benefits of key stakeholders in the power, utilities and energy sector. Panelists discussed the main market drivers including demand-supply signals, change in energy consumption patterns, and external factors that make the transition towards clean, renewable energy necessary in this decade. The Ministry/organisations in the Panel Discussion included Government of Madhya Pradesh, Azure, Acme, Renew Power, Everstone Capital, Sterlite Power.

SPEAKERS, PANELISTS & DELEGATES

Industry Theme Address by Mr. Ranjit Gupta, Chair, FICCI renewable Energy CEOs Council and CEO, Azure Power in the MNRE-FICCI Conference on October 6th, 2021

II MNRE-FICCI Conference on Renewable Energy in India: Emerging Areas and Opportunities (October 7th , 2021)

The MNRE-FICCI Conference on Renewable Energy in India: Emerging Areas & Opportunities organised on 7th October 2021 during the Climate and Biodiversity Week at the Dubai Expo 2021 hosted rich dialogue on the ambitions and future vision of India in new and emerging areas of renewables and clean energy. The event began with valuable insights delivered by Hon'ble Minister of State for New and Renewable Energy, Hon'ble Minister of State for Energy, Government of Maharashtra, Secretary MNRE and Co- Chair of FICCI Renewable Energy CEOs Council & CEO Ayana Power followed by two panel discussions:

Panel Discussion I - India's RE Ambitions: Opportunities for Global RE Developers & Investors

This session deliberated on high-potential opportunities for business entry and exploration in India's renewable power generation sector given policy changes and incentives that promote business profitability and high returns on investment. The session also touched upon areas of new growth that will propel nation-wide RE expansion like grid integration with renewables, grid flexibility, battery storage, smart grid development. The Ministry/organisations in the Panel Discussion included MNRE, SECI, PGCIL, Sembcorp Energy, Amp Energy, Hero Future Energies, OMERS Infrastructure and Alfanar.

Panel Discussion II- India a Manufacturing hub for Renewable Energy

This session explored the transition of India into a manufacturing hub for renewables and the trajectory of this manufacturing boom over the last seven years. We also heard experiences on the current scenario of RE manufacturing in India, their successes and future ambitions for renewable power generation, technology R&D and applications of clean energy in this decade. The Ministry/organisations in the Panel Discussion included MNRE, First Solar, Borosil Renewables, Vestas, Senvion India, Premier Energies and Waaree Energies.

III ISA Event on One Sun One World One Grid (OSOWOG), October 7, 2021

The event was organised by International Solar Alliance (ISA) on OSOWOG - One Sun One World One Grid on a virtual medium. The event was moderated by Mr. Jagjeet Sareen, ADG, International Solar Alliance. The discussion focused on the goals needed to be set for the OSOWOG initiative and potential future challenges.

Shri Indu Shekhar Chaturvedi, Secretary, Ministry of New and Renewable Energy, Government of India delivered the Introductory Speech on ISA and OSOWOG. This was followed by the Keynote Presentation by Mr. Waleed Saleh Alsuraih, Lead Energy Specialist - MENA region, The World Bank Group.

The panel discussion comprised of the following organisations: World Bank Group, ACWA Power, IRENA, GCCIA, Sterlite Power and EDF.

The session involved discussions on how finances can be a challenge for projects like OSOWOG and also how this can be overcome with private sector participation. Advantages of OSOWOG like enhancement of grid stability, reducing the need for batteries, removing redundant RE capacity and ensuring its optimization, as well as, international economic collaboration, were also discussed during the session.

It was also highlighted that with the vast development of interconnectors, technology will not act as an obstacle for OSOWOG. Further, it was pointed out that at the operational level there is a need for getting the regulators engaged or synchronisation of regulations since the process of establishing regulations allowing the trade of energy within the participating countries can be time consuming. Doing so, will save time and will allow the interconnectors to function seamlessly.

IV SECI Conference in EXPO 2020 in Collaboration with MNRE on Amalgamation of Future Technologies in the Journey to wards 450 GW RE by 2030 (October 8, 2021)

This event on the third day of the Ministry of New and Renewable Energy (MNRE) and FICCI's participation during the Climate and Biodiversity Week at Expo 2020 Dubai was led by the Solar Energy Corporation of India (SECI), in partnership with MNRE.

The session showcased the capacities, credentials, and market outreach of SECI, the only Central PSU dedicated to the renewable energy sector, and its ambitious future plans in the expansion of RE in India. The session also highlighted the role of new technologies like battery energy storage and hydrogen in the road to achieving the RE goals for India. SECI primarily is a power procurement intermediary offering payment security to investors and has instituted a transparent bidding process for the selection of RE projects.

The event began with opening remarks and context setting by Ms. Suman Sharma, Managing Director of SECI. It was followed by Address from Shri Indu Shekhar Chaturvedi, Secretary, MNRE and then Keynote Address by Shri R.K. Singh, Hon'ble Cabinet Minister for Power, New and Renewable Energy, Government of India.

The Conference also had presentations on SECI Financial Strengths and Future Prospects and on Innovative Roadmap to realize 450 GW RE by 2030 - Impetus on firming of RE Power through Energy Storage and Green Hydrogen by SECI Officials.

V IREDA Conference in Expo 2020 Dubai in Collaboration with MNRE (October 8, 2021)

This event on the third day of MNRE and FICCI's participation during the Climate and Biodiversity Week at Expo 2020 Dubai was led by the Indian Renewable Energy Development Agency (IREDA). The session showcased IREDA's role in reaching India's RE targets by provision of financing support to the RE sector. The session had presentations from IREDA on its Business Plan and its financing products. The Opening session was chaired by Shri Indu Shekhar Chaturvedi, Secretary, MNRE followed by a panel discussion.

Panel Discussion on Evolving Scenario in RE Financing in India– IREDA Conference

This session explored the current and future scenario for funding of renewable energy projects in India and investment facilitation. The session highlighted that over the next decade, the RE investment needs for various sectors in India; over USD 200 billion for renewables investment, USD 200 billion for investments in electric mobility, and between USD 100-200 billion for investments in green hydrogen and grid upgrading that cumulatively forms an investment opportunity equalling a quarter of India's total GDP.

The Government/Organisations in the Panel Discussion included IREDA, MNRE, Govt. of Madhya Pradesh, Suzlon SolarArise, Amplus Solar, PRESPL, Nagarjuna Hydro, Global Infrastructure and CEEW.

CHAPTER 7

RENEWABLE ENERGY RESEARCH AND TECHNOLOGY DEVELOPMENT PROGRAMME

7.1 INTRODUCTION

Research, design, development and technology demonstration for its validation are one of the core requirements for the growth of New & Renewable Energy. Ministry of New & Renewable Energy (MNRE) supports research, design, technology development and demonstration for renewable energy to develop new and renewable energy technologies, processes, materials, components, sub-systems, products & services, standards and resource assessment so as to indigenously manufacture new and renewable energy systems and devices. The objective of the programme is to make the industry globally competitive and renewable energy generation supply, self-sustainable/profitable and thereby contribute to increase share in total energy mix in the country.

R&D Projects received from R&D institutions /universities, industries and NGO's etc. in the field of solar, wind, solar-wind hybrid, storage, small hydro power, biogas, hydrogen and fuel cells, geothermal, etc. are considered by the Ministry for financial support.

7.2 POLICY AND GUIDELINES

A comprehensive policy framework on Renewable Energy Research and Technology Development Programme is in place to support R&D in new and renewable energy sector, including associating and supporting R&D earned out by industry for market development.

Ministry provides up to 100% financial support to Government/non-profit research organizations/ NGOs and upto 50 to 70% to industry. Budget allotted for Renewable Energy Research and Technology Development (RE-RTD) Programme is Rs. 228 crores for FY 2021-22 to 2025-26.

The policy framework provides guidelines for project identification, formulation, monitoring, appraisal, approval, and financial support. The R&D projects received from R&D/academic institutions, industries, etc. are evaluated through subject experts. The qualifying projects are appraised by R&D Project Appraisal Committees. The projects recommended by the committees are sanctioned to prospective implementing agencies. The projects are monitored by Monitoring Committees. Projects on completion are reviewed in Project Appraisal Committee Meetings for their achievements.

7.3 RD&D FOCUS

The RD&D efforts are continued with emphasis on cost reduction, reliability and efficiency improvement of renewable energy systems, components, and BOS. The project in accordance with the R&D thrust area of the ministry in solar thermal, SPV, biogas, wind, wind-hybrid, storage, small Hydro Power, hydrogen, and fuel cells, geothermal, etc. are supported for RD&D activity. The projects in other areas not covered under the R&D thrust areas are also considered for financial support based on their applications and practical importance.

Support is provided for development, demonstration, testing, standardization, and validation of technologies/ systems/ components with emphasis on application oriented R&D, improving efficiency, reliability and cost effective for indigenous development and manufacture. Participation of industry is encouraged. In solar thermal, the thrust areas include the development of solar thermal technology for power generation and industrial process/heat, storage systems, hybridization, etc.

In Solar Photovoltaic (SPV), thrust is on improving Si PV efficiency, reducing the cost, developing solar cells by using new material, production of Si material from sand, improving modules quality and reliability, development of standard designs for support structure for SPV systems, materials and fabrication technology for solar cells and modules, inverters, power conditioning units, grid integration, etc. In addition, focus would be on storage solutions. The thrust areas in biogas include development of efficient and cost effective designs of biogas plants, standardization of multiple designs of biogas plants, standardization of biogas slurry based bio-fertilizer, bio-manure up-gradation, development of biogas purification systems, development of efficient biogas engine for power generation. In wind, the thrust areas include wind turbine system design, integration, off-shore technology and wind solar hybrid systems. In Small monitoring systems, pumped storage systems, etc. R&D in hydrogen and fuel cells will focus on hydrogen production from various feedstocks, technology for storage and Hydropower (SHP), thrust areas include development of ultra-low head turbines (below 3m), generators, development of efficient and cost effective fuel cells for stationary, transport applications etc.

7.4 INSTITUTIONAL MECHANISM

The Ministry is supporting creation of enabling conditions for institutional mechanism for collaboration for faster development and demonstration of technology for commercialization. The Ministry has taken initiatives strengthening its institutions, namely, National Institute of Solar Energy (NISE), Gurugram, Sardar Swarn Singh National Institute of Bio-Energy (SSS-NIBE), Kapurthala and National Institute of Wind Energy (NIWE), Chennai with their functions for pursuing RD&D, testing, standardization and certification in solar, bioenergy and wind energy systems, respectively. These initiatives envisage supporting projects in consortia including industry for technology development on cost sharing basis by partner ministries/departments/industries.

7.5 SOLAR R&D

7.5.1 Solar Photovoltaics

The details of activities being carried under Solar R&D (SPV) are given below:

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

Education and Training: To extend the knowledge and expertise at NCPRE various courses, workshops and training sessions were organized for industry personals, faculty and students from other organizations and institutions.

NCPRE organized virtual workshop, "PV R&D Vision 2026: Role of Government, Industry and NCPRE" at the behest of MNRE on April 26, 2021. The goal of this workshop was to come up with tangible ideas and identify areas where MNRE, NCPRE and Industry can work together to support the 'Aatmanirbhar Bharat' (Self-Reliant India) in the next decade.

Fig. 7.1: Glimpses of Virtual Workshop PV R&D Vision 2026: Role of Government, Industry and NCPRE

NCPRE along with NTPC organized an online workshop "Diagnostic Techniques for Solar PV Plants" during 10-11 August, 2021. The total no. of participants were 135 in this workshop. Another online workshop was conducted on 05 November, 2021. This workshop was organized jointly by NCPRE and SINTEF as part of an Indo-Norwegian project titled **Czochralski Growth of Low-oxygen Silicon Single Crystals for High-efficiency Solar Cell Applications.** The workshop focused on the silicon crystal growth. NCPRE also participated in CII Conference & Exhibition **Aatmanirbhar Bharat - Self-Reliance for Renewable Energy Manufacturing** organized during 15 – 16 July, 2021.

The facilities developed at NCPRE are unique and of its kind, to extend these to the reach of researchers working on PV across India, a pilot project called Photovoltaic Users Mentorship Program (PUMP) is being implemented at NCPRE. Theme based proposals from researchers at various academic institutions and R&D labs were invited with the objective that the people working in the area of PV in other institutions can get benefited from the expertise of investigators and the facilities built at NCPRE through funding from MNRE. They can come up with their innovative ideas and can use the facilities as well as receive guidance and mentorship from NCPRE investigators. Under the PUMP initiative, 60 proposals were received, 57 proposals have been selected, out of which 32 are completed, 19 are under revision, 5 is ongoing and 1 is approved. These proposals were reviewed by NCPRE team members and based on the quality and relevance of these proposals, required mentorship has been provided.

Crystalline Si Solar Cells: Standard Al:BSF Solar cells with champion cell efficiency of 19.4 % were made on 6 in x 6 in, pseudo-square, mono Si wafers. 18 % efficient, 6 in x 6 in mc-Si solar cells employing the texturization process developed at NCPRE (Indian patent applied) for diamond wire sawn (DWS) wafers are made. PERC cells with efficiency of 18% demonstrated on 6 in x 6 in, pseudo-square, mono Si wafers using a made in India Laser ablation system for removal of the passivation dielectric. NCPRE is collaborating with the manufacturer for further improvements in laser system to enable higher efficiency cell fabrication. Indian patent number 374367 granted, titled "Method of fabricating inverted pyramid on crystalline silicon using lithography free fabrication technique". Two more Indian patents related to silicon solar cell technology, one related to integration of copper metallization and another related to inexpensive deposition of passivation layers, are under examination.

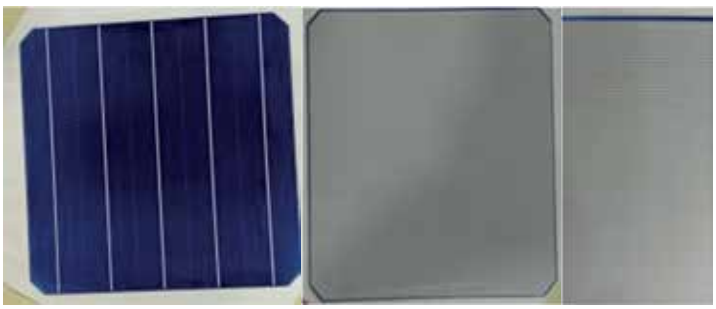

Fig. 7.2: Photographs of the front and backsides of the PERC cells fabricated at NCPRE

Thin Film Materials and Devices: Single junction perovskite solar cells having power conversion efficiency (PCE) of 20.64 %@area 0.2 cm2; 17%@area 0.42 cm2 and 12.2%@1 cm2 was fabricated. Semi-transparent single junction perovskite solar cells with PCE of 10.3%@area 0.2 cm2 with an aim to further improve it is process. Transparent cell will be used for 4-terminal Perovskite/Si tandem junction solar cell.

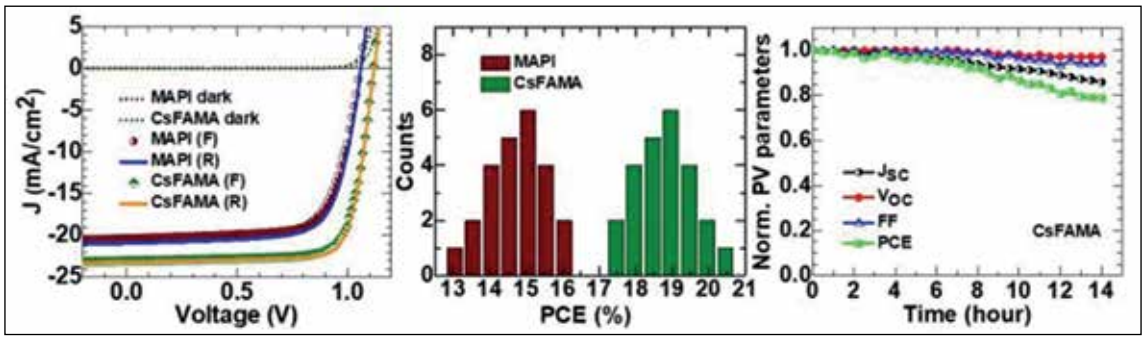

Fig. 7.3: Characteristics of Single-junction Perovskite Solar Cells fabricated at NCPRE using classical CH3NH3PbI3 (MAPI) and thermally stable (FA0.83MA0.17)0.95Cs0.05Pb(I0.9Br0.1)3 as an absorber. Stability studies are carried out under constant 1 sun illumination conditions in ambient without any encapsulation to devices.

Energy Storage: To tackle the ever-growing demand of energy consumption, the Energy Storage group of NCPRE is working on the indigenous development and manufacturing of the Li-ion (LiB) and Na-ion battery (SiB) as storage system for portable as well as stationary storage applications. A framework for thermal management and control strategy to minimise thermal degradation in Li-ion batteries in a stand-alone PV-Battery Energy Storage (BES) hybrid system is being developed. Apart from these, a part of the group has been focussing on developing redox flow batteries for large scale deployment.

The group has been successful in developing 10-14 Ah Li-ion pouch cells along with 2.8 Ah Li-ion cylindrical cells. The chemistry utilized is lithium NMC/Graphite i.e., Li-NMC as cathode and graphite as anode, keeping in mind the market to be addressed. Depending on the power requirement of the device, the fabricated Li-ion cells with designated capacity were connected to demonstrate the operation of a television and a table with a LED as shown in the picture below. Further, work on NMC/Si-C, NMC/LTO, LR-LMO/Graphite and all solid-state batteries are under the development stage as the second generation high energy density and fast charging batteries. Lithium-Sulfur battery has also been demonstrated as a pouch cell.

Fig. 7.4: (a) Prototype of 14 and 7 Ah NMC/graphite Li-ion pouch cells, Li-S pouch cell and 2.5-2.8 Ah NMC/graphite Li-ion cylindrical cells (b) Demonstration of the application of Li-ion pouch cells to operate and television, LED and table fan and it's future application in isolated homes, (c) World class cell fabrication facility established at IIT Bombay, and (d) formed a start-up "Virya Batteries" with safe lithium ion battery and its demonstration.

The sodium-ion battery research is blooming as an indigenous solution to stationary storage applications. The dedicated group has successfully developed a 3.2 – 3.4 V, 2-layer pouch cell with NVP/Hard carbon chemistry, right from the materials to device. The team has also been able to demonstrate a high specific Na-ion full cell with doped ammonium vanadium oxide (NVO) cathode against hydrogenated sodium titanium oxide (NTO), with a capacity retention of 94% over 400 cycles. Air/moisture stable layered oxide cathode having a lifetime of more than 1000 cycles and hard carbon/NTO is a chemistry that is in the developmental stage.

These LiBs and SiBs are developed in the prototyping lab funded by MNRE with a production capacity of ~4 kWh per day in the format of 10-14 Ah pouch cell and a capacity of ~1 kWh per day in the format of 2.5-2.8 Ah 18650 cylindrical cells.

Power Electronics: A hybrid 2.5 kVA and standalone 300 VA solar PV inverters design has been finalized and 5 prototypes developed is in the laboratory testing stage. The first prototype for 3 HP BLDC motor with surface pump with sensor less control algorithm, field testing is completed. GaN is the emerging technology because of its operation in MHz range which helps in developing the high power density converters therefore we have developed a first porotype of GaN based motor driver for 3 HP BLDC motor operating at 1 MHz frequency. A comprehensive test bench comprising of solar emulator, battery emulator, and an electronic load is developed to test solar inverters up to a rating of 25 kVA.

(a) Field testing of the developed BLDC pump (b) GaN based motor driver

Fig. 7.5: Experimental Verification of the 3 hp BLDC Motor and Controller for Surface Pump Application.

Fig. 7.6: A Comprehensive Test Bench comprising of Solar Emulator, Battery emulator, and an electronic load is developed to test solar inverters

Module Reliability: A mini-field survey is being planned to be conducted by the end of 2021 at a multi-MW power plant in collaboration with a leading drone based IR company to develop guidelines and best practices for the industry. **(Fig. 7.7)** Applications of Data Analytics, Machine Learning in PV are being explored. For example, a deep learning-based software program was developed to automatically distinguish defective and non-defective cells from their EL images. Also, a Python based program was developed to predict the Performance Loss Rates of systems based on their SCADA data

with tighter tolerance than the offered by usual tools used in the PV industry for this purpose such as RdTools. Benchmarking of accuracy of various PV module performance simulation models was done and the most accurate model was identified - which could reduce the uncertainty in the predicted and actual performance of PV modules in the plants. Uncertainty in the STC correction of various algorithms was studied to identify the best procedure for this purpose. A study on hydrophobic properties of the 4 commercial anti-soiling coating involved 89 days of field exposure in Mumbai which included 3 weeks of heavy rainfall. It was shown that abrasion due to frequent cleaning and acid rain are significant factors to influence the decrease of contact angle seen in the field. Cleaning cycle simulator has been developed which can deposit the dust uniformly on glass coupons and perform repeated cleaning with different types of brushes. This setup is being used to study the abrasive impact of various brushes on glass samples. **(Fig. 7.8)**

A laboratory facility for temperature dependent resistivity of module materials such as back-sheets and encapsulants has been developed. The data from these experiments and an in-house developed FEA model could help in accurate prediction of leakage currents in PV modules under high voltage bias in the field. Prototyping of an equipment to find the adhesion strength between two layers of the PV module (EVA/Glass, EVA/Cell, EVA/Back-sheet) using the more accurate Width Tapered Cantilever Beam method is completed. Further the impact of various packaging methods for PV modules on cracks generated during transportation has been studied. Considerable progress was made in the design of indigenous I-V tracer and reference cell system which can automatically perform I-V tracing of PV modules and transmit the data wirelessly. **(Fig. 7.9)**

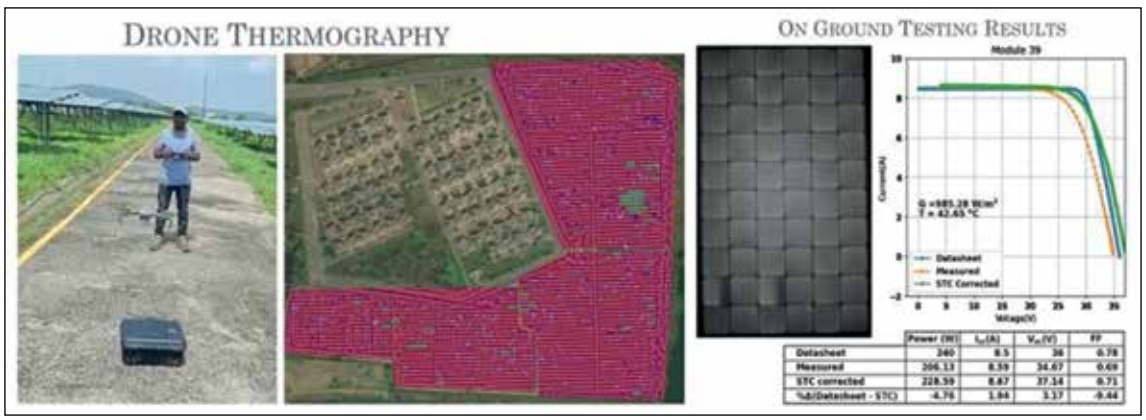

Fig. 7.7: Drone based IR Imaging and subsequent on-ground testing & analysis

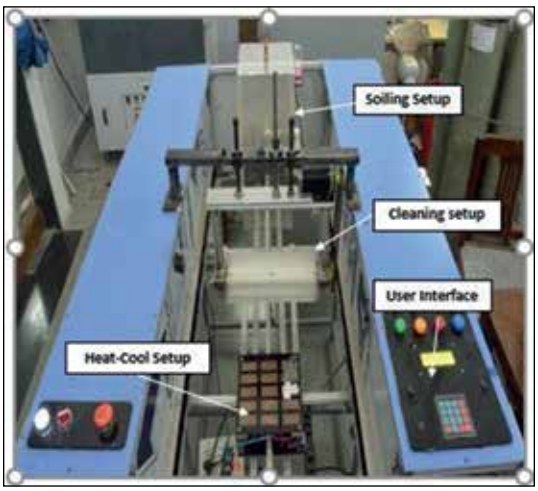

Fig. 7.8: Cleaning Cycle Simulator

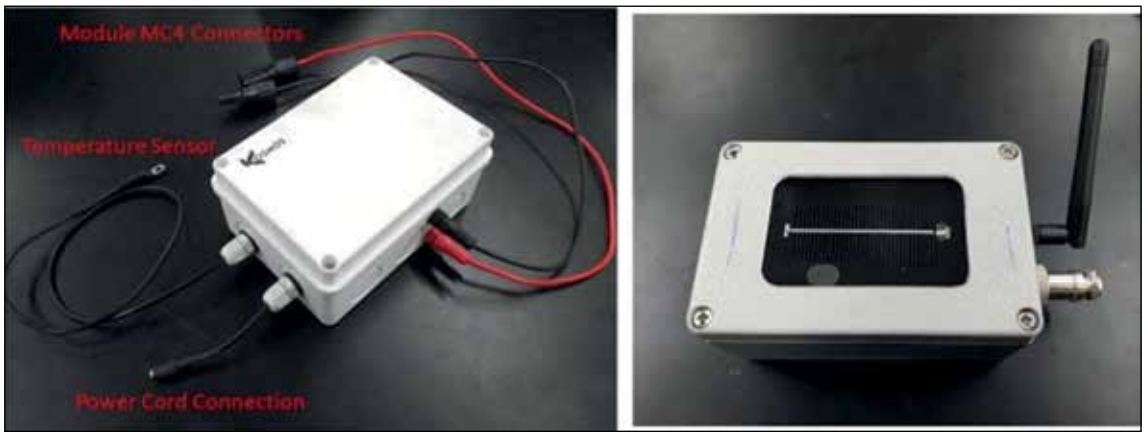

Fig. 7.9: Indigenous I-V Tracer and Reference Cell System

B. As a part of the ongoing activity, the research group of Prof. Shaibal K. Sarkar from the Department of Energy Science and Engineering at IIT Bombay, demonstrates significant development in perovskite solar cells eyeing to the scalability and futuristic high throughput production.

The group have initiated and optimized a rapid process to deposit metal oxide layer within a few seconds, which usually takes hours. The devices made with the newly developed process are at per the conventional process. Below the current density versus the voltage characteristics of one of the representative device that show an efficiency of 20.2%.

In addition the group also developed a post device making process through which the efficiency can be improved by ~2-2.5%. The process is a simple and scalable technique and claimed to be compatible with the production line. Below the current density versus voltage characteristics depict the improvement of a device with efficiency 18.2% and after the process the efficiency of the same device raised to 20.6%.

