



ANNUAL REPORT 2022-23



सत्यमेव जयते

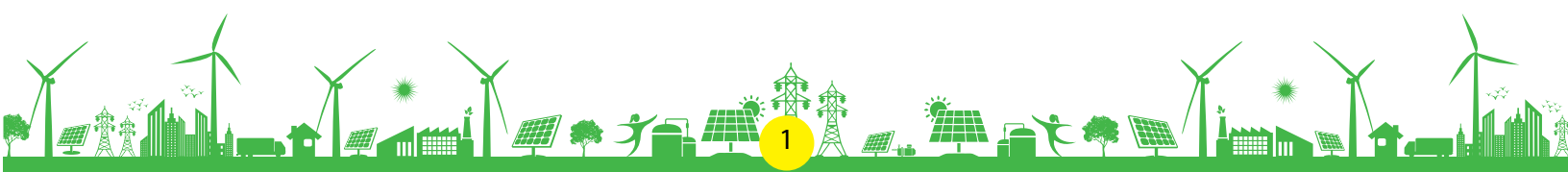
Government of India

Ministry of New and Renewable Energy



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CHAPTER 1

OVERVIEW - A YEAR OF KEY POLICY REFORMS AMID
GEOPOLITICAL CHALLENGES

1.1 COMMITMENTS AND ACHIEVEMENTS

As per the updated Nationally Determined Contributions (NDC), India now stands committed to achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030. So far, a total of 167.75 GW Renewable Energy capacity has been installed as on 31.12.2022 in the country. Further, projects of 78.75 GW capacity are under various stages of implementation and 32.60 GW capacity are under various stages of bidding.

India stands 4th globally in Renewable Energy Installed Capacity, 4th in Wind Power capacity & 4th in Solar Power capacity (as per REN21 Renewables 2022 Global Status Report).

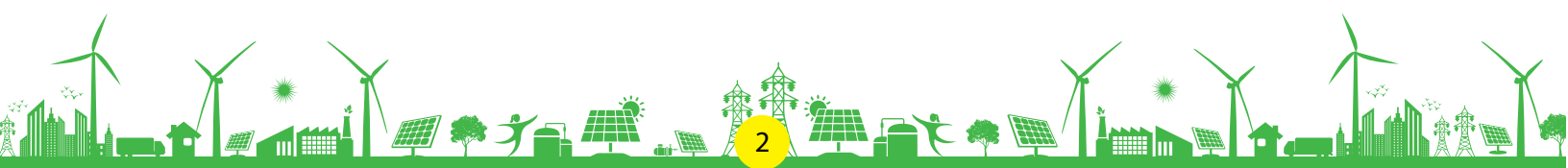
The installed Renewable energy capacity (including large hydro) has increased from 76.37 GW in March 2014 to 167.75 GW in December 2022, i.e. an increase of around 2.20 times. Total Solar Power Capacity in the country has increased from 2.63 GW in March, 2014 to 63.30 GW in December 2022, i.e., an increase of 24.07 times.

Table 1.1 : Sector-wise Cumulative Achievements (as on 31.12.2022)

Sector	Installed capacity (GW)	Under Implementation (GW)	Tendered (GW)	Total Installed/ Pipeline (GW)
Solar Power	63.30	51.13	20.34	134.77
Wind Power	41.93	12.93	1.20	56.06
Bio Energy	10.73	---	---	10.73
Small Hydro	4.94	0.54	0.00	5.48
Hybrid/ Round the Clock (RTC)/ Peaking Power/ Thermal + RE Bundling	---	---	11.06	11.06
Sub-Total	120.90	64.6	32.6	218.10
Large Hydro	46.85	14.15	---	61.00
Total	167.75	78.75	32.60	279.10

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 31.12.2022, 88.45 MW capacity solar power plants were installed under scheme's Component-A, about 1.81 lakh stand-alone solar pumps were installed under Component-B and 1174 pumps were reported solarised under individual pump solarisation variant of Component-C.

1.2.2 Roof Top Solar (RTS) Programme Phase-II

Against the target of 4 GW RTS in Residential sector under the programme around 1.66 GW capacity reported installed as on 31.12.2022. Overall nearly 7.6 GW capacity of grid-connected RTS plants reported installed in the country as on 31.12.2022. Phase II of the Rooftop Solar Programme timelines have been extended up to 31.03.2026.

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 have been awarded, as on 31.12.2022, out of which around 1.5 GW has been commissioned as on 31.12.2022 and balance are under implementation.

1.2.4 Development of Solar Parks and Ultra Mega Solar Power Projects

Under this scheme, 57 Solar Parks with a cumulative capacity of 39.28 GW in 13 states were approved, as on 31.12.2022.