They also started working on the series connected mini-modules with the hybrid perovskite materials. The figure aside shows the physical picture of one of such devices.

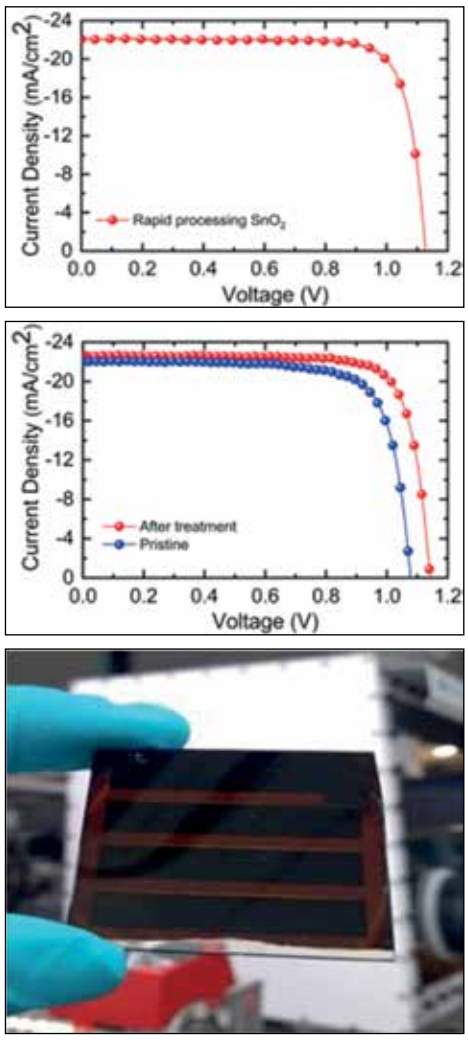

Fig. 7.10

C. NISE has completed several R&D projects which are given below.

Project-1: Setting Up of a Centre of Excellence on Hydrogen Energy at National Institute of Solar Energy (NISE), Gwal Pahari, Haryana

National Institute of Solar Energy has a Hydrogen production, storage and dispensing facility in its campus which was established in 2014 under an R&D project supported by MNRE. This facility consists of a 5 Nm3/hr capacity alkaline electrolyser for Hydrogen production, a two-stage reciprocating compressor for raising the pressure up to 450 bar, a high-pressure storage system with a capacity of storing about 60 kg of hydrogen and a H35 hydrogen dispenser that can dispense hydrogen at about 350 bar. The facility is powered by a 120 kWp dedicated SPV power plant.

NISE is currently implementing another R&D project entitled "Setting Up of a Centre of Excellence on Hydrogen Energy at National Institute of Solar Energy (NISE), GwalPahari, Haryana" with the financial support of MNRE. The project was sanctioned in February, 2019 with a total budget of Rs. 10.30 crore for a duration of 3 years. Following are the key updates:

i. Augmentation of hydrogen production capacity by setting up additional 10 Nm3/hr capacity hydrogen production facility is in process. NISE has procured electrolyser system from M/s Eastern Electrolysers Ltd., Noida. Installation and commissioning of this new 10 Nm3/hr electrolyser system is in final stage. The electrolyser would be integrated with the existing hydrogen facility.

ii. Also, the existing electrolyser module of 5 Nm3/hr capacity that developed technical problems has been repaired and will be re-installed with the help of the engineers from OEM and Air Products and Chemicals, USA. The facility would be utilised for providing hydrogen to the existing two numbers of dual fuel vehicles and some other hydrogen fuelled vehicles after it becomes fully operational.

iii. As per the requirements of the project, NISE is also involved organising specific workshops/ webinars/ online training programs in the area of Hydrogen Energy. NISE has organised one webinar and one online training program on Hydrogen Energy and published two scientific research papers in peer reviewed international journals. In addition, NISE has also carried out some specific studies related to Hydrogen Energy and has submitted their reports to MNRE.

Project-2: Development of high efficiency (21%/ 19%) PERC type of c-Si/mc-Si solar cells

This project is jointly executed by BHEL ASSCP & NISE. In this project, NISE is responsible for testing & characterization of materials and devices to support BHEL for high efficiency PERC cell development. As a part of the project, NISE contributed its capital fund to establish a laboratory space of 140 sq. m, ISO Class 8 clean room i.e., **Advanced solar cell characterization laboratory** in the Aditya Bhawan for housing the test and characterization equipment under a single roof.

NISE has procured and commissioned all the test & characterization equipment proposed in this project including i) Spectral Response Measurement System (QE-SRMS), ii) Spectroscopic Ellipsometer, iii) Optical Microscope, iv) Semi-Automatic Four Probe resistivity meter, v) Electrochemical Capacitance Voltage (ECV) Profiler, vi) Surface Profilometer and vii) Field Emission Scanning Electron Microscopy (FESEM) with EDS facility. These facilities are being used for testing of the samples processed by BHEL time-to-time to optimise the process parameters and to make benchmark efficiency solar cells.

Project-3: Design and Development of High-Efficiency Solar Water Pumping Systems

The key updates of the project are as follows:

i. **Establishment of state-of-the-art testing and R&D facility for solar water pumps:** The state-of-the-art testing and R&D facility has been developed at the National Institute of Solar Energy (NISE). The test facility developed at NISE is unique of its kind

and can test solar water pumps up to 50 HP capacity. Solar array simulators have been installed for hot and cold profile testing and manual module mounting structures as well as automatic tracking structures have been installed for regular testing activities as well as for various R&D activities.

ii. **Enhancing efficiency & water output of solar water pump controllers:** Solar Water Pump Controller Efficiency is affected by change in temperature, radiation, and head. Tests are being performed in NISE's SWP lab to find out the parameters that affect the controller efficiency. Work is under process to enhance the part-load efficiency which occurs at intermediate/ partial radiation and head/load. In addition, NISE is studying the impact of different module technologies on the water output, e.g., tested the solar water pump with bifacial modules to enhance the daily water discharge.

iii. **Testing accuracy of remote monitoring system for solar water pumping applications:** Tests for deducing the accuracy of remote monitoring systems have been performed. NISE found that even though voltage, current, and power were measured accurately, an error was reported in measuring the flow rate. In other words, there is a huge difference between the reported flow rate (via the RMS system) and the measured flow rate.

iv. **Designing and testing micro-irrigation system:** NISE's SWP lab is designing a micro-irrigation system that will be light and portable. A micro-irrigation system that works on a similar principle is developed and demonstrated in the laboratory.

D. The MNRE has also sponsored a project on solar photovoltaics for development of high efficiency PERC solar cells. The PERC cell project is being implemented jointly by BHEL-ASSCP and NISE. In this project, BHEL has the responsibility of cell processing while NISE has the responsibility of device simulation as well as complete characterization of solar cells. BHEL has installed all the equipment pertaining to PERC cell fabrication viz. Diffusion furnace, PECVD tool for dielectric deposition and Laser system for dielectric ablation. NISE has installed all their testing and characterisation equipment including FE-SEM, optical microscope, spectroscopic ellipsometer, ECV, resistivity measurement tool and surface profilometer.

Fig. 7.11: Diffusion furnace installed at BHEL ASSCP
(capable of processing POCl3& BBr3 diffusion along with dry and wet oxidation)

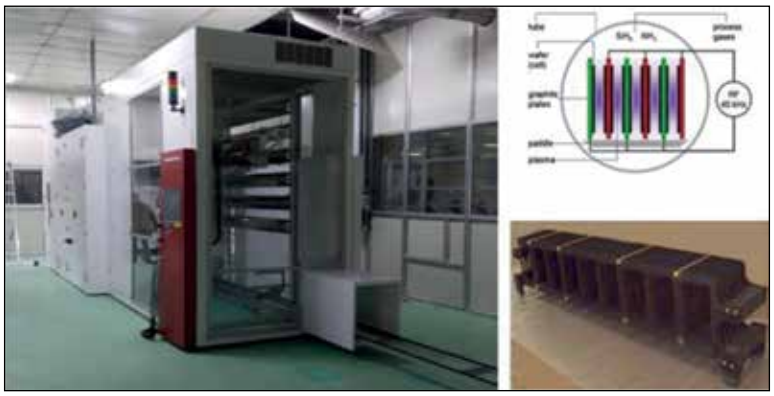

Fig. 7.12: PECVD installed at BHEL ASSCP (capable of processing depositing dielectric stack at rear side (AlOx with capping layer of SiONx/SiNx) and front side ARC

Fig. 7.1 3: Laser system installed at BHEL ASSCP (capable of laser ablation by utilizing various regimes (Nano, Pico & Femto seconds) using IR, Green and UV lasers)

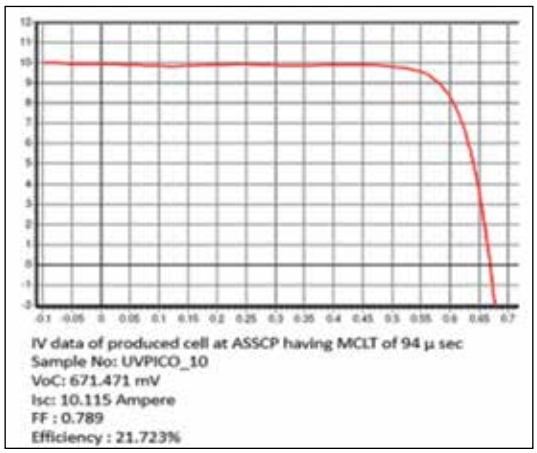

Fig. 7.14: I-V data of PERC solar cell produced at BHEL ASSCP using control wafer showing highest efficiency achieved 21.72 %.

The experimental trials for PERC development have been carried out extensively and the individual process steps have been optimised. Initial results have given an average efficiency of ~21% on control wafers and work is in progress to develop indigenous PERC cell with benchmark efficiency. (22%) as set by the expert committee.

E. The MNRE has sanctioned new R&D projects entitled "Design and Development of high performance supercapatteries for solar applications (Solar Lantern, Solar Home Light)" implemented by Dr. S. P. Gairola, Uttaranchal University Dehradun and Dr. Yogesh Kumar Sharma, Indian Institute of Technology, (IIT-Roorkee).

F. Ministry of New and Renewable Energy, Govt. of India sanctioned a project entitled "National Primary Standard Facility for Solar Cell Calibration" to CSIR-NPL. The objective of the project is to establish "Laser based - Differential Spectral Responsivity Primary Reference (LDSR) Solar Cell Measurement System" at CSIR-NPL. The facility for solar cell calibration is being developed under scientific co-operation with Physikalisch-Technische Bundesanstalt (PTB), Germany.

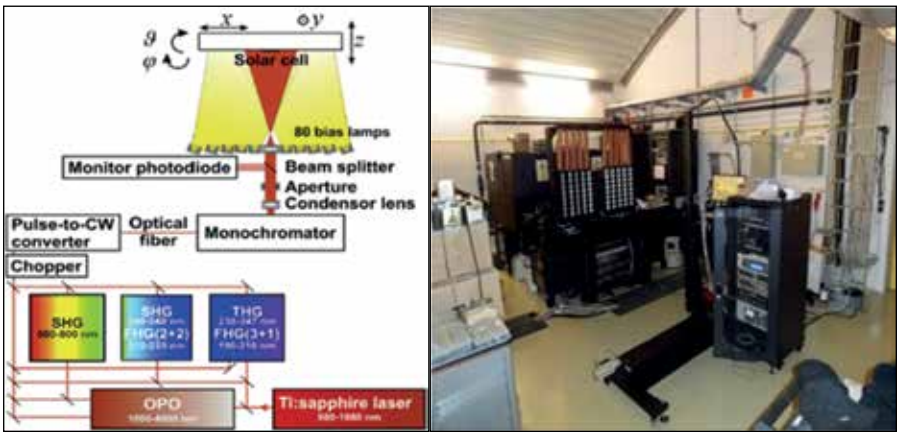

Fig. 7.15: (a) Schematic of the LDSR system, (b) Representative image of Primary Standard Facility under development

The primary reference solar cell calibration facility is being set-up with realization of decreased uncertainty (0.35% or better at k = 2) for the calibration of solar cells that meets the need of R&D institutes and PV industry. Once operational, this facility will be used by other "test & calibration" labs in the country for the primary calibration of "Reference Solar Cells", which is the starting point in the PV calibration chain.

CSIR-NPL is also working on preparation of required infrastructure for LDSR facility installation. Accordingly, a required area of ~100 m2 of (Class 10000) has been earmarked (PV Metrology Room), and working for required changes to meet the requirements of STC, IEC60904 standards so as to enable the facility installation. These activities are inline and progressing.

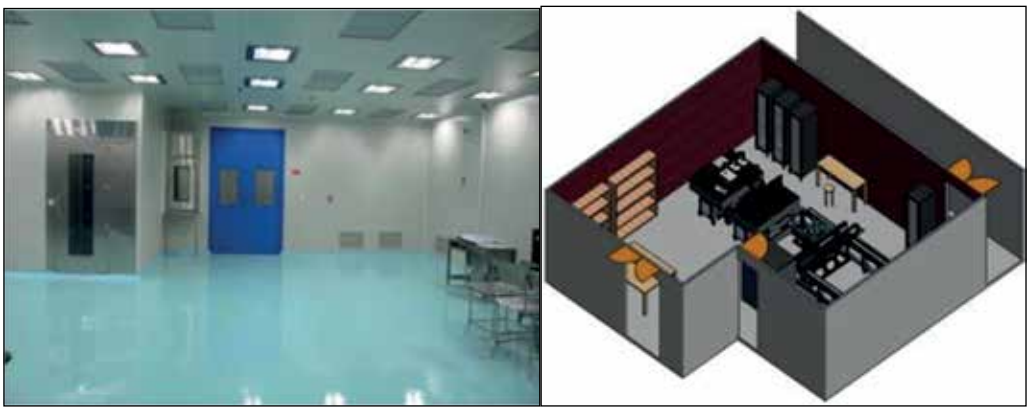

Fig. 7.16: (a) Clean-room (Class 10000, 10m x 10m area) under preparation at CSIR-NPL for installation of the LDSR facility, (b) Schematic of the arrangement of the LDSR system and its components in the space being prepared at CSIR-NPL.

7.6 SOLAR THERMAL

7.6.1 The details of activities being carried under Solar Thermal (ST) are given below:-

A. 1 MWe (3.5 MWth) solar thermal power plant with 16 hours thermal storage for continuous operation based on parabolic dish solar concentrators designed and fabricated indigenously, at an estimated solar to electricity efficiency of about 16-18 %. The configuration of the power plant will include 770 solar dishes having a provision of thermal storage and each having 60 m2 area. The project was successfully commissioned and working satisfactory on 24 x7 basis. It is unique world class thermal power plant based on cast iron cavity heat storage.

Fig. 7.17

B. Indian Institute of Science (IISc), Bangalore, has developed its prototype of pressurized air solar receiver, as part of the project titled "Development of High Efficiency Receiver for Supercritical CO_2 Integrated with Static Focus Parabolic Dish". The hybrid volumetric and cavity type receiver design consists of open-end dome-end cylindrical cavity surrounded by concentric annular porous medium, as shown in the figure below. Receiver design provides flexibility of testing different materials – steel mesh, ceramic honeycomb and foams. The receiver has been tested with a Scheffler dish concentrator having a fixed focus.The solar simulator facility under this project is being designed, built and characterized by IISc Bangalore in collaboration with 3EN CleanTech Pvt. Ltd., Dharwad, Karnataka.

Fig. 7.18 Installation of cast Iron receiver with piping and Insulation

C. The Ministry has sanctioned a R&D Project entitled "Development of a monitoring system for the energy reception elements in Solar Thermal Plants" to TERI New Delhi in collaboration with M/s Eptisa, Spain. The project is to develop a reliable, low-cost tool that gives a precise and direct evaluation of the optical efficiency of each solar collector element including identification of the cause of the error. This project has achieved its objectives of development of technique and system. The research collaborators have developed LiDAR (Light Detection and Ranging) technology with specially developed software for measuring the misalignment of absorber tube of PTC (**Fig. 7.19**). The project collaborators have demonstrated the system and are now exploring possible commercialisation opportunities.

Fig. 19 (LiDAR)

D. Ram Krishna Dharmarth Foundation (RKDF) University at Bhopal, in Collaboration with Rensselaer Polytechnic Institute (RPI) of USA, are jointly executing a project on 'System Design, Erection, Testing & Commissioning of 40 kWth and 10 kWe pilot plant with 24x7 Thermal storage'. This Project is aiming at the feasibility Study of MWe Scale Concentrated Solar Thermal Plant integrated with 24 x 7 Thermal Energy Storage. The Thermal storage device has been developed at ENLYS Energy, Hampton, USA jointly designed by RKDF & RPI University through a series of experiments on Halide salt through a test bed designed to produce solar heat at over 1400 oC and having energy density in excess of 300 kWh / m3.

The Halide Salt imported from RPI, USA, under collaborative agreement with RKDF University was tested and found very innovative in terms of high energy density and heat retention time of several hours. In order to produce this salt indigenously RKDF has collaborated with IISER, Bhopal and used this salt in the Thermal Energy Storage (TES) device to produce steam in off Sunshine hours. A view of the steam turbine running on the indigenous TES together with testing of both types of salts is as under:

Fig. 7.20

7.6.2 Solar Radiation Resource Assessment (SRRA) Stations

In order to strengthen the solar resource assessment and to meet the requirement of availability of Solar Radiation data, In Phase- I program, 51 SRRA stations and in Phase- II, 60 SRRA stations and 4 Advanced Measurement Stations are installed at selected locations spread all over the country. This exercise has been coordinated by National Institute of Wind Energy (NIWE), Chennai an autonomous institution of the Ministry. A central server facility for data collection from all these stations has been set up at NIWE. The data so collected will be useful in developing a solar atlas for the country. In addition, all the solar power projects selected under the Mission have also set up radiation monitoring equipment at their project sites. NIWE has launched a Solar Atlas of India for firming of solar potential of the Country.

7.7 BIOGAS RESEARCH, DESIGN AND DEVELOPMENT

RD&D project on Biogas sector continued during the year. The work on the following projects was continued during the year:

(a) Development & Performance evaluation of a 3 KW biogas based power generation system utilizing Lignocellular Biomass, at IIT-Guwahati.

Under this project, the 4 objectives of the project have been completed with the optimization of operating parameters of a 5 hp gasoline engine along with the performance study by a performance study by a 16 m3 of biogas produced per day from lignocellulosic feed stock materials mainly cow dung, rice straw, duck weed and switch grass and to produce 3 kWe biogas power generation has been successfully installed and maintained by IIT Guwahati at Auaniati Satara, North Guwahati, Assam under this project. All the objectives, of the assigned project have been achieved including performance studies with the modified engine and comparative results with 100 % Gas engine. The project completion report has been received and comments of experts on the same have been received for finalization and acceptance.

(b) Development of Hybrid-High rate bio-methanation reactor using locally available media for treating waste water and solid waste at Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu).

Under this project, three lab scale hybrid reactors with acrylic sheet one of which served as control and the other two reactors with different packed media were fabricated. The stability of the reactors attained with affluent pH of 7 to 7.5 and the biogas production observed 250-300 ml in each reactor. The performance evaluation of high rate reactor and hybrid high rate reactor with community wastewater was completed and HRT was optimized. The efficient waste water treatment system through high rate and hybrid high rate bio-methanation reactor was developed, which is economic over adopting aerobic waste water treatment systems, which generates biogas and is being utilized for power generation and thermal energy applications. The R&D project incorporated the scrubber design and for upgrading the biogas produced from waste water of TNAU hostel premises. The project has been completed by TNAU and the Project Completion Report has been received and comments of experts on the same have been received for finalization and acceptance.

(c) Development of suitable pre-treatment system for paddy straw disintegration for biogas generation leading towards commercialization of technology.

A research project was awarded by MNRE entitled Development of suitable pre-treatment system for paddy straw disintegration for biogas generation leading towards commercialization of technology to the Indian Institute of Technology, Delhi, to address the issue in–field burning of paddy straw stubble in northern Indian states and provide a sustainable solution for the same. In the project a laboratory scale hydrothermal reactor has been developed for pre-treatment of paddy straw at different temperature and reactor loading rates. Further, a field scale hydrothermal reactor having 50 L capacity has also been fabricated for performing field

scale experiment for performance evaluation of the model. Two of the 3 major objectives of the project have been completed.

7.8 NATIONAL GREEN HYDROGEN MISSION

In the Independence day address on 15 August, 2021, Hon'ble Prime Minister announced the National Green Hydrogen Mission and stated the goal to make India the global hub of Green Hydrogen production and export. With abundant renewable energy potential and land resources, India has the potential to produce low cost Green Hydrogen at a large scale. It gives India an opportunity to make Green Hydrogen in India for the world, in line with the Hon'ble Prime Minister's vision.

MNRE is accordingly developing the National Green Hydrogen Mission with the objectives of decarbonising major economic sectors, making India energy independent and serving as an inspiration for the global clean energy transition. The draft Mission is currently under inter-ministerial consultation.

The Mission proposes a framework for demand creation, support for indigenous manufacturing, Research & Development, pilot projects in emerging areas, and an enabling ecosystem of policies, regulations and standards. The Mission will ignite demand for Green Hydrogen through consumption mandates in select sectors. To support large scale affordable Green Hydrogen production and indigenous manufacturing, a basket of interventions, interalia including fiscal and financial incentives is proposed. The proposed measures are expected to scale up activities in domestic demand sectors and enable bulk export of Green Hydrogen and its derivatives.

7. 9 HYDROGEN R&D

The Ministry has also been supporting a broad-based Research and Development programme on different aspects of Hydrogen. Status of achievements under the 4 ongoing projects is as follows:

i. Indian Institute of Science, Bangaluru has established a production plant for high purity Hydrogen generation through biomass gasification.

ii. ARCI Centre for Fuel Cell Technologies, Chennai is setting up an integrated automated manufacturing line for producing 20 kW PEM Fuel Cell stacks.

iii. Dayalbagh Educational Institution has developed novel materials for Hydrogen production through Photoelectrochemical splitting of water. Two patents were granted for materials developed under the project in 2021.

iv. National Institute of Solar Energy, Gurugram under the project to establish a Centre of Excellence on Hydrogen Energy, have procured electrolyser and other equipment for augmenting the Green Hydrogen production capacity to demonstrate various applications.

7.10 ENERGY STORAGE

MNRE has been supporting a broad-based Research and Development Programme on Renewable Energy including energy storage. Projects are supported in industrial, academic and research institutions. Further, Ministry as a member of the Inter-Ministerial committee for the Faster Adoption and Manufacturing of Electric Vehicles in India (FAME-II) scheme continued to provide inputs on different aspects of electric mobility.

7.11 WIND R & D

Two R&D projects are being executed by National Institute of Wind Energy. The activities carried out on these two R&D projects are given as under:

7.11.1 Met-Ocean measurements (Wind, Wave, Tide, Current, Water level measurements) at Gulf of Khambhat and Gulf of Mannar

With an objective to identify the potential subzones and blocks for promotion of offshore wind farm development in the country, NIWE was entrusted with carrying out a detailed offshore wind resource measurement along with geotechnical and oceanographic studies under this project.

7.11.2 Integrated Wind & Solar Resource Assessment through Mapping and Measurements

Under this project, 50 numbers of 100 m tall integrated wind-solar monitoring stations with 5 levels of instrumentation are to be installed in the country. Wind resource measurements will also be carried out using Sound Detection & Ranging (SODAR) along with measurements from integrated wind-solar monitoring stations concurrently. The measurements carried out using integrated wind- solar measurements and the SODAR will be used to estimate the wind solar power potential of the country at 150 m level and for the preparation of 150 m wind-solar hybrid map. As on December 2021, NIWE had commissioned 23 no of IWSRA stations and data collection from these states are under progress.

7.12 STANDARDS & QUALITY CONTROL IN RENEWABLE ENERGY SECTOR

7.12.1 Standards on Renewable Energy

The standards followed in various programmes being implemented by MNRE are given in **Table 7.1**

Table 7.1: Standards followed under various MNRE programmes

Sl. No	Programme	Product and Standard Title	Standards
1.	Solar Power	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules (Si wafer based)	IS 14286: 2010/ IEC 61215: 2005, IS/IEC 61730 (Part 1): 2004 & IS/IEC 61730 (Part 2): 2004
		Thin Film Terrestrial Photovoltaic (PV) Modules a-Si, CiGs and CdTe)	IS 16077: 2013/ IEC 61646: 2008, IS/IEC 61730 (Part 1): 2004 & IS/IEC 61730 (Part 2): 2004
		Power Invertors for use in Photovoltaic Power Systems	IS 16221 (Part 2): 2015/IEC 62109-2: 2011
		Utility-Interconnected Photovoltaic Inverters	IS 16221 (Part 2):2015/IEC 62109-2 :2011 & IS 16169 :2014/IEC 62116 :2008
		Storage Batteries for SPV Applications	IS 16270 : 2014
2.	Wind Power	Wind turbine - Wind turbines- Part 22: Conformity Testing and Certification.	IS/IEC 61400-22
		- Type and Component Certification Scheme	IECRE OD-501
3.	Small Hydro Power	Turbines and generator (rotating electrical machines)	IEC 34 – 1: 1983 IEC 61366-1: 1998 IEC 61116-1992 IS: 4722-2001 IS 12800 (part 3) 1991 IEC 60308

Sl. No	Programme	Product and Standard Title	Standards
		Governing system for hydraulic turbines Transformers	IS 3156 – 1992 IS 2705 – 1992 IS 2026 - 1983
		Inlet valves for hydro power stations & systems	IS 7326 - 1902
4.	Biomass Energy	Biomass Power Boiler	ASME – BPVC – Section – 1IBR 1950 and amendments thereof or conforming to these standards.
		Steam turbine	IEC 60045 DIN 1943(German) CSN(Czekh Republic) 080030 ASME PTC 6.2 (Steam turbine in combined cycle) or conforming to these standards.
		Alternator/Rotating Electrical Machines	IS-4722 (Rotating Electrical Machines) IS-5422 (50HZ Turbine type Generators-Basic requirements for rotating machines, reference shall be made to IS4722) IEC60034
		Power Transformers	IEEE 115 or conforming to these standards IS 2026
		Biogas (Bio-methane) - Specification	IEC 60076 or its equivalent standard IS 16087: 2016

7.12.2 Quality Control in SPV Power Projects

7.12.2.1 Quality Control Order (QCO)

The technical regulation for quality control of SPV Systems, Components and Devices as per Quality Control (Requirement for Compulsory Registration under BIS Act) Order 2017, which was notified by MNRE vide Government of India Gazette Notification No. 2561 dated 5th September, 2017 was implemented as per schedules notified time to time. Active interaction was made with industry, test labs, and BIS for implementation of the said quality control order, which includes SPV Modules, Inverters and battery storage used in SPV power projects. All products listed in the said order should conform to specified Indian Standard/corresponding IEC, and products qualifying the standards from BIS recognized test labs are required to be registered by the respective manufacturers with BIS.

Testing of the above mentioned products is carried out in BIS recognized test labs following series guidelines notified by MNRE in consultation with related stakeholders including BIS. Only products registered with BIS are allowed for deployment in projects. In the case of SPV inverters, since the series guidelines are applicable up to 150KW capacity as per the capacity of test labs available and the nos. of such test labs are very limited, the manufacturers are exempted from BIS registration on the condition that such manufacturers should have valid IEC certificates as per IEC standards corresponding to IS specified in the Quality Control Order. The self-certification of SPV inverters for manufacturers having valid IEC certificates was first extended up to 31.12.2021 and then further extended up to 30.06.2022 during the year 2021-22.

7.12.2.2 BIS Registration of Products

The nos. of registration granted by Bureau of Indian Standards (BIS) for SPV Modules, SPV inverters and Storage Battery as per standards specified in MNRE Quality Control Order till 31/1/2022 is given in **Table 7.2**. Out of 364 nos. manufacturers who were granted registration for SPV Modules, 208 Nos. are domestic manufacturers (57%). The MNRE has decided that only SPV Modules with BIS Mark will be used in SPV Power Projects in the country. Thus, the Quality Control Order has given boost to not only quality control of SPV Modules but also domestic manufacture of SPV Modules with quality at international level, hence fulfilling the objective of Atmanirbhar Bharat.

Table 7.2: Registration nos. granted by BIS under MNRE Quality Control Order(CRO) 2017 till 31.1.2022

Details of Indian Standards	Product Category	Domestic	Foreign
IS 14286 : 2010/ IEC 61215 : 2005, IS/IEC 61730 (Part 1) : 2004 & IS/IEC 61730 (Part 2) : 2004	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules (Si wafer based)	176	115
IS 16077 : 2013/ IEC 61646 : 2008, IS/IEC 61730 (Part 1) : 2004 & IS/IEC 61730 (Part 2) : 2004	Thin Film Terrestrial Photovoltaic(PV) Modules a-Si, CiGs and CdTe)	0	3
IS 16221 (Part 2) : 2015/IEC 62109-2 : 2011	Power Invertors for use in Photovoltaic Power Systems	8	1
IS 16221 (Part 2):2015/IEC 62109-2 :2011 & IS 16169 :2014/IEC 62116 :2008	Utility-Interconnected Photovoltaic Inverters	16	37
IS 16270 : 2014	Storage Batteries for Solar Photovoltaic Application	8	0

7.12.3 Webinars to commemorate 75 years of India's Independence (Azadi Ka Amrit Mahotsav)

As part of the MNRE's 75 Weeks Webinars to commemorate 75 years of India's Independence (Azadi Ka Amrit Mahotsav), the first week program of webinars on Standards and Quality Control was organized from 7th June to 12th June, 2021. The webinars focused on policy and practices in standard development and implementation.

The second week of webinar was organized from 31st August to 3rd September, 2021 with objective to discuss the availability of standards and testing infrastructure for solar photovoltaic modules in the country.

The third week of webinar was organized on 30th November 2021 which was focused on policy initiatives on standards and performance testing of Inverters and Batteries

CHAPTER 8

RENEWABLE ENERGY IN NORTH EASTERN REGION STATES

8.1 INTRODUCTION

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 and Bio-gas plants among others, 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 65,837 MW, a substantial part of which is suitable for grid connected applications. State-wise details are shown in **Table 8.1**.

Table 8.1: State-wise Renewable Energy Potential in the North Eastern States of India

Sl. No.	STATES / UTs	Small Hydro Power	Bio-Energy		Solar	Total
			Biomass Power	Waste To Energy		
		(MW)	(MW)	(MW)	(MW)	(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
	Total	**3261.49**	**260**	**16**	**62300**	**65837**

8.3 The state wise status of Renewable Energy capacity installed, as on 31.12.2021, in the North-Eastern Region is given in **Table 8.2**.

Table 8.2: State-wise installed capacity of Renewable Power as on 31.12.2021

Sl. No.	STATES / UTs	Small Hydro Power	Bio-Power	Solar Power	Total Capacity	Capacity Addition during 2020-21
1	Arunachal Pradesh	131.105		11.23	142.34	1.07
2	Assam	34.11	2.00	68.57	104.68	17.01
3	Manipur	5.45		12.20	17.65	0.81
4	Meghalaya	32.53	13.80	4.13	50.46	0.28
5	Mizoram	36.47		7.88	44.35	0.90
6	Nagaland	30.67		3.04	33.71	0.13
7	Sikkim	52.11		4.65	56.76	2.71
8	Tripura	16.01		14.87	30.88	1.31
	Total (MW)	**338.46**	**15.80**	**126.57**	**480.83**	**24.22**

8.4 SMALL HYDRO POWER PROGRAMME

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 and Sikkim are given in **Table 8.3**. The major Small Hydro Power Projects which are currently under implementation is given in **Table 8.4**.

Table 8.3: State wise list of potential sites and installed projects SHP Projects in the North Eastern Region States (as on 31.12.2021)

Sl. No.	State	Total Potential Capacity (MW)	Total Installed Capacity (MW)
1	Arunachal Pradesh	2064.92	131.11
2	Assam	201.99	34.11
3	Manipur	99.95	5.45
4	Meghalaya	230.05	32.53
5	Mizoram	168.9	36.47
6	Nagaland	182.18	30.67
7	Sikkim	266.64	52.11
8	Tripura	46.86	16.01
	Total	**3261.49**	**338.455**

Table 8.4: Small Hydro Power Projects currently under implementation in NE Region

Sl. No.	Name of the Project	Capacity (MW)	Implementing Agency
Arunachal Pradesh			
1	Tirrunallah in Longding District	0.1	Department of Hydro Power Development
2	Fure in Kurukungme District	0.05	Department of Hydro Power Development
3	Pakhankha in Changlang District	0.5	Department of Hydro Power Development
4	Payu at Pinchi in KurungKumey District	0.5	Department of Hydro Power Development
5	Khajalong in West Kameng District	2.0	Department of Hydro Power Development
6	Sumbachu SHP in Tawang District	3	Hydro Power Development Corporation of Arunachal Pradesh
7	Taksang Chu SHP in Tawang District	3.4	Hydro Power Development Corporation of Arunachal Pradesh
Meghalaya			
8	Ganol SHP West Garo Hills District	22.50	Meghalaya Power Generation Corporation Limited

Sl. No.	Name of the Project	Capacity (MW)	Implementing Agency
9	Riangdo SHP in West Garo Hills District	3.0	Meghalaya Power Generation Corporation Limited
Mizoram			
10	Kawlbem in Champhai District	3.50	Power & Electricity Deptt., Government of Mizoram
11	Tlawva SHP in Champhai District	5.00	Power & Electricity Deptt., Government of Mizoram
Nagaland			
12	Ponglefo SHP in Kiphire District	1.00	Department of Power, Government of Nagaland
Sikkim			
13	Chatten Stage-II in North Sikkim District	3 .00	Sikkim Power Development Corporation Limited

8.5 PM'S PACKAGE FOR ARUNACHAL PRADESH

The Hon'ble Prime Minister had announced a package of Rs. 550 crore to electrify border villages of Arunachal Pradesh. Accordingly, a plan was made to illuminate 1,053 un-electrified villages of all border districts of Arunachal Pradesh by installation of 5,758 SPV Home Lighting Systems and 153 Micro or Small Hydel Projects. The project is completed except commissioning of five numbers of Small Hydro Power Projects by the Department of Hydro Power Development.

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 2023-24. 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.

Under the Scheme Ministry approved 6 nos Solar Parks with an aggregate capacity of 290 MW in NE States. Based on the request of the State Nodal Agencies and due to slow progress, three Solar Parks of an aggregate capacity of 230 MW were cancelled. The solar parks currently under implementation in States of NE Region are given in **Table 8.5**.

Table 8.5: Solar Parks currently under implementation in the NE Region States (as on 31.12.2021)

Sl. No.	State	Capacity (MW)	Name of the Solar Power Parks Developer (SPPD)	Land identified at
1.	Manipur	20	Manipur Tribal Development Corporation Ltd. (MTDCL)	Bukpi village, Pherzawl District
2.	Meghalaya	20	Meghalaya Power Generation Corporation Ltd (MePGCL)	Thamar, West Jaintia Hills & Suchen, East Jaintia Hills districts
3.	Mizoram	20	Power & Electricity Department	Vankal, Champhai district, Mizoram

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

Under the Phase II of the Grid-connected Rooftop Solar Programme Central Financial Assistance (CFA) upto 40% of the benchmark cost is provided for RTS projects up to 3 kW capacity and 20% for RTS system capacity beyond 3 kW and upto 10 kW in residential sectors. For Group Housing Societies (GHS) and Residential Welfare Associations (RWA), CFA is limited to 20% for RTS plants for supply of power to common facilities maximum upto 500 kW capacity.

The Phase II of the programme has provision of incentives to DISCOMs. As per the scheme DISCOMs will get the incentive for achieving in the financial year above the baseline capacity as on 31st March of the previous year. There is no incentive for capacity addition up to 10% capacity. There is 5% incentive for addition beyond 10% and up to 15%; and 10% incentives for addition beyond 15%.

Aggregate capacity of 82.3 MW has been allocated to 7 North- Eastern States as on 31.12.2021 under the Programme, details of which are given in **Table 8.6.**

Table 8.6: State-wise Aggregate Capacity Allocated to N-E States as on 31.12.2021

S.No.	States/UTs	DISCOM Full name	Aggregate allocated capacity in (MW)	Capacity installed (MW)	Rate discovered through tender	Portal developed
1	Assam	Assam Power Distribution Company Limited	2.00	Nil	Yes	Yes
2	Manipur	Manipur State Power Distribution Company Limited	1.00	0.069	Yes	Yes
3	Meghalaya	Meghalaya Power Distribution Corporation Limited	70.00	Nil	Yes	Yes
4	Mizoram	Electricity Department Mizoram	1.50	Nil	Yes	No
5	Nagaland	Electricity Department	4.80	Nil	No	No
6	Sikkim	Energy And Power Department Sikkim	2.00	Nil	No	Yes
7	Tripura	Tripura State Electricity Corporation Limited	1.00	Nil	No	No
		Total	**82.30**	**0.069**		

8.8 OFF GRID SOLAR PV PROGRAMME

Solar Off-grid Programme is being implemented in the North Eastern Region through Off-grid and Decentralized Solar PV Applications Scheme Phase-III and Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyaan (PM-KUSUM) Scheme. Under Off-grid and Decentralized Solar PV Applications Scheme Phase-III, solar study lamps, solar street lights and off-grid solar power plants (up to 25 kW) are being installed in North Eastern Region. Under PM-KUSUM Scheme, grid connected solar power plants up to 2MW, standalone solar pumps and solarization of existing agricultural pumps are being supported. Under Atal Jyoti Yojana (AJAY) Phase-II, solar street lights are being installed with partial support through MPLAD Scheme.

Fig. 8.1 : Solar Rooftop Installations at IIT, Guwahati

Under Off-grid and Decentralised Solar PV Applications Scheme Phase -III, following projects for installation of off-grid solar power plants have been completed:

Table 8.7: Projects where installations have been completed under Off-grid and Decentralised Solar PV Applications Scheme Phase-III

State	Completes Projects
Manipur	25 kWp capacity Solar power plant at Deputy Commissioner's office, Kangpoki District.
Mizoram	24 nos. of Solar power plants of aggregate 230 kWp capacity for various Government buildings.
	53 nos. of Solar power plants of aggregate 460 kWp capacity in Community hall, Government offices, Schools, multi farming cooperative Society.
	29 nos Solar power plants of aggregate 249 kWp capacity in Government buildings.

Further, under the Phase-III Scheme, 49,958 Solar Street Lights have been installed and 3,12,356 of Solar Study Lamps have been distributed in North Eastern States for the FY 2020-21. Detailed status of installation/distribution as on 31.12.2021 is given in **Table 8.8**.

Table 8.8: Status of installation or distribution of Solar devices as on 31.12.2021

State	Solar Street Lights Installed (Nos.)		Solar Study Lamps Distributed (Nos.)	
	Under Scheme	During FY 2021-22	Under Scheme	During FY 2021-22
Arunachal Pradesh	20000	11267	200000	92970
Assam	13949	10833	--	--
Manipur	19550	9300	60664	10025
Meghalaya	--	--	55390	55390
Mizoram	15000	10208	144705	48000
Nagaland	9810	920	24000	24000
Sikkim	--	--	6900	6900
Tripura	11000	7430	300000	75071
Total	**89,309**	**49,958**	**7,91,659**	**3,12,356**

Under PM-KUSUM Scheme, the progress made in the North Eastern Region till 31.12.2021 is presented in **Table 8.9**.

Table 8.9: Progress made under PM-Kusum Scheme in the North Eastern Region

S. No.	State	Component-A (MW)		Component-B (Nos)		Component-C (Nos)		
		Sanctioned	Installed	Sanctioned	Installed	Sanctioned (IPS)	Sanctioned (FLS)	Installed
1	Arunachal Pradesh	0	0	50	0	0	0	0
2	Assam	50	0	1000	0	500	0	0
3	Manipur	0	0	150	18	0	0	0
4	Meghalaya	5	0	200	35	0	10000	0
5	Nagaland	0	0	50	0	0	0	0
6	Tripura	5	0	3100	421	2600	0	

Under the **Atal Jyoti Yojana (AJAY) Phase-II**, 10,501 solar street lights are being installed in Lok Sabha constituencies of the North Eastern States including Sikkim. Solar street lights sanctioned till 31.03.2020 are being installed. Till the given date sanctions were received from District Administration of the concerned constituencies for 13,005 nos. of lights, out of which 10,501 have been installed till 31.12.2021. Out of this, some 2,157 have been installed under FY 2021-22 in the region.

Details of all SPV systems and standalone SPV power plants in the North Eastern States as on 31.12.2021 are given in **Table 8.10**.

Table 8.10: SPV Systems and Stand-alone Power Plants in the North-Eastern States (as on 31.12.2021)

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	218551	25008	22	963.2
2	Assam	46879	647761	29248	45	1605
3	Manipur	24583	69722	32292	54	1580.5
4	Meghalaya	14874	96140	5800	54	2004
5	Mizoram	12060	155217	20325	37	3894.6
6	Nagaland	1045	30766	16045	3	1506
7	Sikkim	15059	30200	504	0	850
8	Tripura	32723	364012	14948	572	867

8.9 BIOGAS PROGRAMME

The New National Biogas and Organic Manure Programme (NNBOMP) was 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 (SNAs). MNRE has not allocated any targets to the State Nodal AgenciesDepartments for implementing the NNBOMP in the States of Assam, Arunachal Pradesh, Manipur Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura during the year 2021-22. A total 966small family type biogas plants were installed during the Financial Year 2020-21 ending 31.03.2021.

A Biogas Development and Training Centre for all the NER States for providing training and technical support under the NNBOMP was established and was functional at Department of Mechanical Engineering, Indian Institute of Technology, Guwahati, Assam up to 31.03.2021.

8.10 STATUS OF WIND ENERGY PROGRAMME IN THE NORTH-EASTERN STATES

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 meter level is estimated to be 406 MW. The State-Wise break-up is given in **Table 8.11**.

Table 8.11: State-wise Wind Power Potential Estimation of NE Region

Sl. No.	States	Estimated potential (MW)
1	Arunachal Pradesh	201
2	Assam	53
3	Manipur	7
4	Meghalaya	44
5	Nagaland	3
6	Sikkim	98
	Total	**406**

In the North-Eastern States, there are scattered potential pockets available for Wind farm development due to the localized Wind flows. To tap these, the Ministry decided to carry out extensive Wind Resource Assessment studies in NE regions including Sikkim. Accordingly, as on 31.12.2021, a total of 92 Wind Resource Assessment instrumentation using 25 meter and 50 meter meteorological masts were carried out at NE regions and the requisite data collection from all these Wind Resource Assessment Stations were completed and subsequently closed down. The State-Wise break-up is given in **Table 8.12**.

Table 8.12: Status of Wind Resource Assessment Centres Set up and Closed Down

State	No. of Stations installed & commissioned	Level of Wind Resource Assessment stations
Arunachal Pradesh	15	25 m & 50 m
Assam	16	25 m & 50 m
Tripura	10	25 m & 50 m
Manipur	15	25 m & 50 m
Mizoram	9	25 m & 50 m
Nagaland	6	25 m & 50 m
Meghalaya	17	25 m & 50 m
Sikkim	4	25 m
Total	**92**	

In addition, Wind Resource Assessments are also carried out at NE region using the existing Telecommunication towers. As on 31.12.2021, a total 80 of Telecom Towers of heights ranging from 40m to 60m were utilised for this purpose and the requisite data collection from all these telecom towers were also completed and subsequently closed down. The details are given in **Table 8.13**.

Table 8.13: Telecom Tower utilised & Closed Down as Wind Resource Assessment Centers

State	No. of Stations installed & commissioned	Level of Wind Resource Assessment stations
Meghalaya	15	50 m & 60 m
Mizoram	5	40 m & 60 m
Tripura	6	50 m & 60 m
Arunachal Pradesh	5	40 m & 50 m
Nagaland	7	50 m
Manipur	9	40 m & 60 m
Assam	33	50 m & 60 m
Total	**80**	

CHAPTER 9

PRODUCTION LINKED INCENTIVE (PLI) SCHEME: 'NATIONAL PROGRAMME ON HIGH EFFICIENCY SOLAR PV MODULES'

9.1 INTRODUCTION & BACKGROUND

After approval by the Cabinet on 7th April, 2021, Ministry of New and Renewable Energy (MNRE) has issued Scheme Guidelines for Production Linked Incentive Scheme 'National Programme on High Efficiency Solar PV Modules' on 28th April, 2021, for achieving manufacturing capacity of Giga Watt (GW) scale in High Efficiency Solar PV modules.

9.2 AIMS AND OBJECTIVES

Aims: To promote manufacturing of high efficiency solar PV modules in India and thus reduce import dependence in the area of Renewable Energy. The **objectives** of the scheme inter-alia include the following:

i. To build up solar PV manufacturing capacity of high efficiency modules.

ii. To bring cutting edge technology to India for manufacturing high efficiency modules. The scheme will be technology agnostic in that it will allow all technologies. However, technologies which result in better module performance will be incentivized.

iii. To promote setting up of integrated plants for better quality control and competitiveness.

iv. To develop an ecosystem for sourcing of local material in solar manufacturing.

v. Employment generation and technological self-sufficiency.

9.3 OUTLAY: This Pli Scheme has an outlay of Rs. 4,500 crore.

9.4 INVITATION OF BIDS AND RESPONSE RECEIVED: On 25.05.2021, Indian Renewable Energy Development Agency Limited (IREDA), the implementing agency on behalf of MNRE, for this PLI Scheme, issued Bid Document for selection of manufacturers for setting up manufacturing capacities for high efficiency solar PV Modules under this PLI scheme. An overwhelming response was received with 18 bids corresponding to solar PV manufacturing capacity of 54,809 MW were received.

9.5 PROGRESS MADE: Letter of Awards have been issued by IREDA on 11.11.2021/02.12.2021 to three successful bidders for setting up 8,737 MW capacity of fully integrated solar PV module manufacturing units (involving manufacturing of polysilicon + ingot-wafer + cell + module) with PLI amount of Rs. 4455 crore and IREDA's charges of Rs. 44.55 crore @1% of PLI. These 8,737 MW solar PV manufacturing capacities are expected to get commissioned in three years from the date of sanction and will be eligible for getting PLI on annual basis on sales of high efficiency solar PV modules for 5 years from commissioning or 5 years from scheduled commissioning date, whichever is earlier.

9.6 BENEFITS FROM THE SCHEME: The PLI Scheme for High Efficiency Solar PV Modules with present outlay of Rs. 4,500 crore will bring about a manufacturing capacity of around 8,737 MW fully integrated solar PV modules in the country. It will also bring in an investment of around Rs. 19,221 crore. The scheme is also expected to give a boost to the ancillary industries comprising EVA, Solar glass, Back-sheet, Junction Box among others and is likely to result in import substitution of around Rs. 15,290 crore every year.

9.7 EMPLOYMENT GENERATION: The scheme is expected to provide direct employment of around 26,000 persons and indirect employment of around 1,05,000 persons.

CHAPTER 10

SPECIALISED INSTITUTIONS

10.1 NATIONAL INSTITUTE OF SOLAR ENERGY (NISE)

10.1.1 National Institute of Solar Energy (NISE), an autonomous institution under Ministry of New and Renewable Energy (MNRE), is the National Research and Development (R&D) institution in the field of Solar Energy. NISE supports Ministry of New and Renewable Energy in implementing the National Solar Mission (NSM), R&D activities in Solar Energy and various Skill Development Programmes. NISE also carry out research and development activities in the areas of Solar Hydrogen and Fuel Cells.

10.1.2 NISE has established itself as the leading institutions in the field of Solar Energy offering Resource Assessment, R&D, Design, Development and Demonstration of Solar Energy Technologies for various applications. These applications include Testing, Certification and Standardization, Monitoring and Evaluation. NISE is also the designated body for co-ordinating Economic and Policy Planning, Human Resource Development (HRD) and as the prime collaborator with various National and International organisations.

10.1.3 NISE is maintaining NABL accredited Solar Photovoltaic module testing laboratory, lighting system test laboratory, power electronics testing facility, battery testing facility, 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.

10.1.4 Research and Development

Details of various research and development projects being carried out at NISE are given in **Table 10.1**

Table 10.1: Details of ongoing R&D Projects

Sl. No.	Project	Funding Agency	Remarks
	R & D Solar PV		
1.	'Development of high efficiency (21%/19%) PERC type of c-Si/mc-Si solar cells'. A joint project between NISE and BHEL for developing PERC type solar cells with benchmark efficiencies in the country.	**MNRE**	NISE procured and commissioned all the test & characterization equipment proposed in this project. NISE has facilitated a class 8 cleanroom facility to inhouse all the advanced cell characterization tools. This facility is being used to characterize the cells fabricated at BHEL and to optimize the process parameters for efficient enhancement.
2.	"Design, development and qualification of large area (156 mm x 156 mm), secondary reference solar cells"	**DST**	This large area reference solar cell will replace conventional small area (50 cm x 50 cm) reference solar cell, reducing the influence of the inhomogeneity of solar simulators. A course of action for procurement of equipment proposed in the project has been established and procurement is in process.

Sl. No.	Project	Funding Agency	Remarks
	R & D Solar PV		
3.	"Sustainable innovations for clean energy in immunization and primary health care in India"	**UNICEF**	With this project, UNICEF and NISE aim to jointly advocate for strengthening the reach and quality of immunization and primary health care services through the scaling up of provision of regular and high-quality solar energy at primary health care facilities across the country.
4.	"High-Efficiency Solar Water Pumping Systems"	**MNRE**	Update on the key deliverables during FY 2021-22 is given below: NISE has established a State of Art Solar Water Pump Testing Facility for up to 50 HP with 16 rigs system. NABL accreditation for the newly developed facility is in process. To increase daily water output research was also carried out on solar water pumping systems by using Bifacial Modules. NISE has also demonstrated the low-cost rugged solar-based Micro irrigation system.
5.	"Optimization of Solar Photovoltaic Based Water Pumping Performance with Dc Motor"	**SERBTARE**	This collaborative research project between NISE and Vellore-Tech University was approved in December, 2021. The study will focus on the centrifugal pump (surface pump) as well as the submersible pump coupled with induction or brushless DC motors by evaluating the performance of solar water pumping systems using various statistical tools with modeling and interpretation.
6.	"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"	**DST**	The project is completed in FY 2021-22. Through this facility, RO quality clean water with 30,000 litres/day is being supplied to the entire Faridpur village since December, 2020.
7.	Performance analysis of bifacial solar PV modules	**NISE**	Installation of 5 kW bifacial at vertical tilt, 5 kW bifacial at latitude tilt and 10 kW mono-facial PV systems at latitude tilt has been completed. Data monitoring and analysis is in process.

Sl. No.	Project	Funding Agency	Remarks
	R & D Solar PV		
8.	Design and development of innovative solar products Solar Charge station for e-rikshaw & e-bicycle and other low- end applications. Solar PV rikshaw with extended range (in km) and reduced battery capacity	**NISE**	Both the products are in prototype design phase.
9.	"Design, development and field testing of Mini-Greenhouse based Solar Dryer"	**NISE**	The Project aims to provide a faster drying solution to the apricot farmers of Ladakh with increased output without any discoloration of the final product, improving the quality and hygiene of the dried products. Prototype has been developed, and field-tested is ongoing at Ladakh.
10.	"Atmospheric water generator using desiccants for generation of pure water from air"	**NISE**	The project aims to develop a lab-scale prototype for generating water from air using desiccants. The Project also utilizes an evacuated tube-based solar dryer for enhancing water generation. Prototype design is in process.

10.1.5 Solar Photovoltaic Testing Facility (PVTF)

10.1.5.1 PV Module Testing Laboratory

NISE has NABL (National Accreditation Board for Testing & Calibration Laboratories) accredited laboratory for PV module testing as per ISO/IEC 17025:2017 standard for Qualification Testing and Customised Testing as per customers' requirements. This facility is recognised by Bureau of Indian Standard (BIS) for PV Module Testing as Type 2 category facility. The laboratory has the capability of performing testing of PV module as per following standards:

Standard No.	Details
IEC 61215-1-1: 2016/IS 14286-1-1: 2019	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules
IEC 61215-1-2: 2016/IS 14286-1-2: 2019	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-2: Special requirements for testing of thin-film Cadmium Telluride (CdTe) based photovoltaic (PV) modules
IEC 61215-1-3: 2016/IS 14286-1-3: 2019	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-3: Special requirements for testing of thin-film amorphous silicon based photovoltaic (PV) modules

Standard No.	Details
IEC 61215-1-4: 2016/IS 14286-1-4: 2019	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-4: Special requirements for testing of thin-film Cu(In,GA)(S,Se)2 based photovoltaic (PV) modules
IEC 612151-1- 2021 (DML testing facility is under procurement)	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules
IS/IEC 61701: 2011// IEC 61701:2020	Salt mist corrosion testing of photovoltaic (PV) modules
IEC 61853-1 & 61853-2, 61853-3, & 61853-4(Spectral response system for only solar cell is available)	Photovoltaic (PV) module performance testing and energy rating - Part 1, 2, 3 & 4: Irradiance and temperature performance measurements, power rating, Spectral responsivity, incidence angle and module operating temperature measurements, Energy rating of PV modules, Standard reference climatic profiles
IEC TS 62804-1:2015	Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon
IEC TS 60904-1-2:2019	Photovoltaic devices - Part 1-2: Measurement of current-voltage characteristics of bifacial photovoltaic (PV) devices

In addition, this laboratory also supports in-house R&D activities to investigate the performance & reliability of PV modules and other R & D based testing services to external customers. Some of R&D based testing services are listed below:

i Light induced degradation (LID) testing and Light and elevated temperature-induced degradation (LeTID) testing of PV module as per the standard and customer requirement.

ii Climate specific model based accelerated testing of PV module to evaluate the module performance & reliability under harsh climatic conditions.

iii Testing and characterization of PV module cleaning device as per the test specifications developed at NISE or defined by customer.

iv Testing of new and innovative products as per the customized testing procedure.