1.2.5 PLI Scheme: 'National Programme on High Efficiency Solar PV Modules'

The Government of India is implementing the Production Linked Incentive (PLI) Scheme for National Programme on High Efficiency Solar PV Modules, for achieving manufacturing capacity of Giga Watt (GW) scale in High Efficiency Solar PV modules with outlay of Rs. 24,000 crore. Around 8.7 GW fully integrated solar PV module manufacturing capacities awarded under PLI Tranche-I of outlay Rs 4,500 crore, are under implementation. For selection of manufacturers under Tranche-II of outlay Rs 19,500 crore, bid document has been issued by Solar Energy Corporation of India (SECI) on 18.11.2022.

1.2.6 Green Energy Corridor

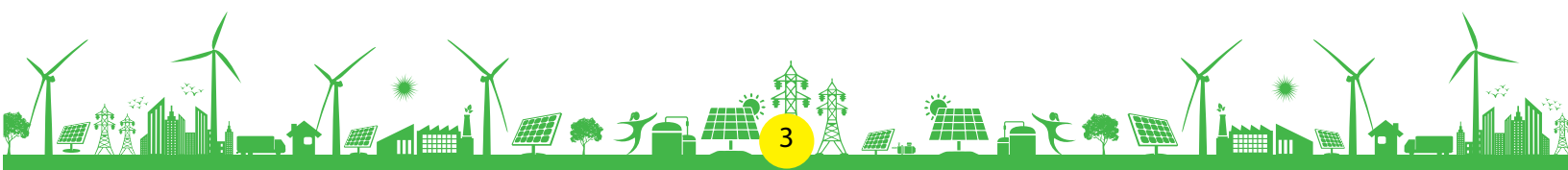
As on 31.12.2022, 8759 ckm of intra-state transmission lines have been constructed and 19868 MVA intra-state substations have been charged. Under the second phase of Intra-State Transmission System Green Energy Corridor Scheme (InSTS GEC-II) approved on 6th January, 2022, the 7 states of Gujarat, Himachal Pradesh, Karnataka, Kerala, Rajasthan, Tamil Nadu and Uttar Pradesh, are currently in the process of issuing tenders to implement projects for evacuation of 20 GW renewable capacity.

1.2.7 Human Resource Development Programme

Around 4,363 *Suryamitras* were trained from April, 2021 to December, 2022 totaling 51,529 trained *Suryamitras*. Ministry has also launched the Jal-Urjmitra Skill Development Programme and Vayumitra Skill Development Programme (VSDP) (Phase-1) in 2022.

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

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



1.2.9 Solar-Wind Hybrid:

Amendments in 'Guidelines for Tariff Based Competitive Bidding Process for Procurement of Power from Grid Connected Wind Solar Hybrid Projects were issued on 09.03.2022 and 02.11.2022. The amendments allow authorized representatives of procurers to conduct bidding. The commissioning schedule of hybrid projects has been increased from 18 months to 24 months. The delay in commissioning on account of delay in Long Term Agreement operationalization has been rationalized.

1.2.10 Wind Energy:

Based on MNRE's recommendation, concessional custom duty benefit (CCDC) for several wind turbine components has been extended till 31.03.2025 by Ministry of Finance (Notification No. 02/2023-Customs dated 01.02.2023).

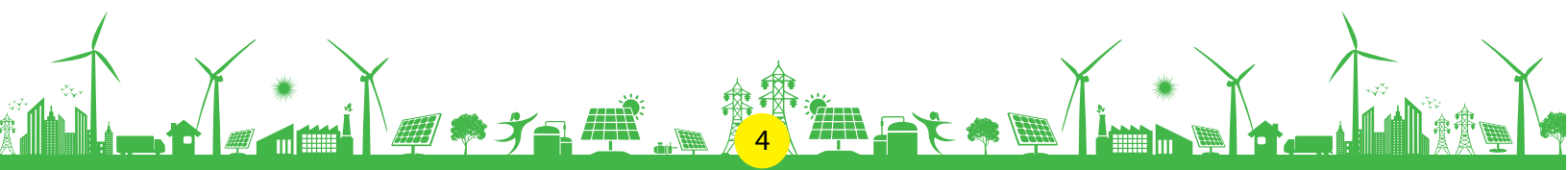
1.2.11 Bioenergy:

As on 31.12.2022, the cumulative installed capacity of biomass power and cogeneration projects stood at about 10.2 GW. The total installed capacity of waste to energy as on 31.12.2022 is 522.42 MWeq.