In the FY 2020-21, the laboratory has upgraded its facilities with addition of solar simulator with temperature control as shown in **Fig. 10.1**. Also, the facilities to test the modules as per IEC 61730-1, 2 Photovoltaic module safety qualification and Outdoor PID testing are under development. In this financial year, number of Photovoltaic module test requests received was thirty.

Fig. 10.1: Temperature Controlled Sun Simulator for testing of PV modules up to 650 W

10.1.5.2 Power Electronics Laboratory

The Power Electronics Laboratory (PEL) at NISE conducts testing of all types of power conditioning units (PCUs) including hybrid, standalone, Grid-tied inverters (GI), and pump controllers up to 100 kVA. PEL is accredited by NABL as per ISO/IEC 17025: 2017. This facility is recognized by the Bureau of Indian Standard (BIS) for 16169: Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters. Total five numbers of test requests have been received in this financial year. The laboratory is well equipped with facilities for testing as per IEC/IS standards/MNRE specification/ customer specification given below:

i. IEC 61683:1999: Photovoltaic systems – Power conditioners – Procedure for measuring efficiency
ii. IS 16169/ IEC 62116: 2008 Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters
iii. CEI IEC 61727:2004 Photovoltaic (PV) systems- Characteristics of the utility interface
iv. IEC 62509: 2010 Performance and functioning of charge controller
v. EN50530: 2010 Overall efficiency of grid-connected photovoltaic inverters
vi. IEC 60068-2 -1: 2007 Environmental test A: cold
vii. IEC 60068-2 -2: 2007 Environmental test B: Dry heat
viii. IEC 60068-2 -14: 2009 Environmental test N: Dry heat Change of temperature
ix. IEC 60068-2 -14: 2005 Environmental Test Db: Damp heat cycle
x. Universal solar pump controller as per MNRE specifications
xi. Other than these, R&D based developmental testing are also offered to our valued customer

Forthcoming, the power electronics laboratory at NISE has the following activities for further enhancement as given below:

i. IS 16221 (Part 2): 2015/IEC 62109-2: 2011: Safety of Power Converters for Use in Photovoltaic Power Systems: Part 2 Particular Requirements for Inverters
ii. IEC TS 62910:2015: Utility-interconnected photovoltaic inverters - Test procedure for low voltage ride-through measurements

10.1.5.3 Battery Test & Characterization

NISE has a NABL accredited and BIS recognized Battery test lab for testing of batteries for solar photovoltaic applications. The laboratory has the capability of doing testing of different types of battery technology: Leads acid, Li-ion, Ni-Cd, Ni-M-H. In this financial year, total 16 number of testing requests were received. The laboratory follows different National/ International Standards and details are as follows:

i. IEC61427/IS 16270: 2014 Secondary cells and batteries for solar photovoltaic application – general requirements and methods of test
ii. IS 16047: Part 3: 2018 Secondary cells and batteries containing alkaline or other non-acid electrolytes- Secondary lithium cells and batteries for portable applications Part 3 Prismatic and cylindrical lithium secondary cells, and batteries made from them (first revision)
iii. IS 13369: Stationary lead acid batteries (with tubular positive plates) in monobloc containers
iv. IS 1651: Stationary cells and batteries, lead-acid type (with tubular positive plates)

10.1.5.4 Advanced SPV system & lighting laboratory

The Solar Photovoltaic (SPV) and Lighting laboratory is involved in performance testing and reliability of off-grid PV systems against latest standards and specifications adopted by BIS/ MNRE. The lab is well equipped with modern testing equipment like Integrating Sphere Photometer for Total Luminous Flux

measurement, Digital Programmable AC/DC power supplies, and other Digital Auxiliary equipment for conformity/ type testing of wide range of products. The laboratory is proficient in testing according to the below standards:

i. IES LM-79-08/IS 16106: 2012 (Method of Electrical and Photometric Measurements of Solid-State Lighting products)

ii. Testing of solar lighting systems as per MNRE specifications

Testing is also carried out according to the manufacturer defined technical specifications. The products include all type of lighting in solar photovoltaics, e.g., Solar Lantern, Solar study lamp, Solar Home Lighting, Solar Street lighting, etc. In this financial year, total 15 number of testing requests were received. A photograph of Solar PV lighting test set-up at NISE is shown in **Fig. 10.2**.

Fig.10.2: Testing of Solar Street Lights with Integrating sphere system

10.1.5.5 Advanced Solar Cell Characterization Laboratory

NISE has state-of-the-art Advanced Solar Cell Characterization Laboratory with ISO class 8 clean room facility. The lab housed several advance cell characterization tools including (i) Spectral Response Measurement System (QE-SRMS), (ii) Spectroscopic Ellipsometer, (iii) Optical Microscope, (iv) Semi-Automatic Four Probe resistivity meter, (v) Electrochemical Capacitance Voltage (ECV) Profiler, (vi) Surface Profilometer and (vii) Field Emission Scanning Electron Microscopy (FESEM) with EDS facility. **Fig.10.3** shows the photograph of cleanroom facility at NISE. Primarily, this facility is being utilised to support BHEL in developing benchmark efficiency PERC cells. In future, NISE will provide advanced cell characterization services to other academic & R&D organizations and PV industry to optimise their cell processes and developing high efficiency solar cells.

Fig. 10.3: Advanced Solar Cell characterization laboratory with ISO class 8 clean room facility at NISE

10.1.5.6 Solar Water Pump Test Facility

Solar Water Pumping System Test Facility at NISE is a well-equipped, state-of-the-art testing facility for solar water pumps testing in India. The laboratory conducts test in strict conformation with MNRE guidelines. Initially, the laboratory is equipped to conduct tests on solar water pumps with capacities ranging from 0.5 HP to 10 HP (**Fig. 10.4, top**). With the view to cater futuristic requirements, the laboratory is upgraded for the testing of pumps up to 50 HP under "Design and Development of High Efficiency Solar Water Pump Project" funded by MNRE (**Fig. 10.4, bottom**). The Test Facility is equipped with advanced tools such as solar array simulators, automatic data loggers, power analysers, power meters, flow meters, pressure transmitters, automatic gate valves, automatic and manual dual axis module mounting structures and various other sophisticated sensors and dedicated software. All tests are performed against National and International standards. Currently, Solar PV pumping lab is in the process of getting NABL accreditation.

The newly developed facility is also being used for carrying out the R&D activities of solar water pumping systems as well as Testing, certification, standardization of pump sets.All major pumping technologies such as submersible, surface, AC and DC systems can be tested using the facility. NISE is also creating awareness on PM-KUSUM Schemes and tested pumps under this scheme. SWP lab team demonstrated Micro-irrigation concept and working on low cost optimized design of the system. Solar based micro pumps have been tested under an innovative solar water pumping system. SWP lab is also working on regress testing of two solar water pump samples of CI material provided by SIEM under Solar Photovoltaic Water Pumping Systems Subcommittee, MED 20:7 has been tested for phase 1 as per the BIS recommended specification developed by NISE in 2020.

Fig. 10.4: Solar Water Pump Test facilities for up to 10HP (top), and for up to 50HP (bottom) at NISE

10.1.6 Solar Thermal Technologies

10.1.6.1 Solar Dryer-cum-Space Heating System

In 2021-22, NISE has carried out an in-house R&D project titled 'Design, development and field testing of Mini-Greenhouse based Solar Dryer,' in the Union Territory of Ladakh. Mini-greenhouse based solar dryer aims to provide a faster drying solution to the apricot farmers of Ladakh with increased output without any discoloration of the final product, improving the quality and hygiene of the dried products. The drying system has higher capacity of approx. 200 kg per batch and is lower in cost which is an improvement over the previous solar dryer developed by NISE. The system is easy to

transport and install, which makes it easier and convenient to use by the farmer. **Fig. 10.5** shows the photograph of solar dryer in operation.

Fig. 10.5: Mini-Greenhouse based Solar Dryer: (a) Field testing in Ladakh, (b) Placing of apricots on mesh tray, (c) Fresh apricots fed inside the dryer, (d) Apricots during the drying process

10.1.6.2 Solar Cold Storage System

In the FY 2021-22, 11 numbers of solar cold storage systems developed by NISE have been installed at various locations in India. NISE has been involved in the monitoring and testing of one of the solar cold storage systems shipped to Kenya (**Fig. 10.6**).

Fig. 10.6: A 5 MT solar powered cold storage with thermal energy backup application in Kenya

10.1.7 Solar Radiation Resource Assessment (SRRA)

The Solar Radiation Calibration Laboratory (SRCL) at NISE (**Fig.10.7**) is operational since 2016 for calibration of solar radiation measuring sensors from National Solar Radiation Network of MNRE. Following activities were carried out during the FY 2021-22:

i. Total 6 pyranometers have been calibrated at the facility from private organizations under the commercial program.

ii. The periodical calibration data analysis is being carried out to develop the calibration protocols for improving the quality and reliability of measured solar radiation data.

Fig. 10.7: Calibration of Radiometers at NISE

10.1.8 Skill Development and Capacity Building

NISE has taken several initiatives towards skill development and capacity building activities. This year, a total of 3016 Suryamitras were trained in the field of installation and maintenance of the solar photovoltaic systems, across different states. NISE conducted 08 online National programs, imparting training to 235 professionals and 1 International training programs (e-ITEC) thereby provided training to 36 participants from 18 countries in online mode. NISE also successfully organized the hands-on training and lab experiments for the students of B.Sc. of Shri Vishwakarma Skill University, Gurugram-Haryana, during December, 2021 (**Fig.10. 8**).

Fig. 10.8: Students from Shri Vishwakarma Skill University performing Lab Experiments during training programme

10.1.9 Hydrogen Energy

An 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 is under implementation. The project 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. (**Fig.10.9**) shows the Hydrogen production cum dispensing facility at NISE. The following activities have been undertaken during 2021-22:

i. The existing hydrogen generation cum dispensing station is being made operational. Electrolyser module has been repaired and is being installed.

ii. Installation of new electrolyser of 10 Nm3/hr capacity for augmenting Hydrogen production capacity of the existing facility is in progress.

iii. NISE also conducted a skill development programme on "Hydrogen Energy: Production, Storage and Utilization", on 12th January, 2022.

Fig.10.9: Hydrogen production-cum-dispensing facility at NISE

10.1.10 Outreach Activities

NISE has continued its consultancy services and provided consultancy on field inspection,field testing, and services towards preparation of feasibility reports for solar projects. In 2020-21, 10 consultancy projects were awarded to NISE. **Fig. 10.10** shows the photographs of performance evaluation of two PV power plants by NISE consultancy team.

Fig. 10.10: Inspection and testing of PV modules in Rooftop (left) and Floating PV power plants

One more collaborative project between NISE and Industry, funded by DST has been completed, recently. Through the implementation of this clean drinking water project, 30,000 litre /day clean drinking water is being supplied to people of village Faridpur district Gurugram. This complete set-up is powered by Solar panels with 30 kWp capacity as shown in **Fig. 10.11**.

Fig. 10.11: IoT based Solar Powered Clean Drinking Water supply through automated dispensing installed at Faridpur village, Haryana.

10.1.11 National/International Cooperation

NISE partners with government, academia, entrepreneurs and non-profit organisations for partnering and accelerate the growth of renewable energy technologies. In the year 2021-22, NISE has established its partnerships with esteemed organizations by signing 11 MoUs with various organisations in the country.

10.1.12 Administration and Finance

The Government of India has sanctioned 41 regular posts including the post of Director General. The Institute has framed Recruitment Rules for the sanctioned 41 regular scientific, technical and administrative posts. The Rules were approved by the Governing Council in its 3rd meeting held on 6th April, 2015. Efforts were made to fill up these posts through written test/ interviews. Out of 40 sanctioned regular posts, the selection process has been completed for 31 posts, out of which 26 have joined.

10.2 NATIONAL INSTITUTE OF WIND ENERGY (NIWE)

10.2.1 NIWE's main activities include Wind (onshore & offshore) & Solar Radiation Resource Assessment; preparation of standards for wind turbines; testing and certification of wind turbines 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:

I0.2.2 Wind & Solar Resource Measurements Division

Wind Resource Assessment (WRA) programme data is being used widely to establish wind farms in the country. Under this program of the Ministry, 912 dedicated wind-monitoring stations have been established with the support of State Nodal Agencies. In addition, Wind Resource Assessment studies were also carried out using 80 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, 43 nos. of Wind monitoring stations are under operation. During the current year, twenty three (23) 100 m wind monitoring Stations were commissioned and data collection is underway.

Further, during this year, 21 sites have been registered for wind measurement by private sector from various States in India. The wind data from three (3) private Wind Monitoring stations have been analyzed. Ten consultancy projects focused in various wind farm developmental needs were undertaken for a variety of clients from public/government/private sector during this period.

Carbon Neutral Ladakh: To assess the wind power potential of Ladakh & Kargil region towards the development of wind power projects, NIWE had installed a Light Detection & Ranging System (LiDAR) at Ladakh and a 50 m wind monitoring station at Kargil and data collection from these stations/ sites are underway.

Fig. 10.12: 50 m wind monitoring station installed at Kargil

NIWE had installed and commissioned three (3) nos. of 100 m integrated wind –solar resource assessment stations at at the proposed 30 GW Renewable Energy Park (Khavada region), Kutch District, Gujarat and data are being collected. The data from these resource assessment stations will facilitate the project developers/ investors in developing the wind/ solar power projects in the region and achieve the target set by Government of India.

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 has carried out calibration of nine Pyranometers under commercial mode at NIWE calibration Laboratory.

10.2.3 Research and Development (R&D) activities undertaken at NIWE

a) NIWE had taken up an Indo-Danish Research Project on **"Maintenance and Repair Strategy for Wind Energy Development"** in collaboration with Denmark Technical University and industrial partners. The objective of the project is to provide the Indian wind energy industry with guidelines and approaches for efficient repair, ensuring the long-term integrity and reliable work of wind turbines.

b) NIWE had taken up an **R&D project entitled "Optimized Design and Operation of Hybrid Power Plant (HYBRIDize)"** - with three (3) year project duration. The objective of the project is to provide a framework for the promotion of a large grid connected wind-solar PV hybrid system for optimal and efficient utilization of transmission infrastructure and land, reducing the variability in renewable power generation and achieving better grid stability.

Fig. 10.13: DST Wind Turbine Instrumentation Work at Kayathar Research Station

10.2.4 Wind Turbine Testing Station (WTTS) & Wind Turbine Research Station (WTRS)

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.

Establishment of Renewable Energy Demo Lab at Wind Turbine Test station at Kayahar, Tamil Nadu: The Renewable Energy Demonstration Lab at Wind Turbine Test Station (WTTS), Kayathar, Tamil Nadu was inaugurated and dedicated to the nation by Secretary to the Government of India, MNRE in the August presence of the Joint Secretary (Wind) and Director General NIWE on 20th August, 2021. This training centre will be used for running major Upskilling and Reskilling Human Resource programs for the benefit of the Renewable Energy Sector.

Fig. 10.14: Renewable Energy Demo Lab at Wind Turbine Test Station at Kayathar, Tamil Nadu

Fig. 10.15: Inauguration of Renewable Energy Demo Lab by Secretary, MNRE

10.2.5 Offshore Wind Development

Marine Spatial Planning for offshore wind farms in Tamil Nadu

Marine Spatial Planning is one of the activities carried out under the Indo-Danish EnergyPartnership Programme's work package on "Enabling framework that streamlines site selection,clearances, and procurement while lowering the risk to investors." This work package is carried outby the Danish Energy Agency (DEA), MNRE, and NIWE. During the year 2021-22, this work package was engaged for the maritime spatial planning for offshore wind farms in Tamil Nadu. Theprimary objective of this study was to identify and prepare an initial implementation plan for 5 GW of offshore wind projects within Tamil Nadu's defined wind zones in order to support the overalltarget of 30 GW by 2030.

10.2.6 Data Analytics

NIWE has undertaken various projects covering Verification of wind monitoring procedure, Energy Yield Assessment, Detailed Project Report preparation, and Project Monitoring Consultancy service. The analysis was completed as per the Industry standard using the wind data and wind flow modelling analysis. The energy yield calculation was made for P50, P75, P90 & P95 for 1, 10 & 20 years and provided to the client in a report. 10 Nos. of consultancy projects to the tune of 500MW will be carried out upto March, 2022.

10.2.7 Standards and certification Division

NIWE is involved in the preparation of Indian standards on wind turbines by supporting Bureau of Indian Standards (BIS). Fifteen Indian standards on wind turbines have been finalized, so far byNIWE. NIWE has obtained accreditation for Certification Services valid up to 15th April, 2023 as per the ISO/IEC 17065 standard from National Accreditation Board for Certification Bodies(NABCB), Quality Council of India.

10.2.8 Training Courses

NIWE has conducted the following International & customized training courses:

i Online International Training Course on "Wind Energy Technology" sponsored by Ministry of External Affairs (MEA), Government of India under e-ITEC programme. The course was attended by 36 participants from 18 ITEC countries.

ii Online Customized Training Course on "Wind Turbine Technology" for the Employees of M/s. Gail (India) Limited and M/s. Oil and Natural Gas Corporation Limited.

10.2.9 Azadi Ka Amrit Mahotsav

NIWE with the support of MNRE has scheduled eight (8) week events of Azadi Ka Amrit Mahotsav to commemorate the 75 years of India's Independence.

10.2.10 Global Wind Day Celebrations 2021

NIWE organizes the Global Wind Day celebration, on 15th June of every year. As part of 2021 Global Wind Day celebration, Drawing and Quiz Competitions on different topics were organized for school students. 1455 students were enrolled for their registration and 470 students participated in the drawing competition from 54 schools and 89 students participated in the Quiz competition from 24 colleges from different districts and states through online platform.

10.2.11 Vayumitra Skill Development Programme

The programme was launched by MNRE through NIWE with an objective to create skilled workforce for the Indian wind energy sector especially the trained manpower for the operation & maintenance of wind farms in the country as per the industry demand/needs so as to achieve the Government of India targets and other future targets. This programme aims to train close to 5000 participants and 900 Trainers in O&M Electrical & Instrumentaion Technician, O&M Mechanical Technician and Site Surveyor for Wind Power Plants and 34 Assessors.

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), Kapurthala is an autonomous Institution under the Ministry of New and Renewable Energy (MNRE), Govt. of India, set up as an apex Institution for carrying out state-of-the-art research and developmental activities, biomass resource assessment, testing, validation and training for promotion of bioenergy in the country.

During the year 2021-22, R&D activities were taken up in the frontier areas including bioethanol and biogas production from agro-residue, biomass cookstove performance, waste biomass conversion to activated carbon, biomass gasification, and solar- biomass hybrid systems. The research carried out was published in reputed journals of the frontier bioenergy area. The Institute took leading role in preparing all technical documents related to bioenergy as entrusted by MNRE time to time. The Institute participated in all technical programs and meetings of the Ministry of New and Renewable Energy, particularly related to bioenergy sector, for discussion on R&D, strategy and policy, progress and dissemination of knowledge and technology in the area.Several projects on different R&D processes for biofuels and bioenergy are going on under different divisions:

10.3.2 Thermochemical Conversion Division: During the FY 2021-22, the division explored the scope of biomass hybrid systems and biomass characterization and developed the following projects to cater the ongoing energy requirement of the country:

(a) **Densification of agro-waste and biomass characterization:** The division carried out biomass characterization of more than 50 different types of biomass, using Proximate Analysis, Ultimate Analysis and by estimating Gross Calorific Value of the samples. The results are analysed to identify suitable biomass for pellets and briquette production.

(b) **Solar Biomass Hybrid dryer:** The division is working on development of Solar Biomass Hybrid drier for drying of agro waste and vegetables in collaboration with Bharat Heavy Electricals Ltd. The R&D focuses on the design of solar thermal system along with biomass combustion chamber for its commercialization.

(c) **Solar Thermal Pyrolyzer for biochar production:** During the year, the division designed a solar thermal energy based pyrolyzer for biochar production. The unique system is designed, which can give biochar along with liquid oil (bio-oil) and syn gases. It is estimated that the obtained biochar can further activated for making activated biochar for various applications. and its application in carbon capturing.

10.3.3 Biochemical Conversion Division: Biochemical Conversion Division has basic facilities of Analytical, Bioprocess, Microbiology and Molecular Biology Laboratories. Various funded and In-house research projects are going on:

(a) Exploration of Lignocellulolytic Enzymes producing Thermophiles from hot springs of Western Himalayan region for Biorefinery Applications

The project titled as above under the Department of Science and Technology (DST) Women Scientist Scheme (WOS-B) (KIRAN Division) has been funded by the DST, Ministry of Science and Technology to Dr. Shivika Sharma under the mentorship of Dr. Sachin Kumar with the total project cost of Rs.32.16 lakh for 3 years. The project aims to explore micro-organism from hot springs of Himachal Pradesh for the application in biofuel production.

(b) Thermophilic anaerobic consortium enrichment for enhanced biogas/ biomethane production:

An in-house project is developed on "Thermophilic anaerobic consortium enrichment for enhanced biogas/ biomethane production". The project is taken up by a Senior Research Fellow under SSS-NIBE Bioenergy Promotion Fellowship.

The main focus of the proposed work is to develop the robust thermophilic bacterial consortium for the enhanced biogas yield or biogas component. To further enhance the biogas yield and enrich the methane component, there are various techniques which could be integrated and optimized with the thermophilic anaerobic digestion process accordingly. The scope of the present study is to enhance biogas production via thermophilic anaerobic consortium to harness maximized energy from a particular waste.

Fig. 10.16: Laboratory-scale plants for biogas production from water hyacinth having different thermophilic inoculums

(c) Upgradation of Biogas to BioCNG

An in-house project is developed on 'Upgradation of Biogas to BioCNG'. The project is taken up by a Junior Research Fellow under SSS-NIBE Bioenergy Promotion Fellowship.

Fig. 10.17: Lab scale biogas plant using agricultural waste

(d) Biogas/ Bio-CNG plant design and standardization

An in-house project is developed on 'Biogas/ Bio-CNG plant design and standardization'. The project is taken up by a Research Associate under SSS-NIBE Bioenergy Promotion Fellowship.

A technology has been developed for anaerobic digestion of crop residues, variety of grasses and kitchen waste using a thermophilic consortium for biogas production at a reduced HRT and enhanced biogas yield. The major objective of the project is to design and develop a biogas/bioCNG plant set-up based on the lab-scale, techno-economic and lifecycle assessment feasibility studies.

10.3.4 Chemical Conversion Division

The Chemical Conversion Division and Electrochemical Conversion Division have carried out following activities for the promotion of bioenergy:

(a) Assessment of biomass residue availability and bioenergy yields in India

The project aims to estimate the energy potential of biomass including agricultural residue, animal manure, MSW, etc. within the project the data on annual crop production, livestock and the human population was primarily obtained from the Ministry of Agriculture and Farmer's Welfare, Ministry of Animal husbandry, Dairying and Fisheries, the Report on Sustainable Waste Management in India, 2012 and the Census of India, 2011. After assessing the data, it is found that the technical potential of bioenergy of the residues collectively is 3649 PJ in 88581 million cubic metres of biogas or 1797 PJ in 78832 Million litres of cellulosic ethanol.

(b) Integrated Analysis of Increased Bioenergy Futures in India in context of sustainability

This work modelled future bioenergy pathways in India to understand four crucial dimensions of sustainability: water availability, greenhouse gas emissions, air pollution, and land-use change. For modelling, the Global Change Analysis Model (GCAM) was used. GCAM is an integrated assessment model that includes detailed depictions of India's socioeconomics, energy system, land use, agriculture, water availability & use and emissions. The GCAM model tests the sustainability of increased bioenergy demand in India. The relevant assessed data is provided to PNNL(Pacific Northwest National Laboratory, USA) for further assessment and progress to achieve the desired objective.

(c) Setting up Biomass based Hydrogen and Fuel Cell Lab

Laboratory set up is being established for Fuel cell and hydrogen Energy. R&D activities have been initiated in the area of renewable energy through electrochemical conversion of fuels/ bio-fuels in fuel cell by designing inexpensive biomass derived electro-catalysts. The research is primarily focused on biomass-based nano-carbon hybrid materials for state-of-the-art energy storage and conversion system for renewable energy generation. We are in progress in developing a fuel cell, hybrid biofuel cells and supercapacitor for clean and self-sustainable energy storage devices, biomass-based biofuel cell and electrochemical study of nano-porous carbon materials. NIBE is working on developing low-cost fuel cells for the production of clean energy.

Specified areas identified for R&D works in line with recently adopted R&D Policyof MNRE are:

i. Advanced Biomass-based Functional Nanomaterials for Energy and Environmental Applications like Fuel cell (PEMFC), Water Splitting, Electrochemical CO_2 conversion etc.

ii. Electrochemical applications: Porous hetero atom doped carbons from renewables, graphene/ CNT composites, biomass derived carbon supported mesoporous metal oxides etc. for Fuel cells, Supercapacitors among others.

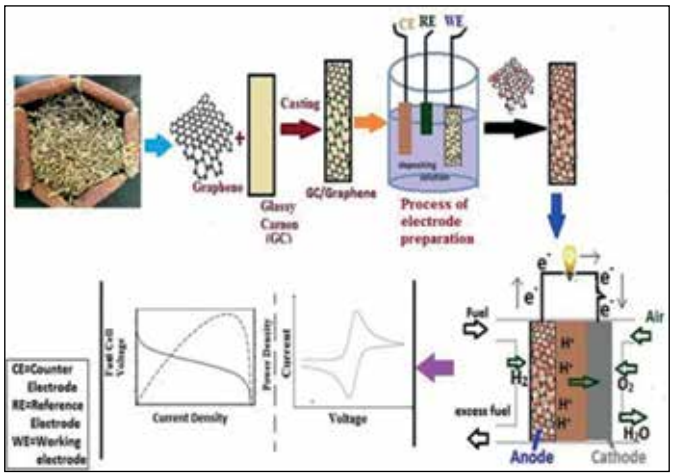

Fig. 10.18: A schematic of the activities planned for Fuel cell and hydrogen laboratory

(d) Hydrogen separation through membrane technology:

R&D works has been initiated for hydrogen production through gasification technology though water gas-shift reaction. The main purpose of water gas-shift reaction is to increase the hydrogen yield, then after purification technology is applied for the hydrogen separation from other gases. In this project, water gas shift reaction and purification technology are integrated using metal memberane, which increases the yield.The project has been formulated with technical collaboration of CSIR, CMERI, Ludhiana.

10.3.5 R&D activities under Mission Mode:

10.3.5.1 National Mission on Use of Biomass in Thermal Power Plant: Ministry of Power initiated the National Mission on Use of Biomass in Thermal Power Plant, under which the institute is nominated as member of Subgroup I and Subgroup IV.

Activities under Sub-group I:The Subgroup I team is working on R&Ds of Biomass Pellets and Briquettes and has formulated a project for agro-residue based fuel characterization and composition analysis in the state of Punjab and Haryana. The important parameters that will be studied extensively includes, calorific value (CV) and CV loss due to storage, sulphate and chloride contents in biomass, ash fusion and complete ash analysis etc.

This project proposal cost is Rs. 256 lakh of which Rs. 111 lakh for dedicated equipment and facility creation. The project is under consideration for sanction at the Mission Directorate.

Activities under Sub-group IV: The institute has been nominated as Coordinating Laboratory for Testing of Solid Biofuels including Biomass Pellets and Briquettes. A tentative budget of Rs.109.30 lakh has been submitted for developing the testing facilities.

10.3.5.2 External Projects

The institute has awarded a research project titled 'Exploration of lignocellulolytic enzymes producing thermophiles from hot springs of Western Himalayan region for biorefinery applications' under DST Women Scientist Scheme: WOS-B (KIRAN Division). The project cost is Rs. 32.16 lakh for 3 years duration.

10.3.6 Publications

During 2021-22, Seven (7) publications across various journals, conference Reports, and books, were brought out by scientists working in the Institute.

10.3.7 Academic Programmme in Renewable Energy

The institute started an academic course of Masters in Technology in Renewable Energy, in joint collaboration with Dr B R Ambedkar National Institute of Technology (NIT) Jalandhar during 2020. In the current year, the second batch of M Tech in Renewable Energy for Academic Session 2021-22 was started in August, 2021. The students of Academic Session 2020-21 are undergoing M Tech thesis work at NIT-J, NIBE, NISE and NIWE.

The PhD programme was also started in joint collaboration with Dr B R Ambedkar National Institute of Technology (NIT) Jalandhar for Research fellows working in the institute.

10.3.8 Training Programmes

10.3.8.1 National training programme on Biofuel Production & Application for Transportation- Recent Advances and Future Prospects

A one-day virtual National training program on "Biofuel Production & Application for Transportation – Recent Advances and Future Prospects" was held on 1st October, 2021 at SSS-NIBE under the umbrella of "Azadi Ka Amrit Mahotsav". During the training program various topics including Bio-diesel, Bio CNG & CBG, Hybrid Biofuels, Green Diesel, Pyrolysis oil, Ethanol, Hands on display of working with production plants, process and analytical equipment were elaborately covered.

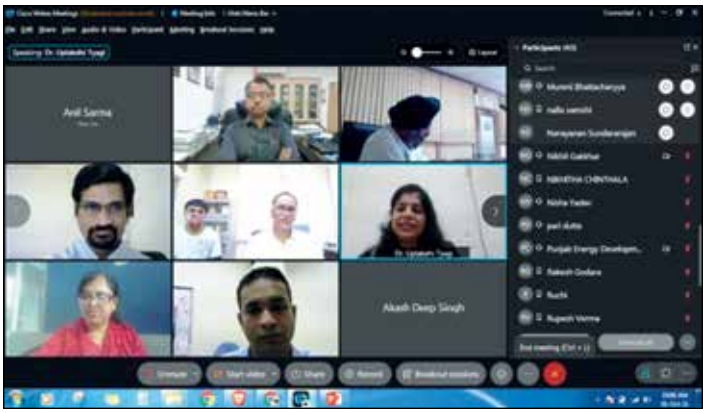

Fig. 10.19 :Inaugural Session of National Training Program on Biogas Technology and its Implementation

10.3.8.2 National Training Programme on Biogas Technology and its implementation

A 2-day national training programme on 'Biogas Technology and its Implementation' was organized during 25-26 November, 2021 in a virtual mode in collaboration with Indian Biogas Association (IBA). The participants from all over the country participated through online mode.

Fig. 10.20: A screenshot of virtual training programme

The training programme was organized in four modules: Biogas Process and Design; Biogas Operation & Maintenance; Biogas Upgradation; Policy & Financing. During the two days, the various experts including Prof. PMV Subbarao, IIT Delhi; Dr Shanmugham, CSIR-CLRI, Chennai; Dr Vivekanada, MNIT, Jaipur; Dr Ram Chandra, IIT Delhi; Sh. Gaurav Kedia, IBA; Sh. Abhijeet Mukherjee, IBA; Sh. Srinivas Kasulla, Arka Brenstech Pvt. Ltd., Gurugram; Sh. Dhruv, Spectrum Energy Ltd., Gurugram; Sh.SR Meena, MNRE; Ms. Kanchan Bhalla, IREDA; Sh. Bikram Kumar Singh, SBI; Sh. Siddharth Prabhakar, Canara Bank delivered their lectures through online mode. The certificates were distributed to all the participants on successful completion of the 2-day national virtual training programme.

10.3.9 International Collaboration

i. The US South Asia Group for Energy (SAGE) collaboration was continued in this year with Lawrence Berkeley National Laboratory (LBNL) and Pacific Northwest National Laboratory (PNNL).

ii. Collaboration between NIBE and SAGE are going on through regular online meetings on three projecrs i.e. Cookstove, Resource Projection and Biomass Hybrid systems.

iii. LBNL Team has been training the Team of NIBE with strong intent to develop cookstove lab of the institute at par with ISO standards. The National Cookstove test center would be upgraded as 'Center of Excellence.

iv. The next phase of collaboration will focus on collaborative projects/ study on biomass-based hydrogen, sustainable farming etc.

10.3.10 Coordination Activities

SSS-NIBE has signed Memorandum of Understanding (MoU) with different organizations to operate a collaborative venture for the development and dissemination of bio-energy through academic and research. The list of MoUs are given in **Table 10.2**.

Table 10.2: MoUs signed by NIBE

Sl. No.	MoU	Date of MoU Signed	Date of MoU valid upto
1.	SSS NIBE & National Institute of Wind Energy	8 February 2021	7 February 2026
2.	SSS NIBE & CSIR - Central Mechanical Engineering Research Institute, CoEFM, Ludhiana	31 July 2021	30 July 2026
3.	SSS NIBE & Association of Renewable Energy Agencies of States, Delhi	27 August 2021	26 August 2026
4.	SSS NIBE & Punjab Energy Development Agency (PEDA), Chandigarh	8 September 2021	7 September 2026

10.4 SOLAR ENERGY CORPORATION OF INDIA LIMITED (SECI)

I0.4.1 Introduction

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).

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

During FY 2020-21, it registered a total revenue of Rs. 5,464.68 crore and Profit After Tax (PAT) of Rs. 177.71 crore. The company is debt-free and enjoys AAA credit rating.

10.4.2 Business Activities

10.4.2.1 Tenders for Solar projects under National Solar Mission

SECI is an implementing agency of MNRE for development of solar projects under the National Solar Mission (NSM). Under this mode (referred as developer-mode), 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. Investment in these projects is made by the respective project developers. SECI signs long term Power Purchase Agreements (PPA) with the developers and long term Power Sale Agreements (PSA) with various DISCOMs for offtake of power, as a power trading intermediary.

Earlier, SECI used to float tenders under Viability Gap Funding (VGF) schemes of MNRE (NSM Ph-II, Batches-I, III & IV). Tenders under CPSU scheme (Phase-II), Manufacturing linked solar and floating solar have also been awarded in earlier years. Presently, tenders are being floated on tariff-based bidding based on Standard Bidding Guidelines.

During FY 2021-22, SECI has issued tenders for 1200 MW capacity. The cumulative awarded capacity is 32.69 GW of solar projects and 3 GW capacity of manufacturing facilities. Of this, 9.09 GW capacity of projects have been commissioned (till 31.12.2021).

Fig. 10.21: 600 MW Solar projects installed under ISTS 1 tender

Fig. 10.22: 300 MW Solar Projects installed under ISTS IV tender in Karada, Jaisalmer

10.4.2.2 Tenders for Wind Power Projects

SECI brings out tenders for setting up of large-scale Wind Power Projects on Pan-India basis in developer-mode, towards fulfilment of National target.

The company has issued tenders for 2400 MW capacity, out of which 1200 MW capacity is awarded during FY 2021-22 (till 31.12.2021), thereby bringing the cumulative awarded capacity (Wind) by SECI to 12730.7 MW. Of the awarded capacity, 3.69 GW has been commissioned (till 31.12.2021) and balance capacities are under various stages of implementation.

10.4.2.3 Tenders for Hybrid Projects

To cater to demand for bringing firmness and flexibility in RE power, SECI comes up with innovative tenders, viz. Solar-Wind Hybrid Projects, RE with assured supply during peak hours and Round the Clock (RTC) RE Power.

During FY 2021-22, SECI has issued tenders for 2400 MW capacity and has awarded 1200 MW, bringing the total awarded capacity to 5350 MW (till 31.12.2021). Out of this, 201.18 MW of hybrid projects have been commissioned till 31.12.2021.

Fig. 10.23: Wind Turbine installed in Hybrid Tranche I-2X 195 MW Hybrid Project at Jaisalmer (Rajasthan)

Fig. 10.24: 2x195 MW Project under Hybrid Tranche I at Jaisalmer (Rajasthan)

10.4.2.4 Grid Connected Roof-Top Programme

SECI has played a pivotal role in promoting Rooftop Solar through competitive bidding route in the country under various schemes of MNRE.

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. 78.39 MW capacity of projects were awarded to various developers, of which more than 20 MW has been commissioned. Other projects are under execution or inspection.

10.4.2.5 Other Schemes of MNRE for promotion of RE

SECI is also implementing other schemes of MNRE in which it is tasked with disbursal of Central Financial Assistance (CFA) to the respective implementing agencies based on progress milestones. Major schemes are: (a) Solar Parks Scheme (MNRE has allocated 33821 MW of solar parks, of this 6680 MW of Solar Park Infrastructure has been completed (as on 31.12.2021) (b) Canal Top/ Canal Bank Scheme (94 MW projects have been commissioned) and (c) Scheme for Defence Establishments (181.4 MW of projects have been commissioned).

Further, Solar Parks in the states of Andhra Pradesh, Karnataka, Madhya Pradesh, Kerala, and Uttar Pradesh are being implemented through Joint Venture companies of SECI with the respective state designated agencies.

10.4.2.6 Project Development

Apart from implementation of tenders and schemes for setting up of large-scale Solar and Wind Projects through third party investments, SECI also engages in development of RE projects through its own investment. The company also offers Project Management Consultancy Services to other Government Agencies and PSUs for RE projects. Some of these initiatives are listed below:

i **Projects under PMC-**SECI is implementing about 131 MW of projects for various entities under PMC mode and about 287 MW capacity (cumulative) has been commissioned. Some of the major projects include 300 MW Singareni Collieries Company Ltd, 50 MW Project for IREDA, 50 MW Solar Project for THDC and 15 MW for BEL.

ii SECI has also undertaken Feasibility Studies for Damodar Valley Corporation (DVC). These include Floating Solar PV (FSPV)– 48 MW, Ground Mounted PV-75 MW; Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd (UPRVUNL)–7 Locations; Bhakra Beas Management Board (BBMB) – 30 MW FSPV, Singareni Collieries Company Ltd–250 MW FSPV.

iii **CAPEX Projects-** SECI has operational projects of 21 MW capacity under its ownership and the company is looking to expand its portfolio in Renewable Energy. Details of existing and ongoing projects are shown in **Table 10.3**.

Table 10.3: Renewable Energy Portfolio of SECI

Sl. No.	Name	Location	Capacity (MW)	Status
1.	Solar	Badi Sid, Rajasthan	10	Commissioned
2.	Rooftop solar	Andaman & Nicobar Islands	1	Commissioned
3.	Solar	Kolar, Karnataka	10	Commissioned
4.	Solar + BESS	Leh, Ladakh	20	Under execution
5.	Solar + BESS	Rajnandgaon, Chhattisgarh	100	EPC contract awarded in _ Project is under execution
6.	Solar	Chhattisgarh	100	Under approval
7.	Solar-wind-BESS hybrid	Ramagiri, Andhra Pradesh	200	Under approval
8.	Floating solar	Getalsud Dam, Jharkhand,	100	Under approval

Sl. No.	Name	Location	Capacity (MW)	Status
9.	Solar + BESS	Lakshadweep	1.95	Under execution
10.	Solar (under CPSU scheme)	Various locations	1200	Project locations are being identified
11.	Solar + Agro PV	Villupuram, Tamil Nadu	50	Under approval

10.4.2.7 Power Trading

SECI has been entrusted responsibility of purchasing power from projects under Solar Wind, Hybrid and any other innovative projects like RTC, Peak Power tenders, with or without batteries by the Government of India and selling it to various DISCOMs etc. through long term PPAs/ PSAs. SECI has a Category I Trading License from Central Electricity Regulatory Commission (CERC) to carry out power trading on pan-India basis. The company trades renewable power generated from projects set up through SECI tenders as an intermediary procurer. SECI has signed PSAs amounting to 38.155 GW (till 31.12.2021). In FY 2020-21, the company has traded 14819 million units of RE power with 29 DISCOMs. In FY 2021-22, the company has traded 16103 million units (as on 31.12.2021) of RE power with 29 DISCOMs. The following PSAs (**Table 10.4**) are under active discussion/under final stage of signing and expected to be executed by 31.03.2022.

Table 10.4: Power Purchase Agreements of SECI

Sl. No.	Capacity (MW)	Category	Buying Utilities
1.	1785	Solar	Rajasthan (RUVNL)
2.	1000	Solar	Telangana Discoms
3.	490	Peak power (Solar+Pumped Storage)	Rajasthan (RUVNL)
4.	300	Solar	J&K
5.	300	Solar	Kerala (KSEBL)
6.	210	Peak power (Solar+Pumped Storage)	Bihar (BSPHCL)
7.	100	RTC	Indian Railways
Total (MW)	**4185**		

10.4.3 New Initiatives

SECI is undertaking several new initiatives for expansion of RE sector and development of new technologies. Major areas being explored are: Development of RE projects in high-altitude areas and islands, Charging of electric vehicles through RE, Promoting cultivation beneath Solar panels, Energy Storage, Promotion of Green Hydrogen & Green Ammonia for industrial use, scaling up Waste to Energy plants among others.In these areas, the company is exploring opportunities and collaborating with other stakeholders for further activities.

10.4.4 Financial Performance

Highlights of Financial performance for fiscal year 2020-21, with comparative position of the previous year, are mentioned in **Table 10.5**.

Table 10.5: Financial Parameters of SECI in Fiscal Year 2020-21

Amount (Rs. in crore)

Particulars	FY 2020-21	FY 2019-20 (for comparative reference)
Share capital	354.00	354.00
Net Worth	873.58	695.72
Total Revenue	5,464.68	4,657.73
Profit / (Loss) Before Tax	237.59	232.65
Profit / (Loss) After Tax	177.71	178.94

i The total income of the company by way of Trading of Power, Project Monitoring Fees, Sale of Power of own Project and other income is Rs. 5,464.68 crore as against corresponding previous year figure of Rs. 4,657.73 crore registering an increase of 17.32%.

ii Profit before tax works out to Rs. 237.59 crores as against the previous year figure of Rs. 232.65 crore and profit after tax (PAT) is Rs. 177.71 crore as against the previous year figure of Rs. 178.94 crore. Thus, registering an increase in PBT of 2.12% & decrease in PAT by 0.69%.

iii The Net Worth of the company stood at Rs. 873.58 crore as against the figure of Rs. 695.72 crore for the previous year, registering an increase of 25.57%.

10.5 INDIAN RENEWABLE ENERGY DEVELOPMENT AGENCY LIMITED (IREDA)

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 2020-21, IREDA has sanctioned loans to the tune of Rs.11,001.30 crore (corresponding previous year Rs.12,696.11 crore) and disbursed Rs.8,826.64 crore (corresponding previous year Rs.8,785.31crore). The above said sanctioned loan (includes co-financed projects/ takeover loans) would support capacity addition of 6,965.82 MW. The sector wise breakup of sanctions and disbursements for the said period and the calendar year 2021 are given in **Table 10.6**.

ii. The sector-wise break-up of cumulative sanctions and disbursements up to 31.12.2021 and projected sanctions and disbursements for the period from 01.01.2022 to 31.03.2022 are given in **Table 10.7**.

Table 10.6: IREDA – Sector-Wise Break-up of Loan Sanctions and Disbursements During FY 2020-21

IREDA – Sector-Wise Break-up of Loan Sanctions and Disbursements During FY 2020-21			Sector-Wise Break-up of Loan Sanctions and Disbursements from 01.01.2021 to 31.12.2021	
(Rs. in crore)				
Sector	**Sanction**	**Disbursement**	**Sanction**	**Disbursement**
Wind Power	524.72	900.65	943.04	555.68
Hydro Power	806.82	682.91	769.48	359.85

IREDA – Sector-Wise Break-up of Loan Sanctions and Disbursements During FY 2020-21			Sector-Wise Break-up of Loan Sanctions and Disbursements from 01.01.2021 to 31.12.2021	
(Rs. in crore)				
Sector	**Sanction**	**Disbursement**	**Sanction**	**Disbursement**
Biomass and Cogeneration	146.87	36.91	74.98	26.16
Energy Efficiency & Conservation	9.91	14.16	12.79	10.39
Solar Energy	2,289.49	1,775.19	3,182.73	2,561.90
Waste to Energy	93.01	147.17		100.87
Biomethanation from Industrial Effluents				
Biomass Briquetting				
Biomass Gasification			22.79	7.33
National Clean Energy Fund (NCEF)				
Bill Discounting				
Bridge Loan	10.81	4.00		
Short Term Loan	4,715.49	4,749.55	8,592.45	6,956.15
Miscellaneous (Guarantee Scheme / Energy Access / Manufacturing / Ethanol / LoC / Transmission / Hybrid / GECL)	2,404.18	516.10	1,766.90	664.18
Total	**11,001.30**	**8,826.64**	**15,365.16**	**11,242.52**

Table 10.7: IREDA Sector-Wise Break-up of Cumulative Loan Sanctions and Disbursements up to 31.12.2021

IREDA – Sector-Wise Break-up of Cumulative Loan Sanctions and Disbursements up to 31.12.2021			Projected Sanctions and disbursements from 01.01.2022 to 31.03.2022	
(Rs. in crore)				
Sector	**Cumulative Sanction**	**Cumulative Disbursement**	**Sanction**	**Disbursement**
Wind Power	27,403.04	18,638.65	1000.00	800.00
Hydro Power	9,593.99	5,704.30	1353.00	1,050.00
Biomass Power and Cogeneration	5,507.75	3,549.22		20.00
Energy Efficiency & Conservation	1,288.89	357.64		
Solar Energy	30,327.85	17,481.61	2500.00	1,700.00
Waste to Energy	961.29	494.68	227.00	145.00

IREDA – Sector-Wise Break-up of Cumulative Loan Sanctions and Disbursements up to 31.12.2021			Projected Sanctions and disbursements from 01.01.2022 to 31.03.2022	
(Rs. in crore)				
Sector	**Cumulative Sanction**	**Cumulative Disbursement**	**Sanction**	**Disbursement**
Biomass (Briquetting, Gasification & Bio-methanation from Industrial Effluents)	127.16	80.04	157.90	38.90
National Clean Energy Fund (NCEF)	156.57	127.14		
Bill Discounting	181.97	161.76		
Loan Facility to Govt. Bodies / Discoms/ Transcos /State Owned Trading Cos (*)	24,614.66	21,041.21	2315.00	3,415.00
Bridge Loan	223.86	156.14		
GECL	264.35	224.33		
Miscellaneous (Guarantee Scheme / Energy Access / Manufacturing / Ethanol / LoC /Transmission / Hybrid / Electric Vehicle)	4,364.59	833.72	4040.95	700.75
TOTAL	**1,05,015.97**	**68,850.45**	**11,593.85**	**7,869.65**

(*) Including Short Term Loans to private entities prior to 28.12.2021 in cumulative achievements.

10.5.3 MoU with MNRE

IREDA has signed a Memorandum of Understanding (MoU) with the Ministry of New and Renewable Energy (MNRE), Government of India setting key targets for the year 2020-21. The performance of Company is rated as "Excellent".

10.5.4 MoU for Green Energy Collaborations

IREDA has signed Memorandum of Understanding (MoU) with several leading CPSEs / Government organizations viz. SJVN, NHPC, TANGEDCO, NEEPCO, BVFCL & THDCIL during the calendar year 2021. Under these MoUs, IREDA proposed to undertake Techno-Financial due diligence of Renewable energy and Energy Efficiency & Conservation projects for the partnered organization. IREDA will also assist in developing an action plan to create and acquire Renewable Energy projects, debt raising through developing financial models, assistance in understanding market instrument, underwriting services and extend its techno-commercial expertise for Green Energy projects.

10.5.5 Resource Mobilisation

The total Borrowings of IREDA stood at Rs.24,000 crore as on March 31, 2021 as against Rs.21,853.55 crore in the previous year.

Paid up capital of IREDA is Rs. 784.60 crore with a net worth of Rs. 2,995.19 crore based on the financial results for the year ended March 31, 2021. During 2020-21, IREDA has raised Rs. 559.15 crore through external resources apart from Rs. 3,609.99 crore through domestic resources.

10.5.6 Dissemination of Information

IREDA continued to create awareness of Renewable Energy technologies, Energy Efficiency and Conservation (EEC) and also its financial assistance schemes by hosting its publications on its website. In order to ensure effective internal communication, a monthly E-bulletin "Odyssey" is hosted on intranet portal. "IREDA Voyage" covering IREDA's initiatives, achievements, awards and accolades etc. is being published annually, which is available at its intranet portal as well as website. For continual positive image-building of the organization media coverage and social media platforms are effectively being utilized by IREDA.

10.5.7 Government Schemes

IREDA is taking up the strategic role of Implementing Agency under Production Linked Incentive (PLI) Scheme for High Efficiency Solar PV Modules for setting-up Solar Manufacturing facilities. The financial outlay for PLI over a five-year period is Rs.4,500 crore. The Scheme envisages to support setting up of integrated manufacturing units of high efficiency solar PV modules by providing Production Linked Incentive (PLI) on sales of such solar PV modules. In response to the Bid Document issued under the PLI Scheme by IREDA, 18 applications were received. Post techno-commercial evaluation, successful applicants have been issued Letter of Award (LoA) for support under the scheme for a total outlay of Rs. 4500 crore.

Further, in line with the CPSU Scheme Phase-II (Government Producer Scheme) for setting up 12,000 MW grid-connected Solar Photovoltaic (PV) Power Projects by the Government Producers with Viability Gap Funding (VGF) support for self-use or use by Government/Government entities, IREDA has conducted e-reserve VGF Based Bidding (Tranche-III) for 5,000 MW capacity. The Letter of Award (LoA) to all the successful bidders have been issued in line with the results of the e-reverse auction carried out on 23rd September, 2021.

10.5.8 Human Resource Development

IREDA values its most important resource i.e. its competent manpower as key assets and core element of organizational success. A safe and inclusive work environment is maintained across the Company, wherein employees can grow both professionally and personally. In light of the unprecedented COVID-19 pandemic, the Company adopted Work from Home facility for all employees. IREDA has taken several initiatives to contain COVID-19 & constituted an exemplary 'COVID Care Response Team' which continuously took care of COVID-19 positive employees and their family members. The Team helped employees and their family members by regular counselling and providing them with all necessary support including delivery of food and medicines, hospitalization, plasma donation, Oxygen Concentrators, Oxygen Cylinders etc. The vaccination drive was also carried out for the safety of its employees.

'Strengthen capabilities' has been the focus area all along in the Company's pursuits towards structured Human Resource Development. In this COVID-19 landscape, the Company has seamlessly moved most of its training regimen onto digital platforms, thereby minimizing any disruption to the knowledge upgradation of its workforce and ensuring their safety. Several In-House virtual training programs were conducted for employees through lecture series and other focused development training programs. IREDA employees were nominated for various programs like training on 'Fundamentals of Credit Analysis', 'Network & Security Administration', 'Resilient Talent Management', 'Human Resource Management in Banks and FIs' conducted by external training agencies through virtual mode. Twenty-One women employees participated in 'Women as Leaders' program conducted by external training agency. The employees participated in virtual trainings around COVID-19 such as 'Mantra on Financial Freedom during COVID-19', 'WASH standard to mitigate COVID-19 risks.

E-Learning policy was introduced for the capacity building of our employees by giving them an opportunity to attend e-learning programmes of premier institutes in their relevant fields, technical & managerial competencies, leadership, self- development, general management programs etc. During the year, the Company achieved a total of 526 man-days of training.

IREDA celebrated International Yoga Day, Vigilance Awareness Week, Hindi Pakhwada and Swachhata-cleanliness and awareness drives during the year under all COVID-19 Protocols. IREDA strictly observe the reservation policy of the Government of India as applicable in the categories belonging to Scheduled Castes/ Scheduled Tribes/ Other Backward Communities/ Person with Disabilities & EWS. IREDA is following the reservation rosters prescribed by the Government. Employee relations continued to be very cordial and harmonious during the financial year. There were no man-days lost during the period under review.

Total number of employees, as on 31.12.2021 is 156 excluding Board Level Executives, comprising 38 female and 118 male employees.

10.5.9 Corporate Social Responsibility /Sustainable Development

IREDA strongly believes in committing to operate in an economically, socially and environmentally sustainable manner. The Company's Corporate Social Responsibility (CSR) initiatives are based on this principle and resonate with Government of India goals as well as the Sustainable Development goals outlined in its policy.

The Company spent Rs.7.08 crore during the year 2021(1st January, 2021 to 31st December, 2021) on CSR activities for the projects which were completed/ongoing during the year (including Rs.5.25 crore spent for the projects which were sanctioned before the year 2021. 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.

During the period January to December, 2021, following activities were undertaken by the IREDA Company under its CSR initiatives as shown in **Table 10.8**.

Table 10.8: CSR Initiatives undertaken by IREDA during the year 2021 (1st January, 2021 to 31st December, 2021)

S. No.	Description	Rs. in lakh
1.	Provision for 500 LPM Medical Oxygen Generation Plant & 125 KVA generator at Community Health Centre Kapkot, District Bageshwar, Uttarakhand	96.97
2.	Provision for 500 LPM Medical Oxygen Generation Plant & 125 KVA generator at Siddharthnagar, Uttar Pradesh	96.97
3.	Provision for Solar PV Systems (5 KW) at 08 Primary Health Centers at Aspirational District- Balrampur, Uttar Pradesh	47.88
4.	Provision for 04 Medical equipments at District Hospital, Aspirational District-Chandauli, Uttar Pradesh	47.98
5.	Provision for Solar PV Systems 03 Govt. Joint Hospitals (30 KW), 11 Community Health Centers (10 KW) and 23 Modern Primary Health Centers (5 KW) at Aspirational District- Chandauli, Uttar Pradesh	393.77
6.	Provision for Infrastructure development 10 Govt. School, Aspirational District-Balrampur, Uttar Pradesh	107.75

S. No.	Description	Rs. in lakh
7.	Provision for Solar PV Systems (3 KW) & 50LPH RO water vending machine at 15 Govt. schools in Mirzapur, Uttar Pradesh	59.85
8.	Provision for "Therapy on Wheels" -Mobile Medical Van at Kullu, Himachal Pradesh	18.04
Total Sanctioned amount during the year 2021		**869.21**

Table 10.9: Projected Sanctions and disbursements under CSR from 01.01.2022 to 31.03.2022

Projected Sanctions	Rs. 2.50 crore
Projected Disbursements	Rs. 10.42 crore

CHAPTER 11

SUPPORT PROGRAMMES

11.1 INFORMATION AND PUBLIC AWARENESS PROGRAMME

11.1.1 India is a part of global renewable energy transition and stands among the top five countries in the world in terms of renewable energy capacity. The Ministry has worked systematically for putting in place facilitative policies and programmes for achieving the goal. In order to percolate the initiatives, benefits and usage of renewable to the masses, information dissemination and publicity is essential. In this background, I&PA programmes for renewable energy are conceptualized and developed for implementation.

11.1.2 In compliance with the instruction issued by Department of Expenditure, Ministry of Finance for Third Party Evaluation of all Central Sector Scheme, the Information and Public Awareness programme (I&PA) of MNRE was also evaluated by Indian Institute of Public Administration (IIPA). The Evaluation team found that the implementation of the scheme on "Information and Public Awareness Programme" is meeting the desired objectives. The scheme has largely been effective in the promotion of renewable energy, in its overarching objectives. As such, the study team, recommended for continuation of the scheme However, it made some recommendations for strengthening the existing programme in the changing scenario of information age in order to make it more efficient and cost effective, which include need to showcase itself on the new social media platformsincluding Facebook, Instagram, LinkedIn, YouTube, etc. For this purpose, the Evaluation team recommended that Ministry may also consider designing an In-House Studio under the I&PA division for the creation of graphics, creative designs, and short video films on the basis of content supplied by MNRE and for maintaining and updating all the web pages of MNRE. Accordingly, a Social Media Cell (In-House Studio) has been set up in the Ministry by Broadcast Engineering Consultants India Limited (BECIL), a Mini Ratna Public Sector Enterprise of Govt. of India.

11.1.3 The Programme is implemented using Government channels viz. (i) Bureau of Outreach and Communication (BOC), (ii) National Film Development Corporation (NFDC); (iii) Doordarshan;(iv) All India Radio (AIR); (vi) State Nodal Departments/Agencies for renewable energy; and (vii) NGOs/ Academic institution, etc., and participation in exhibitions of national importance by the Ministry and also through other relevant Institutions/Organizations. It is also providing information and awareness through its three autonomous Institutions i.e. NISE, NIWE and SSS-NIBE and two PSUs i.e. IREDA and SECI extensively.

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

i. The Ministry of New and Renewable Energy in association with FICCI, participated in the Climate and Biodiversity Week from 1st October, 2021 to 8th October, 2021 at World Expo 2020 Dubai, to showcase India's achievements in Renewable Energy (RE) capacity enhancement and future plans for scaling up capacity in existing RE sectors, as well as initiating capacity addition in new and emerging areas like green hydrogen, battery storage, to name a few. The events covered the themes of India's Renewable Energy Achievements and Ambitions, Emerging Areas and Opportunities for RE in India and also focused events anchored by the SECI and IREDA. In order to showcase the India's Renewable journey and future plans to achieve our commitment as NDC, digital contents on 12 themes touching different aspects of RE including schemes/organizations involved were prepared and displayed on digital screens installed in the MNRE Sector Pavilion in the World Expo 2020 Dubai.

ii. Logo Supports were extended to different events/exhibitions on Renewable Energy.

iii. Several events such as webinar, workshop on the Ministry's programmes, schemes, achievements and future plans etc. were organized under Azadi Ka Amrit Mahotsav and posted on social media platforms and also uploaded on the nodal Ministry's portal i.e. Ministry of Culture.

11.2 HUMAN RESOURCES DEVELOPMENT

11.2.1 Human Resource Development (HRD) scheme of MNRE supports trainings formanpower at all levels including promoting higher studies and research courses in R&D, and academic institutions in Renewable Energy by providing Fellowships to students and research scholars. Support is also provided to R&D and academic institutes for upgradation of their libraries and laboratories for conducting higher degree courses at the Post-Graduate and Doctoral levels in New and Renewable Energy. Under short term training programmes of HRD programme, a Skill Development Programme named ***Suryamitra*** was introduced in 2015 to train 50,000 skilled manpower to create trained workforce for installation, commissioning, operation and maintenance of Solar Energy projects.

The following are the various components of the HRD scheme:

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

ii. Suryamitra and other Skill Development programmes in Solar Water Pumping and Vayumitra training programme in Wind power area.

The following Fellowship programmes are supported by the Ministry:

i. National Renewable Energy Fellowship (NREF) Scheme for pursuing M.Sc./M.Tech/ PhD/ PDF degree courses.

ii. National Renewable Energy Science Fellowship Scheme for eminent scientists working in research institutes with an innovative idea in solar energy.

iii. Support to higher educational institutions for laboratory upgradation.

iv. National Renewable Energy Internship scheme (NREI).

11.2.2 National Renewable Energy Fellowship Scheme

MNRE continued its support to students and scholars for pursuing higher studies such as M.Sc, M.Tech, Ph.D, courses in Renewable Energy in 9 selected Educational Institutions by providing fellowships or stipend under NREF Scheme. In the year 2021-22, 41 no. Ph.D, 24 no. M.Tech or M.E and 11 no. M.Sc fellowships were being provided through Direct Benefit Transfer (DBT). The list of supported institutes are given in **Table 11.1.**

Table 11.1: Institutions supported by MNRE Fellowships under NREF Scheme in 2021-22

S. No.	Institutions to which Fellowships provided (M. Sc, M.Tech, JRF/SRF (Ph.D))
1.	Indian Institute of Technology, Kharagpur
2.	Indian Institute of Technology, Roorkee
3.	Pune University, Pune, Maharashtra.
4.	Pondicherry University, Puducherry.
5.	Shri Mata Vaishno Devi University, Katra, J&K.
6.	Cochin University of Science and Technology, Kochi
7.	Indian Institute of Engineering Science & Technology, Shibpur, West Bengal
8.	University of Lucknow, Lucknow.
9.	National Physical Laboratory (NPL), CSIR, New Delhi
10.	National Institute of Bio-Energy, Kapurthala - National Institute of Technology, Jalandhar

11.2.3 Skill Development Programmes and Trainings in Solar Energy

(a) **Suryamitra Training:** Ministry launched Suryamitra Skill Development Programme in the year 2015 to train 50,000 Suryamitras by the year 2020 and against this target, 47,166 nos. Suryamitras were trained by March, 2020. In FY 2020-21, a target of training of 4,500 Suryamitras have been allocated to National Institute of Solar Energy (NISE), Gurugram and against this 3371 no. Suryamitras were trained and 1038 no. Suryamitras are undergoing training as on 31st December, 2021. These training programmes are being organized through Training Centres and partner organisations in different states across the country empanelled through Expression of Interest (EOI) floated by NISE. A total number of 50,537 Suryamitras have been trained by December, 2021. The state-wise progress of the Suryamitra programme from FY 2015-16 to 2021-22 is shown in **Table 11.2**.

Table 11.2: Progress of number of Suryamitras trained in different States (2015-16 to 2021-2022):

Sl. No	State/UTs	No. of Suryamitra trained						
		FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	FY 2019-20	FY 2020-21 and FY 2021-22 (upto 31.12.2021)	Total
1	Andhra Pradesh	235	398	211	464	488	210	2006
2	Arunachal Pradesh	30	0	0	0	0	0	30
3	Assam	30	151	252	400	561	90	1484
4	Bihar	30	402	287	420	568	180	1887
5	Chandigarh	0	0	58	90	90	0	238
6	Chhattisgarh	90	369	408	360	778	120	2125
7	Delhi	50	0	181	201	240	30	702
8	Goa	30	30	54	60	117	30	321
9	Gujarat	297	954	335	550	856	270	3262
10	Haryana	52	121	374	390	480	30	1447
11	Himachal Pradesh	0	36	138	150	120	30	474
12	Jammu & Kashmir	26	0	60	158	306	30	580
13	Jharkhand	0	152	185	180	269	60	846
14	Karnataka	90	420	513	348	363	81	1815
15	Kerala	57	176	120	142	240	30	765
16	Lakshadweep	0	0	30	0	0	0	30
17	Madhya Pradesh	269	492	597	1164	1616	419	4557
18	Meghalaya	0	0	0	0	0	30	30
19	Maharashtra	660	829	561	883	1275	60	4268
20	Manipur	30	30	30	60	0	0	150
21	Nagaland	30	0	30	0	0	0	60
22	Orissa	0	931	268	567	511	150	2427
23	Puducherry	0	62	0	0	0	0	62
24	Punjab	30	32	141	120	84	30	437
25	Rajasthan	53	581	597	775	1116	360	3482

Sl. No	State/UTs	No. of Suryamitra trained						
		FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	FY 2019-20	FY 2020-21 and FY 2021-22 (upto 31.12.2021)	Total
26	Tamil Nadu	122	436	672	912	1132	120	3394
27	Telangana	90	274	600	950	1401	325	3640
28	Tripura	60	0	28	60	30	0	178
29	Uttar Pradesh	185	664	795	964	1604	446	4658
30	Uttrakhand	60	311	78	231	263	90	1033
31	West Bengal	0	556	564	1313	1566	150	4149
	Total	**2606**	**8407**	**8167**	**11912**	**16074**	**3371**	**50537**

Note: Completion reports of trainings imparted in FY 2020-21 are still awaited by NISE.

(b) **Solar Water Pumping:** Ministry sanctioned 30 nos. of Solar Water Pumping Technician Training Programmes (***Varunmitras***) to train 900 participants on Solar Water Pumping Systems on pan India basis for the FY 2020-21 to National Institute of Solar Energy (NISE), Gurugram which were continued in FY 2021-22. These training programmes are being organised by NISE with various partner institutions such as Government Institutions, Engineering Colleges, Polytechnics and other affiliated institutions, which have been empanelled through Expression of Interest (EOI). Total 849 nos. of Varunmitras were trained against the target of 900 Varunmitras. The State wise progress is shown in **Table 11.3**.

Table 11.3: Progress of Number of Solar Water Pumping Technicians (*Varunmitras*) trained in different States:

Sl. No	State	No. of Participants trained
1	Andhra Pradesh	30
2	Assam	30
3	Bihar	30
4	Chhattisgarh	21
5	Gujarat	60
6	Haryana	60
7	Himachal Pradesh	30
8	Jharkhand	59
9	Karnataka	57
10	Madhya Pradesh	52
11	Maharashtra	60
12	Orissa	30
13	Puducherry	30
14	Punjab	30
15	Rajasthan	60
16	Tamil Nadu	60
17	Telangana	30
18	Uttar Pradesh	60

Sl. No	State	No. of Participants trained
19	West Bengal	60
	Total	**849**

11.2.4 Short Term Training Programmes in Wind Energy

Vayumitra Foundation Course: Ministry sanctioned 10 short-term (5 days) training courses namely "Vayumitra Foundation Course" to train 350 personnel relating to installation, operation and maintenance of Wind Power Projects to National Institute of Wind Energy, (NIWE) Chennai for the year 2020-21 and were continued in 2021-22 due to COVID 19 Pandemic. Out of these 10 programs, 5 nos. of training programmes were conducted at Gandhigram Rural Institute (GRI), Dindigul, Tamil Nadu and 5 programmes at NIWE. All the training programmes were completed successfully and total 360 no. of persons were trained in this programme. Out of 360 nos, 175 Vayumitras were trained in NIWE, Chennai and 185 Vayumitras were trained in GRI, Dindigul.

Ministry also initiated the skill development programme in the area of wind energy to train wind power plant technicians for the operation and maintenance of wind power projects under "Vayumitra Skill Development Programme". National Institute of Wind Energy (NIWE), Chennai an autonomous organistion under the Ministry has been assigned the task of coordination of the trainings under this programme to train 5734 no. of candidates in three years FY 2021-22 to 2023-24.

11.2.5 National Renewable Energy Internship Scheme (NREI)

Under the National Renewable Energy Internship (NREI) programme, the Ministry provides internship opportunity to facilitate students pursuing under-graduate, graduate, post graduate degrees or research scholars enrolled in recognized institutions or universities within India or abroad, as Interns. 10 (Ten) nos. Interns (M. Tech., B.Tech., M.Sc. and M.B.A. students) were provided internships under this programme.

11.2.6 Other Important HRD Activities and Initiatives

(a) **RE courses in ITI:** To initiate RE courses in Wind energy and Small Hydro Power areas in ITIs, two Committees were constituted for designing the ITI course curriculum in Wind energy and Small Hydro Power (SHP) in coordination with Directorate General of Training (DGT), under the Ministry of Skill Development and Entrepreneurship. The committees were well structured by representatives from Directorate General of Training(DGT), M/o Skill Development and Entrepreneurship (MSDE), Wind and SHP industry associations, National Institute of Wind Energy, Chennai and IIT, Roorkee. After a series of meetings of the committees, the Course curriculums for 2 year ITI course of "Wind Plant Technician" and Small Hydro Power Plant Technician were finalized by the committee. Both the course curriculums were forwarded to DGT, MSDE. Ministry also facilitated the formulation of Qualification Pack and course curriculum for short term course in Small Hydro Power area (Jal Urja Mitra) training in coordination with Skill Council Green Jobs and Department of Hydro and Renewable Energy (HRED), IIT Roorkee.

(b) **One day conference on "Advances of Renewable Energy in higher education and research":** To commemorate 75 years of India Independence (Azadi Ka Amrit Mahotsav), an online conference on "Advances of Renewable Energy in higher education and research" was organized by HRD Division, Ministry of New and Renewable Energy, Govt. of India jointly with Department of Hydropower and Renewable Energy, IIT Roorkee on Dec.10, 2021. A total of 252 no. participants from IITs, Engineering colleges, Universities, government, non-governmental organizations and private business agencies met to Identify the varieties of Renewable Energy technology devices, their stages of development, to assess the potential sites for operation and commercialization, to Identify the potential environmental issues associated with these technologies and possible mitigation measures. The conference proceedings include the detailed summaries of the presentations made and the discussions followed.

11.3 ADMINISTRATION - E-GOVERNANCE, VIGILANCE, LIBRARY AND RIGHT TO INFORMATION

11.3.1 E-Governance/Information Technology (IT) Initiatives

To support the Digital India Initiative of the Government of India, the MNRE has made different web portals and Mobile apps for transparency in operations and better service delivery to stakeholders. Further, taking forward a step towards digitization, MNRE has signed an MoU with NIC for complete digitization of the implementation of various schemes and programmes of renewable energy sector on 2nd February, 2022. The Operation & Maintenance, enhancement and upgradation of existing applications, development of new applications along with a data centre will be covered in this joint effort.

Fig. 11.1: Signing of MOU with NIC for complete digitization of schemes of Renewable Energy

MNRE's Web Portals and Mobile Apps - A Step Towards e-Governance:

(a) **Ministry's Official Website (https://mnre.gov.in):** Ministry's official website was updated and re-designed for better dissemination of information to stakeholders. Information at the website is available both in Hindi and English languages.

(b) **SPIN Portal (https://solarrooftop.gov.in/):** This portal was developed for submission of online applications and project completion reports by implementing agencies for availing the financial assistance for installation of solar roof top projects. The portal is also synchronised with UMANG portal.

(c) **HRD Portal (https://hrd.mnre.gov.in):** This Portal is developed for online submission of application under following HRD of the Ministry:

i. National Renewable Energy Internship Scheme;

ii. National Renewable Energy Fellowship Programme;

iii. National Renewable Energy Science Fellowship Programme;

iv. Short Term Training Programme in Renewable Energy;

(d) **CCDC Solar (https://scms.gov.in/):** This portal is for facilitating issuance of concessional custom duty certificate for import of components required for setting up of new solar power projects.

(e) **CCDC Wind (https://ccdcwind.gov.in/):** Similarly, this portal is for issue of concessional custom duty certificate for import of components required for manufacturing of wind turbines.

(f) **Biourja Portal (https://biourja.mnre.gov.in/):** This is for online submission of application for the following schemes:

i. Energy from Urban, Industrial, Agricultural Wastes/Residues and Municipal Solid Waste

ii. Promotion of Biomass-based Co-generation in Sugar Mills and Other Industries in the Country

(g) **Biogas Portal (https://biogas.mnre.gov.in/):** This Portal is for implementation of New National Biogas and Organic Manure Programme (NNBOMP) scheme. This is also available on mobile App platform.

(https://play.google.com/store/apps/details?id=com.app.biogas).

(h) **R&D Portal (https://serviceonline.gov.in/dbt/):** This is for online submission of RE related R&D proposals.

(i) **Solar Off-grid Portal (https://solaroffgrid.mnre.gov.in/):** This portal was developed for online submission of proposals by implementing agencies for installation of off-grid and decentralized solar PV applications.

(j) **PM KUSUM Portal (https://pmkusum.mnre.gov.in/landing.html):** This portal was developed for monitoring of implementation of PM KUSUM scheme, which is meant for farmers.

(k) **Solar Street Light Portal (https://ssl.mnre.gov.in/):** This was developed for monitoring of installation of solar street lights which is also available through a mobile app: (https://play.google.com/store/apps/details?id=com.mnre.streetlightingapp).

(l) **Investment Portal (https://investment.mnre.gov.in/):** This portal is to provide one-stop assistance and facilitation to the Industry and Investors for addressing the grievances of RE developers.

(m) **Akshay Urja Portal (https://akshayurja.gov.in):** This portal provides information about overall potential of renewable which is available, total capacity addition and monthly generation for each energy including grid connected and off grid. These data are available state wise.

(n) **IRIX (Indian Renewable Energy Idea Exchange) portal (https://irix.gov.in):** IRIX is a multi-stakeholder collaborative platform to exchange and catalyse ideas on Renewable Energy.

(o) **eHRMS:** e-HRMS is a common application tool for personnel management activities like leave, posting, promotion, transfer, maintenance of service book among others.

(p) **eOffice:** In a step forward for paperless work in office space, the Ministry has fully implemented eOffice which is meant for effective processing and online movement of files and receipts/ letters. The effectiveness and usefulness of eOffice was particularly visible during the Covid-19 pandemic and during "work from home" periods where the Ministry's work continued without disruption.

11.3.2 Vigilance

Vigilance Division of the Ministry of New and Renewable Energy (MNRE) is entrusted with taking anti-corruption and preventive measures in accordance with different Rules, guidelines and instructions issued by the Government of India and the Central Vigilance Commission. The Division looks after vigilance work within the Ministry and also supervises vigilance work of organisations under it namely three autonomous bodies, National Institute of Solar Energy (NISE), National Institute of Wind Energy (NIWE) and Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE) and two CPSUs, viz., Indian Renewable Energy Development Agency Limited (IREDA) and Solar Energy Corporation of India Limited (SECI). Vigilance Division is also entrusted with the task of the upkeep of Annual Performance Appraisal Reports (APARs) and scrutiny of Immovable Property Returns (IPRs) of officials of the Ministry.

The complaints received in the Vigilance Division during the year 2021- 2022 were examined as per Rules and guidelines and necessary action was taken wherever there was violation of Rules.

Vigilance Awareness Week was observed in the Ministry from 26th October, 2021 to 1st November, 2021 and the following activities were undertaken during the Vigilance Awareness Week:

a. Integrity Pledge was taken by all the staff and officers.
b. Two Lectures on Public Interest Disclosure and Protection of Informer (PIDPI) and Preventive Vigilance were organized.
c. Essay competition for the officials of the Ministry was organized.
d. Slogans on curbing corruption and preventive vigilance with banners were placed in the premises of the Ministry.
e. Poster making competition on vigilance issues was organised.

As part of preventive vigilance, a list of sensitive and non-sensitive posts of the Ministry has been prepared and Administration Division of the Ministry has been sensitised to follow the rotation policy in postings.

Probity related matters on e-portal were uploaded in respect of this Ministry and its Autonomous Organizations and vigilance related information in respect of Board Level Officers is being updated monthly on e-portal SOLVE. Officers of this Ministry are also being reviewed under Rule 56(j) of FR & SR. Reports and returns that are submitted to CVC & DoPT were filed on time.

11.3.3 Library

The Library of the Ministry of New and Renewable Energy acts as a reference centre and knowledge house in the field of renewable energy. At present 12,575 books (including gifted books) are available in the library covering diverse subjects such as Renewable Energy, Climate Change, Natural Sciences, Sustainable Development, History, Sociology, Indian Literature, Computer Science, etc. The collection in the library also includes books of general interest like food, cooking, sculpture, painting, mountaineering, etc. The library is also currently subscribing online Scientific Journals of Elsevier on Energy subject collection for all officers and scientists of this Ministry.

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

The library is currently subscribing to 38 periodicals in Hindi and English languages. Besides, 23 newspapers in Hindi and English languages are also being subscribed. The library is using cloud based library software e-granthalaya version 4.0 for accessing the Library Catalogue to library users, Circulation (issue-return) and Membership Management etc.

11.3.4 Right to Information Act

The Ministry is implementing the Right to Information (RTI) Act, 2005 as per the laid down guidelines of Department of Personnel and Training (DoPT), Central Information Commission and Ministry of Home Affairs. The Procedure and other details regarding seeking information under RTI Act, 2005 are available at the MNRE website www.mnre.gov.in.

The Progress Report in terms of RTI Applications or First Appeals received, disposed-off as well as pendency during the period (01.01.2021 to 31.12.2021) is given in **Table 11.4**.

Table 4: Number of RTI Applications or First Appeals received, disposed-off as well as pendency during the period (01.01.2021 to 31.12.2021

Item	Received	Disposed off	Pending as on 31.12.2021
RTI Applications	594	555	39
First Appeals	55	53	02

In November, 2021, the proactive disclosure page was uploaded on the Ministry's website(www.mnre.gov.in) which contained information as required under the Section 4 of the RTI Act, 2005.

It also contains the details of the Ministry's functions along with its functionaries etc. as requiredunder section 4(1) (b) ofthe RTI Act.

The Ministry has designated Central Public Information Officer (CPIO) and First Appellate Authorities(FAA) to respond to the RTI applications and first Appeals in accordance with subjects assigned tothem. The list of CPIOs and FAAs is given in **Table 11.5**. The RTI Unit of this Ministry headed by ShriAmitava Saha, Dy. Secretary coordinates all the physical and online applications and forwards them to CPIOs and FAAs to reply them within the stipulated time lines.

Table 11.5: MNRE List of Designated Central Public Information Officers (CPIOs) and Appellate Authorities based on allocation of work (As on 31.12.2021)

Sl. No	Subject	CPIO	Appellate Authority
1.	Policy & Regulatory Affairs-ISTS Waiver, Open Access, Electricity Act, Tariff Policy, National Electricity Plan, National Electricity Policy, RE Markets, New Technology- National Hydrogen Energy Mission, R&D, New Proposals under consideration	Shri Dipesh Pherwani, Scientist 'C'	Dr. Vandana Kumar, JS
2.	International Solar Alliance (ISA)	Shri Dipesh Pherwani Scientist 'C'	Shri Aseem Kumar, Director
3.	i. Monthly RE progress data compilation and updation, ii. Preparation of monthly Cabinet DO letter iii. Preparation of brief for perusal of Hon'ble Minister meetings iv. Preparation of background notes/ PPT for meetings of Standing Committee/Power Ministers Conference/ RPM meeting/other review meeting etc. v. Inputs for speech of Hon'ble Prime Minister Independence Day Address/ Hon'ble Finance Minister Budget speech, etc. vi. Preparation of year-end review/brief write ups for PIB vii. Inputs for Annual Report including chapter of NE Region viii. ATR on recommendations of Vision Document ix. All Matters related to National Infrastructure, Pipeline (NIP)	Shri Anubhav Uppal Scientist 'C'	Dr. Pankaj Saxena, Scientist 'G'

Sl. No	Subject	CPIO	Appellate Authority
4	i. Comments on EFC / Cabinet /Power Notes/ Concept paper received from other Ministries/ Departments, ii. All matters related to NITI Aayog monitoring, including Annual PM Infrastructure Sector review & Output Outcome Monitoring Framework (OOMF), iii. Regular updation of E-samiksha portal & other portals including updation of Budget announcements.	Shri Tarun Valecha, Scientist 'B'	Shri J Rajesh Kumar, E.A
5.	Geothermal, Ocean /Tidal	Shri Rohit Thakwani, Scientist 'C'	Shri Girish Kumar Scientist 'E'
6.	Green Energy Corridor	Shri Rohit Thakwani, Scientist 'C	Shri Irfan Ahmad, Director
7.	All matters related to IT, RE in UTs, Study of IT tools like Artificial Intelligence, Data Mining, Block chain and Deep Learning for development of Renewable Energy, Lab Policy & Standards quality control	Shri Vikram Dhaka, Scientist 'C	Shri Arun Kumar, Director
8.	Solar projects in Ladakh under PMDP, Solar Parks in NE States, Jharkhand & Odisha, UMREPP by other CPSUs	Shri Aravindh MA, Scientist 'C	Shri Sunil Kumar Gupta, Sci 'D'
9.	VGF Scheme, Rooftop PV and Small Solar Power Generation Programme (RPSSGP), GBI Scheme, Solar Cities and Green Building, NTPC-Bundling, NTPC-EPC Projects, Konark Scheme/ Matters relatedto D/o Commerce	Shri Aravindh MA, Scientist 'C	Shri Girish Kumar, Scientist 'E
10.	Solar Thermal	Shri Aravindh MA, Scientist 'C	Shri Jeevan Kumar Jethani, Scientist 'E'
11.	All work related to Biomass Power Schemes and policies, Bio energy mission, Biomass cook-stove, and Bio energy related externally aided projects.	Ms. Priya, Scientist 'C'	Sh. Aseem Kumar Director
12.	Waste to Energy, Biomass Gasifier, RPO (Beyond 2022-2023, Compliance Monitoring)	Shri Vijay Kumar Bharti Scientist 'C'	Shri Aseem Kumar, Director
13.	Biogas Power (Off Grid Programme), National Biogas Programme, Biogas Training Centres and Biomass R&D	Shri P M Barik Scientist 'C'	Shri S.R. Meena, Scientist 'D'
14.	All Administrative matters of SECI	Ms. Sunita Sajwan,US	Shri Sanjay Karndhar Scientist 'D'

Sl. No	Subject	CPIO	Appellate Authority
15.	All Administrative matters of IREDA	Ms. Sunita Sajwan, US	Shri Arun Kumar, Scientist 'D'
16.	PM KUSUM Scheme, Solar off grid programmes	Shri Shobhit Srivastava Scientist 'D'	Shri Jeevan Kumar Jethani, Scientist 'E'
17.	HRD & ITEC	Dr. Vasanta V Thakur, Scientist 'D'	Shri G Upadhyay, Scientist 'G'
18.	Rooftop Solar, One Solar City in every State with 100% rooftop on households	Shri Manish Singh Bisht, Scientist 'C'	Shri Hiren Borah, Scientist 'D'
19.	R&D (Wind), Wind Energy (Offshore), Small Wind, Wind Energy (On-shore), Repowering and Hybrid Policies	Shri Rahul Rawat, Scientist 'C'	Shri P K Dash Scientist 'D'
20.	R&D (Solar), R&D Coordination	Shri Kishore Kumar, Dy. Director	Shri Anil Kumar, Scientist 'D'
21.	Energy Storage-Mission on Transformative Mobility & Battery Storage, FAME Scheme, Charging Infrastructure R&D Proposals Electric Vehicle for surface transport, Water Heater	Shri Arun Kumar Choudhary, Sci, 'B'	Shri Anil Kumar, Scientist 'D'
22.	Guidelines & Standard Bidding Documents (SBDs), CPSU Govt. Producer Scheme, Canal Top Solar Scheme, GST Cell, Solar Manufacturing scheme, FDI Cell, Renewable Energy Industry Promotion and Facilitation Board	Shri Sanjay Karndhar Scientist 'D	Shri Ruchin Gupta, Director
23.	Greening of Islands	Shri Sanjay Karndhar, Scientist 'D'	Dr. Vandana Kumar, JS
24.	Organization of RE – Invest, Small hydro Projects, PM's Package of Ladakh Renewable Energy Initiatives, PM Development & Reconstruction package 2015 for Hydro Power for Jammu & Kashmir	Shri S K Shahi Scientist 'D'	Shri G Upadhyay Sci. 'G'
25.	Direct Benefit Transfer (DBT) Cell	Shri Arun Kumar, Scientist 'D'	Shri J Rajesh Kumar, E.A
26.	CCDC for Solar Energy/Power Projects	Shri Arun Kumar, Scientist 'D'	Shri B. K. Panda, Scientist 'F'
27.	Climate Change related initiatives including CDM	Shri J. K Jethani, Sc 'E'	Shri Dinesh Dayanand Jagdale, JS

Sl. No	Subject	CPIO	Appellate Authority
28.	GST related to Biogas	Shri P.M Barik, Scientist 'C'	Shri Ruchin Gupta, Director
29.	GST related to Wind CDC/EDE	Shri A K Manish, Under Secretary	Shri Ruchin Gupta, Director
30.	GST related to Solar CDC/EDE	Shri Arun Kumar, Scientist 'D'	Shri Ruchin Gupta, Director
31.	GST related to Off Grid Solar	Shri Shobhit Srivastava Scientist 'D'	Shri Ruchin Gupta, Director
32.	GST related to Biomass	Ms. Priya, Scientist 'C'	Shri Ruchin Gupta, Director
33.	CCDC for Wind Energy	Shri S K Khurana, US	Shri B.K Panda, Scientist 'F'
34.	I & PA and Seminar & Symposia, Akshay Urja Magazine, Media Policy	Shri A.K Manish, US	Shri Amitava Saha,DS
35.	Vigilance	Shri Arvind Pokhriyal, US	Shri Anurag Sharma, DS
36.	National Solar Mission, Solar Park, Defence Schemes	Shri Devendra Singh, US	Shri Dilip Nigam, Scientist 'G'
37.	International Relations (IR)	Shri PNBV Chalapathi Rao Scientist 'D'	Shri Aseem Kumar, Director
38.	O/o Hon'ble Minister NRE	Shri D.K Pandey, US	Shri Amitava Saha, DS
39.	Legal Cell	Shri A.K. Singh, US	Shri Anurag Sharma, DS
40.	Parliament Work/All Matters related to Parliament	Shri A.K. Singh, US	Shri Pankaj Saxena,Sci. 'G
41.	Public Grievances	Shri A.K. Singh, US	Shri Amitava Saha,DS
42.	Administration – I	Shri Yoginder Singh, US	Shri Amitava Saha, DS
43.	Administration – II	Ms. Sunita Dhewal, US	Shri Amitava Saha, DS
44.	All matters of SSS-NIBE	Shri Yoginder Singh, US	Shri Anurag Sharma, DS
45.	IFD	Shri K G Suresh Kumar, US	Shri Sandeep Mukherjee, DS

Sl. No	Subject	CPIO	Appellate Authority
46.	Budget Expenditure monitoring & Audit	Ms. Sunita Sajwan, US	Shri J Rajesh Kumar, E.A
47.	RTI Matters	Shri Mala Ram Sonwal, Dy. Dir.	Shri Amitava Saha, DS
48.	Cash Section	Shri Mala Ram Sonwal, Dy. Dir.	Shri Anurag Sharma, DS
49.	Library	Ms. Sunita Sajwan, US	Shri Anurag Sharma, DS
50.	Hindi	Shri N.S Dugtal, Dy. Dir.	Shri Amitava Saha, DS
51.	PAO, Budget	Shri Pratap Singh, Sr. Accounts Officer	Shri Arvind Kumar, CCA
52.	All administrative and financial matters of NISE	Shri Devendra Singh, US	Shri Anurag Sharma, DS
53.	All administrative and financial matters of NIWE	Shri Rahul Rawat Scientist 'C'	Shri Anurag Sharma, DS

CHAPTER 12

INTERNATIONAL COOPERATION IN RENEWABLE ENERGY

12.1 The International Relations (IR) Division of the Ministry has been continuously engaging with Department of Economics Affairs (DEA), Ministry of External Affairs (MEA), Indian Missions abroad, Foreign Diplomatic Missions located in India, Multilateral International Organizations, and Agencies, among others for cooperation in the field of Renewable Energy.

12.2 In the current financial year also this Ministry has taken several initiatives for promotion of Renewable Energy. The Ministry has signed Memorandum of Understandings (MOUs), Agreements with various countries and institutes in the field of New & Renewable Energy. Joint Working Groups (JWGs), Bilateral and Multilateral meetings were also conducted for identification, selection and formulation of joint activities. The delegations were led at the level of senior officers from the Ministry for the purpose of these meetings and events.

12.3 Interactions with various countries were also undertaken through various Joint Commission Meetings (JCMs), Joint Working Group (JWG) meetings, Joint Trade Committee (JTC) Meetings organized by other Ministries such as Ministry of External Affairs (MEA), Ministry of Environment, Forests and Climate Change (MoEFCC), Ministry of Commerce & Industry (MoC&I), Ministry of Power (MoP), Ministry of Petroleum and Natural Gas (MoPNG), NITI Aayog and Department of Science and Technology, among others.

12.4 In addition, MNRE has been collaborating under various multilateral cooperation frameworks like Association of South-East Asian Nations (ASEAN), Conference on Interaction and Confidence Building Measures in Asia (CICA), Asia Cooperation Dialogue, Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC), Brazil-Russia-India-China-South Africa (BRICS), G20, India-Brazil-South Africa (IBSA), Indian Ocean Rim Association (IORA), South Asian Association for Regional Cooperation (SAARC), Shanghai Cooperation Organisation (SCO), The Quadrilateral Security Dialogue (QUAD), among others.

12.5 Ministry has also been engaging with various international Institutions and inter-governmental agencies, like Asian Development Bank (ADB), Danish Energy Agency (DEA), European Union (EU), Foreign Commonwealth and Development Office (FCDO), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), International Renewable Energy Agency (IRENA), International Energy Agency (IEA), International Solar Alliance (ISA), Kreditanstalt für Wiederaufbau (KFW), United States Agency For International Development (USAID), United Nations Industrial Development Organization (UNIDO), World Bank (WB), etc., for facilitating technical assistance in terms of studies, pilot projects, grants & line of credits for renewable energy projects in the country.

12.6 The following Memorandum of Understandings (MoUs) and Agreements have been signed in the current year:

i. Memorandum of Agreement between the National Institute of Wind Energy (NIWE) under the Ministry of New and Renewable Energy, Government of India and the University of Massachusetts Amherst (UMA), Amherst, Massachusetts, United States of America (USA), was signed on 22nd September, 2021 for academic and research collaboration.

ii. An Implementation Agreement between Ministry of New and Renewable Energy, Govt. of India and Deutsche Gesellschaft Fur Internationale Zusammenarbeit (GIZ), Govt. of Germany was signed on 30th September, 2021 at New Delhi for IGSP-IN-Solar programme.

iii. An Implementing Agreement between National Institute of Wind Energy (NIWE), Chennai under Ministry of New and Renewable Energy and International Energy Agency (IEA) was signed on 13th August, 2021 for the Wind Technology Collaboration programme.

12.7 Joint Working Group (JWG) meetings, listed, in **Table 12.1**, were organized with various countries in the current year:

Table 12.1: Joint Working Group meetings organised by MNRE

S. No.	Name of the Countries	Date of JWG meeting
1	Joint Working Group (JWG) meeting with IBSA Countries	27th August, 2021
2	Joint Working Group (JWG) meeting India between Denmark	10th September, 2021
3	Joint Working Group (JWG) meeting India between Finland	23rd September, 2021
4	Joint Working Group (JWG) meeting India between Australia	01st October, 2021
5	Joint Working Group (JWG) meeting India between Belgium	28th October, 2021
6	Joint Working Group (JWG) meeting India between Bangladesh	24th November, 2021

12.8 Foreign visits undertaken in the current year by the senior officials of the Ministry are as under:

i. Shri Dilip Nigam, Advisor and Shri A. K. Manish, Under Secretary, have visited the Dubai, UAE during 1-9th October, 2021 to participate in the "World Expo 2020".

ii. Shri J. K. Jethani, Scientist, 'E', visited Glasgow, UK during 31st October to 12th November, 2021 to participate in the 26th UN Climate Change Conference of the Parties (COP26).

12.9 INTERNATIONAL TRAINING PROGRAMMES

National Institute of Solar Energy (NISE) and National Institute of Wind Energy (NIWE) have organized the following International virtual training programmes for delegates from different countries under Indian Technical and Economic Cooperation (ITEC) of MEA:

National Institute of Wind Energy (NIWE), Chennai:

Name of the programme	Duration	Number of Participants	Number of Countries
Online International Training course on 'Wind Energy technology' under e-ITEC programme	22nd Nov. to 3rd Dec, 2021	36	18

National Institute of Solar Energy (NISE), Gurugram:

Name of the programme	Duration	Number of Participants	Number of Countries
e-ITEC Programme in Solar Energy technologies	22nd to 26th Nov, 2021	36	18

12.10 UNITED NATIONS HIGH-LEVEL DIALOGUE ON ENERGY

India has been selected as a 'Global Champion' for the Energy Transition theme under the United Nations High level Dialogue on Energy (UN-HLDE) 2021. MNRE as a nodal Ministry on behalf of Government of India undertook advocacy efforts for promoting energy transition along with Permanent Mission of India (PMI) to the UN at New York and Council on Energy, Environment and Water (CEEW). Several industrial e-consultations were also carried out to promote Energy Transition and facilitate submission of the "Energy Compacts"(i.e. voluntary energy transition commitments) by PSUs / Pvt Sector organizations /Smart cities and other entities. In addition to the national Energy Compact submitted by the Ministry, 20 Energy Compacts from PSUs, Corporates and Smart Cities were submitted from India to the UN under HLDE-2021.

A curtain-raiser was organized virtually on 22nd June 2021, wherein the Hon'ble Minister, Power and NRE addressed the global media about India's role as a Global Champion roleand initiatives taken in this regard. The Hon'ble Minister also co-hosted the Ministerial Thematic Forum on Energy Transition for the HLDE 2021 on 23rd June, 2021 along with other Global Champions for the Energy Transition theme. Secretary, MNRE represented India in the Global Multi Stakeholders Dialogue for the HLDE on 23rd June, 2021, as part of the preparatory process for HLDE 2021.

An Indian side event on "Accelerating Citizen-Centric Energy Transition: India's efforts to achieve the 2030 Agenda" was organized virtually on 24th June, 2021. As part of the event, a special panel discussion on "Corporate commitments to accelerate citizen-centric energy transition" was organized. An e-book on "Accelerating Citizen-Centric Energy Transition: The India Story" and a dedicated website (www.energytransition.in) for energy transition related knowledge resources was also launched during the event by the Hon'ble Minister, Power and NRE.

A webinar on "Women in Renewable Energy and Sustainability" was organized virtually by MNRE and ISA on 7th July, 2021. The objective of the webinar was to open a consequential dialogue towards bringing more and more women to forefront and at leading positions in the Renewable Energy sector as well as impacting women's lives by making entrepreneurial opportunities available to them.

An "India–ISA Energy Transition Dialogue 2021" was organised virtually on 24th August, 2021 by the International Solar Alliance and Ministry of New and Renewable Energy, GOI to facilitate the exchange of ideas between key RE stakeholders on core issues like grid integration to facilitate high renewable energy penetration, frameworks for accelerating RE, and will also enable sharing India story with ISA member countries.

A webinar on 'A Multilateral Approach to Building a Global Hydrogen Economy' on 8th September 2021 was organised by the MNRE to focus on the multilateral effort required to build a global hydrogen economy via conducive international policies, technology co-development, pooled finances for demonstrations, and investments to build markets.

A Special side event on "Ambition to Impact: Opportunities for Global Collaboration in India's Clean Energy Economy" was also organized under the UN High-Level Dialogue on Energy (HLDE) 2021 on 24th September, 2021. Hon'ble MoS, NRE chaired the event. Hon'ble Minister, Power and NRE participated in the HLDE 2021 through a pre-recorded video message held on 24th September, 2021.

12.11 OTHER INTERNATIONAL EVENTS

A workshop on "Renewable Energy for Energy Security" for Conference on Interaction and Confidence Building Measures in Asia (CICA) Member States was organized virtually by MNRE in collaboration with NISE & MEA on 18th June, 2021.

Hon'ble Minister of Power and NRE, as the president of International Solar Alliance chaired the 4th Assembly of International Solar Alliance held virtually on 20th October, 2021.

Hon'ble MoS, NRE participated as a Chief Guest at the UN Day commemoration event organized by UN-India on 22nd October, 2021 and delivered special remarks at the event. During the event, Hon'bleMoS and Director-General, International Solar Alliance participated in a panel discussion on climate action.

12.12 ENGAGEMENT WITH INTERNATIONAL RENEWABLE ENERGY AGENCY (IRENA)

International Renewable Energy Agency (IRENA) is an intergovernmental organization that supports countries in their transition to a sustainable energy future, and serves as a principal platform for international cooperation, centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bio-energy, geothermal, hydro power, ocean, solar

and wind energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

India became the 77th Founding Member of International Renewable Energy Agency (IRENA) in 2009. India was one of the Vice Presidents for the 11th session of the Assembly of IRENA 2021. India regularly participates in the Council and General Assembly meetings of IRENA.

The 22nd IRENA Council meeting was held in a hybrid format on 26-27 October, 2021 at Abu Dhabi, UAE. The delegation was led by the Ambassador of India to the UAE. Joint Secretary (IR), MNRE participated in the meeting virtually. The 12th session of the General Assembly and related meetings of IRENA were held on 14-16th January, 2022 at Abu Dhabi, UAE. The Indian delegation was led by Secretary, MNRE.

12.13 ENGAGEMENT WITH INTERNATIONAL SOLAR ALLIANCE (ISA)

ISA is an inter-governmental treaty-based international organization with a global mandate to catalyse global solar growth by helping to reduce the cost of financing and technology for solar. The ISA was launched on 30th November 2015, and on 6th December, 2017, ISA became the first intergovernmental international organization headquartered in India after ratification of the ISA Framework Agreement by 15 countries. During the first Assembly of the ISA, held on 3rd October, 2018, a resolution was adopted to expand the scope of ISA membership to all the countries that are members of United Nations (UN). 106 countries have signed the ISA Framework Agreement and out of which, 86 countries have also ratified the Framework Agreement of the ISA.

Hon'ble Prime Minister of India proposed One Sun One World One Grid (OSOWOG) during the second RE-INVEST, 2018 to interconnect solar energy infrastructure at a global scale. On the side-lines of the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow, Hon'ble Prime Minister of India and Hon'ble Prime Minister of UK launched the Green Grids Initiative (GGI) - One Sun One World One Grid (OSOWOG) project. The International Solar Alliance (ISA) is an observer to the United Nations Framework Convention on Climate Change (UNFCCC) and actively participated at COP26.

The fourth Session of the ISA Assembly was held virtually on 20th October, 2021. The ISA Secretariat has also conducted a series of technical sessions on various strategic initiatives of the ISA and other emergent issues in the solar and clean energy sectors, between 18 to 21st October, 2021. The technical sessions featured in-depth expert deliberations on various thematic issues to help the ISA Secretariat refine its programmatic focus moving forward. The fourth Assembly of the International Solar Alliance also announced a partnership with Bloomberg Philanthropies to mobilize $1 trillion in global investments for solar energy across ISA's member countries. The two organizations will work with World Resources Institute (WRI) to develop a Solar Investment Action Agenda and a Solar Investment Roadmap.

CHAPTER 13

PROMOTION OF OFFICIAL LANGUAGE – HINDI

13.1 INTRODUCTION: With a view to implement the Official Language Policy of the Government of India, a Hindi Section has been set up in the Ministry. Its functions are as under:

i. Translation work: Various documents of the Ministry including those to be laid in Parliament such as Parliament Questions, Parliamentary Assurances, papers related to Standing Committees and other Parliamentary Committees, Private Member Bills, Calling Attention Notices, Budget related documents, Demands for Grants, Annual Reports, Notifications, General Orders, Advertisements, Tenders, MOUs/ MOAs, Cabinet Notes, Suo Moto Statements/ Speeches and other documents received from Office of the Minister (NRE) and Office of Minister of State (NRE) and Press releases etc. are translated regularly by Hindi Section of the Ministry.

ii. Implementation of the Official Language Policy of the Union; Official Languages Act, 1963; Official Languages (Use for Official Purposes of the Union) Rules, 1976; Directions/Instructions issued by the Government from time to time regarding the use of Hindi; Annual Programme issued by the Department of Official Language, MHA every year for transacting the official work of the Union in Hindi and Presidential Orders issued on the recommendations of the Committee of Parliament an Official Language constituted under the Chairmanship of Hon'ble Minister of Home Affairs.

13.2 During the year 2021-22, concerted efforts were made to ensure proper compliance of the provisions of Official Languages Act, 1963 and Rules framed thereunder.

13.3 For promotion of Official Language Policy and to create more conducive environment for the officials to do more work in Hindi, various programmes and schemes are being undertaken, which include the following:

i. With a view to ensure effective implementation of Official Language Policy of the Govt. of India in the Ministry, certain Check-Points as per the provisions of Official Language Policy have been made and circulated for compliance. Effective steps have been taken for the adherence of these check-points.

ii. Most common 100 bilingual phrases (E-Saral Hindi sentences) of the Ministry have been prepared and uploaded on the website of the Ministry.

iii. Website of the Ministry has been made bilingual and it is being updated from time to time.

iv. Hindi books are purchased in the Ministry and efforts are made to achieve the targets laid down by the Department of Official Language, Ministry of Home Affairs.

v. Addresses of Nodal Agencies have been prepared in Hindi.

vi. All documents coming under section 3(3) of the Official Languages Act 1963, including Press Release, Tender Notices, Rules, General Orders, Notifications, Cabinet Notes, Parliament Questions and other Documents to be laid in the Parliament are presented bilingually.

vii. Letters received in Hindi are invariably replied in Hindi and Rule 5 of the Official Language Rules, 1976 is fully complied with.

13.4 During the year 2021-22, various measures were taken for effective implementation of Official Language Policy in the Ministry. As per the Quarterly Progress Report for the quarter ended on 31st December, 2021, the percentage of Hindi correspondence with offices in regions designated as A, B and C was 74.29%, 52.50% and 68.57% respectively. Continuous efforts are being made to encourage progressive use of Hindi in official work not only in the Ministry but also in its autonomous institutions and PSUs.

13.5 In Order to review the progress made in the implementation of Official Language policy, quarterly meetings of Official Language Implementation Committee are held. Discussions are held on quarterly progress reports received from various Sections and Divisions of the Ministry and other organisation i.e. IREDA, SECI, NIWE, NISE and NIBE. The Sections and Divisions and other Organizations are advised to achieve the targets specified by the Department of Official Language, Ministry of Home Affairs.

13.6 HINDI FORTNIGHT & PRIZE DISTRIBUTION CEREMONY

With a view to create awareness and to increase the use of Hindi in official work, a Hindi Fortnight was observed in the Ministry during 14th to 28th September, 2021. Messages from Hon'ble Minister of Home Affairs, Hon'ble Minister (NRE) and Hon'ble Minister of State (NRE) regarding progressive use of Hindi were also read out. A number of competitions were held and there was a good participation by officers and staff of the Ministry. As many as 36 officers and staff members belonging to Hindi and non-Hindi speaking categories were given cash awards and certificates based on their performances, by the secretary, MNRE during the prize distribution ceremony held on October 26, 2021. Hindi Fortnight was also observed in various autonomous institutions and PSUs of the Ministry. Necessary instructions were issued to them for effective and extensive promotion and propagation of Hindi.

13.7 Hindi Noting and Drafting Incentive Scheme of the Department of Official Language was continued to be implemented during the year.

13.8 HINDI SALAHKAR SAMITI

Hindi Salahkar Samiti of the Ministry has been reconstituted vide resolution dated 8 September, 2021. Hindi Salahkar Samiti works under the Chairmanship of Union Minister (NRE) with the main objective to advise the Ministry with regard to progressive use of Hindi in its official work.

13.9 AKSHAY URJA PURASKAR YOJNA

To promote original book writing in Hindi or translated in Hindi related to the subjects of Renewable Energy, Akshay Urja Purskar Yojna is being implemented in the Ministry. Under this scheme, there is a provision to award a First prize of Rs. 1,00,000 Second prize of Rs. 60,000 and Third prize of Rs. 40,000 for the books originally written in Hindi. For the books translated into Hindi, the amount of first, second and third prize is Rs. 50,000, Rs. 30,000 and Rs. 20,000 respectively. An appreciation letter signed by the Secretary, MNRE is also given to the awardees. Winners of this scheme up to the year 2019 have been awarded.

13.10 ORGANIZATION OF HINDI WORKSHOPS

With a view to encourage the officers and staff to do their official work in Hindi, Hindi workshop is organized quarterly for the officers and staff of different categories.

13.11 INSPECTION OF SUBORDINATE OFFICES AND SECTIONS

With a view to assess the status regarding progressive use of Official Language, inspection of various Autonomous Institutions and PSUs are being carried out from time to time.

ANNEXURE - I

STAFF STRENGTH

MINISTRY OF NEW AND RENEWABLE ENERGY (ADMINISTRATION)

Table 1: Sanctioned and in-position strength in **MNRE** as on 31.12.2021, are as follows:

Group	A	B	C	Total
Sanctioned	141	83	85	309
In Position	86	43	68	197
SC	13	8	19	40
ST	03	02	04	09
OBC	10	11	10	31
Physically Handicapped	01	01	02	04

NATIONAL INSTITUTE OF WIND ENERGY (NIWE)

Table 2: Group-wise sanctioned and In-position posts in **NIWE** as on 31.12.2021 are as follows:

No. of Posts	Group **			Total
	A	B	C	
Sanctioned	18	13	17	48
In Position	17	10	16	44
SC	4	02	05	11
ST	1	-	-	01
OBC	7	05	11	23
PH	-	-	-	-

** Classification of posts as per the G.I., Dept of Per. & Trg. O.M. No. F.No.11012/10/2016 –

Estt. A-III dated 8.12.2017

* Deputation on Foreign Service terms.

INDIAN RENEWABLE ENERGY DEVELOPMENT AGENCY (IREDA)

Total sanctioned strength for Board level is 3 and below Board level is 213. Employees staff strength of IREDA as on 31.12.2021 is given in **Table 3**.

Table 3: Staff strength of **IREDA** as on 31.12.2021 is as follow:

Classification	Board Level	Group A	Group B	Group C	Group D	Total
In Position	02	134	04	18	-	158
SC	-	16	02	04	-	22
ST	-	08	-	01	-	09
OBC	-	22	-	03	-	25
PH	-	03	-	01	-	04

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

Table 4: Group-wise sanctioned and In-positioned posts in **SSS-NIBE** as on 31.12.2021 are as follows:

Group	Board Level	A	B	C	D	Total
Sanctioned	1*	20*	1	4	0	26
In Position	-	3	1	4	-	8
SC	-	-	-	-	-	-
ST	-	-	-	-	-	-
OBC	-	-	-	-	-	-
PH	-	-	-	-	-	-

*The recruitment of DG and 11 Scientists are under process.

NATIONAL INSTITUTE OF SOLAR ENERGY (NISE)

Table 5: Group-wise sanctioned and In-positioned posts in **NISE**, as won 31.12.2021 are as follows:

Group	A	B	C	D	Total
Sanctioned	25	16	0	0	41
In Position	20	6	0	0	26
SC	1	1	0	0	2
ST	0	0	0	0	0
OBC	2	2	0	0	4
PH	1	0	0	0	1

Note: Recruitment is under process for the vacant post.

SOLAR ENERGY CORPORATION OF INDIA (SECI)

Table 6: Group-wise sanctioned and In-position posts in **SECI** as on 31.12.2021 are as follows:

Group	A	B	C	D	Total
Sanctioned	118	35	Non-operational		153
In Position	99	7			106
SC	8	2			10
ST	4	3			7
OBC	17	2			19
PH	1	1			2

PAY AND ACCOUNTS OFFICE, MINISTRY OF NEW AND RENEWABLE ENERGY

Table 7: Group-wise sanctioned and In-position posts in Pay & Accounts Office, **MNRE** as on 31.12.2021 is as follows:

Group	A	B	C	D	Total
Sanctioned	3	5	9	0	17
In-position	3	3	8	0	14
SC	1	0	1	0	2
ST	0	0	1	0	1
OBC	0	0	2	0	2
Physically Handicapped	0	0	0	0	0

ANNEXURE - II

AUDIT PARA

Year	Report No.	Chapter No.	Para No.	Action	Subject	Stage
2018	2 of 2018	IX	9.1	Added Revised ATN	Non-Utilisation of Solar Thermal Power Plant. The updated ATN along with Hindi translation has to be uploaded on the APMS Portal	The updated ATN along with Hindi translation is to be uploaded on the APMS Portal

ANNEXURE - III

GRANTS IN AID TO STATES AND VOLUNTARY ORGANISATIONS

Table 1: Funds released to Implementing Agencies under HRD Programme in FY 2021-22 (as on 31.12.2021)

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	10/1(26)/2015-P&C	National Institute of Solar Energy, Gurugram	25.11.2021	11,15,66,699
2	342-12/11/2019-HRD	National Institute of Wind Energy	13.12.2021	12,74,071

Table 2: Grant given to State PIAs of more than Rs. 50 lakh in Green Energy Corridor from 01.01.2021 to 31.12.2021

S. No.	Sanction No.	Project/Organization Name	State	Fund released	
				Sanction Date	Amount (Rs. in lakh)
1	367-11/26/2017-GEC	Karnataka Power Transmission Corporation Limited	Karnataka	23.03.2021	5735.40
2	367-11/25/2017-GEC	Rajasthan Rajya Vidyut Prasaran Nigam Limited	Rajasthan	25.03.2021	553.40
3	1/7/2015-EFM	Gujarat Energy Transmission Company Limited	Gujarat	26.03.2021	2457.00
	Total				**8745.80**

Table 3: Cumulative CFA released to SPPD/STU/CTU under the Solar Park Scheme as on 31.12.2021 (Rs. in Lakh)

S. No.	State	Solar Park	CFA Released
1.	Andhra Pradesh	Ananthapuramu-I Solar Park	13525.00
2.		Kurnool Solar Park	12025.00
3.		Kadapa Solar Park	5425.00
4.		Ananthapuramu-II Solar Park	5124.80
5.		Hybrid Solar Wind Park	25.00
6.		Ext Trans PGCIL-AP	10955.54
7.		Ext Trans APTRANCO-AP II	4000.00
8.		Ext Trans APTRANCO-Kurnool	8000.00
9.	Arunachal Pradesh	Lohit Solar Park	19.65
10.	Chhattishgarh	Rajnandgaoun Solar Park	15.00
11.	Gujarat	Radhnesada Solar Park	3311.35
12.		Ext Trans PGCIL-Radhnesada	5600.00

S. No.	State	Solar Park	CFA Released
13.	Karnataka	Pavagada Solar Park	19194.55
14.		Ext Trans PGCIL-Pavagada	16000.00
15.	Kerala	Kasargod Solar Park	882.00
16.	Madhya Pradesh	Rewa Solar Park	7633.51
17.		Mandsaur Solar Park	2548.50
18.		Agar Solar Park	1723.50
19.		Shajapur Solar Park	1800.00
20.		Neemuch Solar Park	1560.48
21.		Ext Trans PGCIL-Rewa	6000.00
22.	Maharashtra	Sai Guru Solar Park	217.08
23.		Patoda Solar Park	25.00
24.		Dondaicha Solar Park	625.00
25.	Manipur	Bukpi Solar Park	10.00
26.	Meghalaya	Solar park in Meghalaya	3.07
27.	Mizoram	Vankal Solar Park	58.00
28.	Nagaland	Solar Park in Nagaland	10.00
29.	Rajasthan	Bhadla-II Solar Park	4489.735
30.		Bhadla-III Solar Park	11069.76
31.		Bhadla-IV Solar Park	6025.00
32.		Phalodi-Pokaran Solar Park	1825.00
33.		Fatehgarh Phase-1B Solar Park	25.00
34.		Nokh Solar Park	6685.00
35.		External Transmission System by RVPN for Bhadla II, III & IV	11440.00
36.		External Transmission System by PGCIL- for Bhadla III, IV and Phalodi Pokaran	12000.00
37.	Tamil Nadu	Kadaladi Solar Park	25.00
38.	Uttar Pradesh	Solar Park in UP	2081.80
39.		Jalaun Solar Park	25.00
40.		Lalipur Solar Park	25.00
41.		Jhansi Solar Park	25.00
42.		Mirzapur Solar Park	0.00
43.		Ext Trans UPPTCL	1719.15
44.	Uttarakhand	Solar Park in Uttarakhand	8.25
45.	West Bengal	Solar Park in West Bengal	25.00
	Total		**183810.725**

Table 4: Funds released under 2000 MW VGF Scheme to SECI from 01.01.2021 to 31.12.2021
2000 MW Variable Gap Funding (VGF) Scheme

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F. No. 283/70/2017-Grid Solar	SECI	08.07.2021	13,55,55,512
2	F. No. 283/70/2017-Grid Solar	SECI	14.09.2021	32,83,99,515
3	F. No. 283/70/2017-Grid Solar	SECI	16.11.2021	44,99,85,248
4	F. No. 283/70/2017-Grid Solar	SECI	21.12.2021	26,81,61,060

Table 5: Funds released to Indian Renewable Energy Development Agency Ltd (IREDA) for Payment of Interest on Government of India Fully Serviced Bonds in FY 2021-22 till 31.12.2021

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount Released (Rs.)
1.	340-12/2/2018-IREDA	Indian Renewable Energy Development Agency Ltd (IREDA)	02.08.2021	21,84,00,055
2.	340-12/2/2018-IREDA	Indian Renewable Energy Development Agency Ltd (IREDA)	09.08.2021	8,29,12,877
3	340-12/2/2018-IREDA	Indian Renewable Energy Development Agency Ltd (IREDA)	23.08.2021	32,05,38,082

Table 6: Solar Photovoltaic (Off-grid Solar Division) Fund released above Rs.50 lakh upto 31.12.2021

S. No.	Sanction No.	Project/ Organisation	State	Funds Released	
				Date	Amount (In Rs.)
1	32/11/2020-SPV Division	Haryana Renewable Energy Development Agency	Haryana	05-05-21	11,37,45,000
2	32/97/2021-SPV Division	Haryana Renewable Energy Development Agency	Haryana	30-12-21	51,29,31,550
3	32/11/2020-SPV Division	Haryana Renewable Energy Development Agency	Haryana	14-10-21	98,44,83,904
4	32/12/2020-SPV Division	Department of Agriculture, Government of Uttar Pradesh	Uttar Pradesh	02-08-21	5,00,00,000
5	32/12/2021-SPV Division	Maharashtra Energy Development Agency	Maharastra	31-12-21	9,59,68,985
6	32/22/2020-SPV Division	Punjab Energy Development Agency	Punjab	05-07-21	11,70,00,000
7	32/7/2020-SPV Division	Rajasthan Horticulture Development Society Solar Project	Rajasthan	29-07-21	33,50,00,000
8	32/7/2020-SPV Division	Rajasthan Horticulture Development Society Solar Project	Rajasthan	30-12-21	91,77,38,543

S. No.	Sanction No.	Project/ Organisation	State	Funds Released	
				Date	Amount (In Rs.)
9	32/8/2020-SPV Division	Agricultural Engineering Department, Government of Tamil Nadu	Tamil Nadu	15-09-21	1,63,50,000
10	32/98/2021-SPV Division	Agricultural Engineering Department, Government of Tamil Nadu	Tamil Nadu	30-12-21	18,66,73,283
11	32/3/2021-SPV Division	Ladakh Renewable Energy Development Agency	Ladakh	24-06-21	4,85,95,794
12	32/60/2018- SPV Division	Himachal Pradesh Energy Development Agency	Himanchal Pradesh	28-06-21	18,33,41,625
13	32/6/2021 - SPV Division	Arunachal Pradesh Energy Development Agency	Arunchal Pradesh	05-08-21	1,78,10,100
14	32/31/2019-SPV Division	Uttar Pradesh New And Renewable Energy Development Agency	Uttar Pradesh	22-11-21	55,85,017
15	32/52/2017-SPV Division	Himachal Pradesh Energy Development Agency	Himanchal Pradesh	28-06-21	1,34,52,000
16	32/57/2018-SPV Division	Renewable Energy Development Agency Kargil	Ladakh	14-12-21	7,55,15,505
17	32/60/2018-SPV Division	Jammu & Kashmir Energy Development Agency	Jammu and Kashmir	28-06-21	5,77,47,500
18	32/60/2018-SPV Division	Tripura Renewable Energy Development Agency	Tripura	05-07-21	4,42,17,899
19	32/60/2018-SPV Division (Part-2)	Jammu & Kashmir Energy Development Agency	Jammu and Kashmir	20-10-21	16,30,05,750
20	32/60/2018-SPV Division (Part-2)	Uttarakhand Renewable Energy Development Agency	Uttarakhand	09-11-21	5,42,85,289
21	32/60/2018-SPV Division Part (1)	Assam Energy Development Agency	Assam	30-12-21	8,76,35,280
22	32/60/2018-SPV Division Part (2)	Arunachal Pradesh Energy Development Agency	Arunchal Pradesh	20-10-2021	5,27,67,000
23	32/60/2018-SPV Division Part (2)	Manipur Renewable Energy Development Agency	Manipur	20-10-2021	3,63,71,103
24	32/60/2018-SPV Division Part (2)	Manipur Renewable Energy Development Agency	Manipur	25-10-2021	96,66,761
25	32/60/2018-SPV Division Part (2)	Zoram Energy Development Agency	Mizoram	25-10-2021	50,31,991
26	32/60/2018-SPV Division Part (2)	Arunachal Pradesh Energy Development Agency	Arunchal Pradesh	25-10-2021	1,91,51,839

S. No.	Sanction No.	Project/ Organisation	State	Funds Released	
				Date	Amount (In Rs.)
27	32/60/2018-SPV Division-Part(2)	Tripura Renewable Energy Development Agency	Tripura	30-12-21	3,47,61,826
28	32/27/2019-SPV Division	Zoram Energy Development Agency	Mizoram	30-12-21	1,32,11,226

Table 7: The Private, voluntary organizations and State PIAs received grant of more than Rs. 50.00 lakh during the year 2021-22 (up to 31.12.2021)

S. No.	Sanction No.	Project/ Organisation	State	Organization / Agency	Funds Released		Remarks
					Date	(Rs. in Lakh)	
1	286/6/2017-SHP	Setting up of Karnah (3x4MW) SHP project in Kupwara district of UT of Jammu & Kashmir	UT of Jammu & Kashmir	Jammu and Kashmir State Power Development Corporation (JKSPDC)	03.09.2021	500.00	Release of 1st instalment of CFA
2	289/9/2017-SHP	Renovation & Modernization (R&M) of Maicham-I SHP in Serchhip district of Mizoram	Mizoram	Power & Electricity Department, Mizoram	09.11.2021	80.00	Release of 3rd instalment of CFA
3	289/13/2017-SHP	Renovation & Modernization (R&M) of Tuipanglui SHP in Saiha district of Mizoram	Mizoram	Power & Electricity Department, Mizoram	23.11.2021	61.15	Release of 3rd instalment of CFA
4	285/7/2017-SHP	Preparation of Detailed Project Reports (DPRs) for 48 nos. of new potential SHP sites by Department of Hydro Power Development (DHPD), Arunachal Pradesh	Arunachal Pradesh	Department of Hydro Power Development (DHPD), Arunachal Pradesh	02.12.2021	69.55	Release of 2nd and final instalment of CFA

Table 8: Funds released to Implementing Agencies under "Off -Grid and Decentralized Concentrated Solar Thermal (CST) Technologies for Community Cooking, Process Heat and Space Heating & Cooling Applications in Industrial, Institutional and Commercial Establishments" Programme in 2021-22 (as on 31.12.2021)

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1.	271/6/2019-CST	M/s Megawatt Solutions Pvt. Ltd.	20.19.2021	28,50,000
2.	271/4/2019-CST	M/s Pune Zillha Sahakar Dudh Utpadak Sangh Maryadit, Pune.	23.09.2021	16,70,000

Table 9: Funds released under 750 MW VGF Scheme to SECI from 01.01.2021 to 31.12.2021

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F.No.32/7/2017-Solar Energy Group	SECI	16.11.2021	5,37,00,000

Table 10: Funds released under Scheme for "Installation of grid connected solar project & various off-grid applications for 100% Solarization of Konark Sun Temple & Konark Town" from 01.01.2021 to 31.12.2021

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F.No. 322/8/2019-NSM	OREDA	03.11.2021	5,00,00,000

Table 11: Funds released under RPSSGP Scheme to IREDA from 01.01.2021 to 31.12.2021

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F.No.32/6/2017-Solar Energy Group	IREDA	15.09.2021	72,78,45,923

Table 12: Funds released under DEMO GBI Scheme to IREDA from 01.01.2021 to 31.12.2021

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F.No.283/68/2018-Grid Solar	IREDA	08.07.2021	16,94,72,276
2	F.No.283/69/2018-Grid Solar	IREDA	22.07.2021	27,14,32,437
3	F.No.283/68/2018-Grid Solar	IREDA	29.09.2021	10,50,44,575
4	F.No.283/62/2018-Grid Solar	IREDA	10.11.2021	6,58,37,689

Table 13: Agency-wise details of funds released in FY 2021-22 under phase II of the Rooftop Solar Programme (upto 31.12.2021)

Sl. No.	Sanction Number	Sanction Date	Agency Name	Amount (Rs.)
1	318/24/2021-Grid Connected Rooftop	09-12-2021	Adani Electricity Mumbai Limited	1,44,35,600
2	318/44/2020-Grid Connected Rooftop	30-12-2021	Ajmer Vidyut Vitaran Nigam Ltd	1,29,75,000
3	318/25/2021-Grid Connected Rooftop	29-06-2021	BSES Rajdhani	1,11,26,314

Sl. No.	Sanction Number	Sanction Date	Agency Name	Amount (Rs.)
4	318/25/2021-Grid Connected Rooftop	29-06-2021	BSES Yamuna Power Limited	56,47,000
5	318/32/2021-Grid Connected Rooftop -Part	04-08-2021	Chhattisgarh State Power Distribution Company Limited	1,20,00,000
6	318/24/2021-Grid Connected Rooftop	30-12-2021	Dakshin Gujarat Vij Company Ltd	12,94,89,600
7	318/12/2021-Grid Connected Rooftop-Part(1)	21-12-2021	Dakshin Gujarat Vij Company Ltd	69,20,30,734
8	318/12/2021-Grid Connected Rooftop	02-12-2021	Dakshin Gujarat Vij Company Ltd	44,51,57,326
9	318/69/2019-Grid Connected Rooftop-part (1)	16-06-2021	Dakshin Gujarat Vij Company Ltd	38,30,00,000
10	318/69/2019-Grid Connected Rooftop	19-04-2021	Dakshin Gujarat Vij Company Ltd	28,21,00,000
11	318/12/2021-Grid Connected Rooftop	19-04-2021	Dakshin Gujarat Vij Company Ltd	16,74,11,268
12	318/31/2021-Grid Connected Rooftop	21-12-2021	Eastern Power Distribution Company of AP Ltd	13,12,000
13	318/31/2021-Grid Connected Rooftop	29-07-2021	Eastern Power Distribution Company of AP Ltd	2,01,60,000
14	318/39/2021-Grid Connected Rooftop	09-09-2021	Electricity Department Goa	3,58,66,000
15	318/34/2021-Grid Connected Rooftop	05-08-2021	Jharkhand State Electricity Board	57,24,000
16	318/44/2020-Grid Connected Rooftop	30-12-2021	Jodhpur Vidyut Vitaran Nigam Ltd	2,61,91,080
17	318/24/2021-Grid Connected Rooftop	17-09-2021	Kerala State Electricity Board	9,89,69,200
18	318/2/2021-Grid Connected Rooftop	19-04-2021	Kerala State Electricity Board	10,49,08,500
19	318/24/2021-Grid Connected Rooftop	30-12-2021	Madhya Gujarat Vij Co. Limited	13,27,54,000
20	318/5/2021-Grid Connected Rooftop-Part(1)	26-10-2021	Madhya Gujarat Vij Co. Limited	48,01,80,705
21	318/5/2021-Grid Connected Rooftop	29-09-2021	Madhya Gujarat Vij Co. Limited	1,00,35,31,798
22	318/69/2019-Grid Connected Rooftop-part (1)	16-06-2021	Madhya Gujarat Vij Co. Limited	52,20,00,000

Sl. No.	Sanction Number	Sanction Date	Agency Name	Amount (Rs.)
23	318/69/2019-Grid Connected Rooftop	19-04-2021	Madhya Gujarat Vij Co. Limited	25,69,00,000
24	318/5/2021-Grid Connected Rooftop	12-04-2021	Madhya Gujarat Vij Co. Limited	16,95,15,814
25	318/25/2020-Grid Connected Rooftop	02-12-2021	Madhyanchal Vidyut Vitran Nigam Limited	4,33,20,000
26	318/24/2021-Grid Connected Rooftop	23-09-2021	Maharashtra State Electricity Distribution Company Ltd. - Msedcl-[Msedcl]	59,71,05,724
27	318/19/2020-Grid Connected Rooftop-part (1)	14-12-2021	Northern Power Distribution Company of Telengana Limited	1,10,21,042
28	318/24/2021-Grid Connected Rooftop	30-09-2021	Northern Power Distribution Company of Telengana Limited	2,28,40,800
29	318/19/2020-Grid Connected Rooftop-Part(1)	01-07-2021	Northern Power Distribution Company of Telengana Limited	45,32,651
30	318/13/2021-Grid Connected Rooftop	31-12-2021	Paschim Gujarat Vij Company Limited	1,24,32,13,682
31	318/24/2021-Grid Connected Rooftop	30-12-2021	Paschim Gujarat Vij Company Limited	11,08,03,200
32	318/13/2021-Grid Connected Rooftop	26-10-2021	Paschim Gujarat Vij Company Limited	35,58,47,289
33	318/69/2019-Grid Connected Rooftop-part (1)	16-06-2021	Paschim Gujarat Vij Company Limited	60.60,00,000
34	318/69/2019-Grid Connected Rooftop	19-04-2021	Paschim Gujarat Vij Company Limited	40,06,00,000
35	318/19/2020-Grid Connected Rooftop	14-09-2021	Punjab State Power Corporation Ltd	3,33,00,000
36	318/19/2020-Grid Connected Rooftop-part (1)	13-12-2021	Southern Power Distribution Company of Telengana Limited	8,99,58,834
37	318/19/2020-Grid Connected Rooftop-Part(1)	01-07-2021	Southern Power Distribution Company of Telengana Limited	3,25,74,650
38	318/24/2021-Grid Connected Rooftop	09-12-2021	Tata Power Company Limited	1,28,82,800
39	318/24/2021-Grid Connected Rooftop	30-12-2021	Torrent Power Limited	1,67,68,868
40	318/24/2021-Grid Connected Rooftop	30-12-2021	Torrent Power Limited	5,81,42,800
41	318/9/2021-Grid Connected Rooftop- Part (1)	21-12-2021	Torrent Power Limited	11,53,14,116

Sl. No.	Sanction Number	Sanction Date	Agency Name	Amount (Rs.)
42	318/9/2021-Grid Connected Rooftop	13-12-2021	Torrent Power Limited	14,53,89,840
43	318/10/2021-Grid Connected Rooftop	26-11-2021	Torrent Power Limited	56,17,44,254
44	318/69/2019-Grid Connected Rooftop	21-06-2021	Torrent Power Limited	2,51,00,000
45	318/69/2019-Grid Connected Rooftop-part (1)	21-06-2021	Torrent Power Limited	31,60,00,000
46	318/69/2019-Grid Connected Rooftop-part (1)	21-06-2021	Torrent Power Limited	8,30,00,000
47	318/69/2019-Grid Connected Rooftop	21-06-2021	Torrent Power Limited	5,03,00,000
48	318/10/2021-Grid Connected Rooftop	17-05-2021	Torrent Power Limited	7,74,81,629
49	318/9/2021-Grid Connected Rooftop	07-05-2021	Torrent Power Limited	3,02,05,228
50	318/24/2021-Grid Connected Rooftop	30-12-2021	Uttar Gujarat Vij Company Limited	5,19,83,600
51	318/14/2021-Grid Connected Rooftop-Part(1)	30-12-2021	Uttar Gujarat Vij Company Limited	42,41,11,240
52	318/14/2021-Grid Connected Rooftop	02-12-2021	Uttar Gujarat Vij Company Limited	35,09,33,124
53	318/69/2019-Grid Connected Rooftop-part (1)	16-06-2021	Uttar Gujarat Vij Company Limited	22,70,00,000
54	318/69/2019-Grid Connected Rooftop	19-04-2021	Uttar Gujarat Vij Company Limited	22,42,00,000
55	318/14/2021-Grid Connected Rooftop	08-04-2021	Uttar Gujarat Vij Company Limited	97,30,921

Table 14: Agency-wise details of funds released in FY 2021-22 under phase I of the Rooftop Solar Programme (upto 31.12.2021)

S. No.	Sanction Number	Sanction Date	Agency Name	Amount (Rs.)
1	318/5/2017-Grid Connected Rooftop	13-12-2021	Agency For Non-conventional Energy &Rural Technology	4,67,14,118
2	318/6/2017-Grid Connected Rooftop	30-11-2021	Agency For Non-conventional Energy &Rural Technology	19,31,113
3	318/53/2018-Grid Connected Rooftop-Part (5)	20-07-2021	Central Electronics Ltd.	9,54,98,900

S. No.	Sanction Number	Sanction Date	Agency Name	Amount (Rs.)
4	318/136/2017-Grid Connected Rooftop	12-05-2021	Gujarat Energy Development Agency	2,38,46,000
5	318/16/2021-Grid Connected Rooftop	03-08-2021	Himachal Pradesh Energy Development Agency	6,31,50,962
6	318/17/2021-Grid Connected Rooftop	03-08-2021	Himachal Pradesh Energy Development Agency	7,44,29,253
7	318/15/2017-Grid Connected Rooftop-Part(4)	28-05-2021	India SMETechnology Services Limited	24,12,800
8	318/20/2018-Grid Connected Rooftop-Part (3)	28-05-2021	India SMETechnology Services Limited	24,26,841
9	318/40/2021-Grid Connected Rooftop	29-09-2021	Indraprastha Power Generation Company Limited	11,70,93,922
10	318/68/2019-GCRT	31-08-2021	Indraprastha Power Generation Company Limited	3,85,74,632
11	318/46/2020-Grid Connected Rooftop	09-09-2021	Jammu & Kashmir Energy Development Agency	5,67,97,230
12	318/53/2018-Grid Connected Rooftop-Part(2)	09-08-2021	Jammu & Kashmir Energy Development Agency	7,46,30,934
13	318/46/2020-Grid Connected Rooftop	09-08-2021	Jammu & Kashmir Energy Development Agency	7,04,12,250
14	318/47/2019-Grid Connected Rooftop	12-05-2021	Jharkhand Renewable Energy Development Agency	6,03,63,502
15	318/36/2021-Grid Connected Rooftop	30-09-2021	Punjab Energy Development Agency	38,50,222
16	318/26/2021-Grid Connected Rooftop	02-08-2021	Punjab Energy Development Agency	3,64,04,881
17	318/22/2018-Grid Connected Rooftop	21-05-2021	Punjab Energy Development Agency	29,93,437
18	318/53/2018-Grid Connected Rooftop	21-12-2021	Solar Energy Corporation of India Limited	6,37,50,000
19	318/234/2017-Grid Connected Rooftop	18-05-2021	Solar Energy Corporation of India Limited	73,12,565
20	318/89/2018-Grid Connected Rooftop	06-12-2021	Uttar Pradesh New and Renewable Energy Development Agency	1,54,37,489
21	318/9/2019-Grid Connected Rooftop	31-08-2021	Uttarakhand Renewable Energy Development Agency	5,42,35,272
22	318/9/2019-Grid Connected Rooftop	31-08-2021	Uttarakhand Renewable Energy Development Agency	2,23,22,730

Table 15: Funds released to Implementing Agencies under New National Biogas Organic Manure Programme (NNBOMP) & Biogas power (Off -grid) Generation and Thermal Programme (BPGTP) during FY 2021-22 (as on 10.02.2022)

Sl. No.	Executing Agency	Amount (Rs.)
1.	Non-conventional Energy & Rural Technology (ANERT). Kerala	45,56,700
2.	New & Renewable Energy Development Corporation of Andhra Pradesh (NREDCAP), Tadepalli, (A.P.)	88,41,500
3.	Jal-Jeevan-Hariyali Mission, RDD Bihar, Patna	15,64,500
4.	Chhattisgarh State Renewable Energy Development Agency (CREDA), Raipur (C.G.)	1,27,04,400
5.	Maydhya Pradesh State Agro Industries Development Corporation Ltd. (MPSAIDC), Bhopal	1,54,15,210
6.	Maharashtra Energy Development Agency (MEDA), Pune	18,40,000
7.	KREDL, Bangalore, Karnataka	34,25,000
	Total	**4,83,47,310**

Table 16: Academic Institutions received Grant of Rs. 10 Lakh or more under Hydrogen and Fuel Cell Programme during the FY 2021-22 (as on 31.12 2021)

S. No.	Name	Fund Released (Rs.)
1.	Dayalbagh Educational Institute	53,00,000

Printed at: India Offset Press, New Delhi-64

सत्यमेव जयते

Government of India

Ministry of New and Renewable Energy