1.3 NEW INITIATIVES

Apart from the progress achieved under the schemes outlined in Section 2, the Ministry introduced policy reforms and enablers to push progress in key segments like green hydrogen, decentralized renewable energy, rooftop solar, wind repowering, and offshore wind. Key examples are noted below:

- a. **Launch of National Portal on Rooftop Solar:** The Ministry launched a National Portal for Rooftop Solar (solarrooftop.gov.in) on 30.07.2022 to enable residential consumers from any part of the country to apply for rooftop solar without waiting for Discom to finalise tender and empanel vendors. Since its launch, the portal received applications worth 117 MW solar capacity, and more than 18 MW projects have been granted.
- b. **Green Hydrogen:** The National Green Hydrogen Mission with an initial outlay of Rs.19,744 crore was approved in January 2023 with the overall objective to develop at least 5 million metric tons of green hydrogen production capacity per annum with an associated renewable energy capacity addition of about 125 GW in the country by 2030.
- c. **Energy Storage:** Solar Energy Corporation of India (SECI) concluded the bidding process for setting up pilot Projects of 500 MW/1000 MWh Standalone BESS under Tariff-Based Global Competitive Bidding (ESS-I) at Fatehgarh III Substation of Powergrid.
- d. The Ministry of New and Renewable Energy under its **"Women in RE: Call for Action"** initiative acknowledges the role of women stakeholders in RE sector and thrives to drive attitudinal change by recognizing their contribution across the RE value chain. An Inter-Ministerial multi-stakeholder Committee to promote Women-centric policies, programs, and intervention in RE sector has been constituted for convergence across women-centric schemes. This will ensure engagement of self-help groups, producer groups and use of other community models for implementation of DRE schemes, capacity building and skill upgradation of women in RE.
- e. **India's first 24x7 solar-powered village in Gujarat:** On 09.10.2022, Modhera in Gujarat, famous for its Sun Temple emerged as India's first continuous solar-powered 'Suryagram', with Battery Storage.
- f. **The National Bioenergy Programme** was launched on 2.11.2022 comprising the following sub-themes: (i) Waste to Energy Programme (Programme on Energy from Urban, Industrial, and

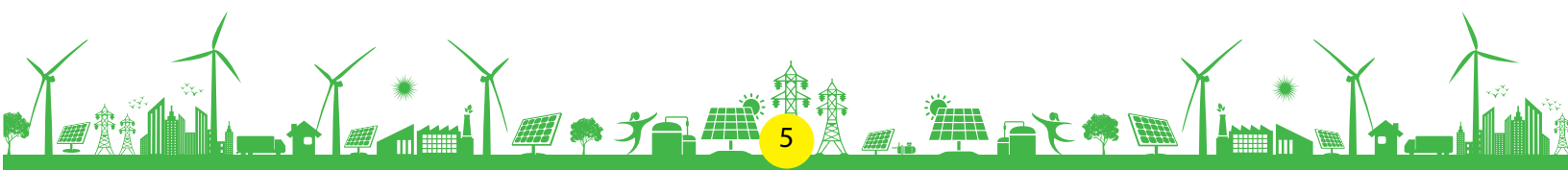


Agricultural Wastes/ Residues); (ii) Biomass Programme (Scheme to support Manufacturing of Briquettes & Pellets and Promotion of Biomass (non-bagasse) based cogeneration in Industries; and (iii) Biogas Programme: for promotion of family type Biogas plants.

- g.** The Ministry issued a Framework on 14.02.2022 for the **Promotion of Decentralized Renewable Energy (DRE) Livelihood Applications** for promoting DRE access and sustainable livelihoods in the country including in rural and remote areas.
- h. Winds of change:**
 - i.** **Draft National Repowering Policy for Wind Power Projects** was issued for stakeholder's consultation in October, 2022, with the objective for optimum utilization of wind energy resources by maximizing energy (kWh) yield per km² of the project area and utilizing the latest state-of-the-art onshore wind turbine technologies.
 - ii.** **Offshore Wind:** The Ministry took several steps to kick start the offshore wind sector in the country. These, *inter-alia*, include: (i) **Strategy paper for offshore wind** energy was issued indicating the off-shore wind auction trajectory of 37 GW by 2030; (ii) Ministry sought approval from Department of Expenditure, Ministry of Finance on **Viability Gap Funding (VGF) scheme of Rs. 15608.65 crore** for the initial 3 GW of offshore wind energy projects; (iii) **Draft Offshore Wind Energy Lease Rules, 2022** have been finalized and legally vetted by Ministry of Law & Justice which is presently under notification; (iv) Draft contractual documents for offshore wind energy projects were circulated for stakeholders' consultation.

1.4 INTERNATIONAL COOPERATION

- a.** The fifth Assembly of the International Solar Alliance (ISA) was held on 18.10.2022. India and France have been re-elected as the President and Co-President of the ISA Assembly for a third consecutive two-year term for the period October - 2022 to October - 2024.
- b.** 1st December, 2022, marked an important day in India's history as it assumed the G20 Presidency from Indonesia to convene the G20 Leaders' Summit for the first time in the country in 2023. The Ministry will play a crucial role in spearheading the discussions of the G20 Energy Transitions Working Group.



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-christened 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 Bhupinder Singh Bhalla, IAS (UT:1990) is the Secretary in Ministry of New and Renewable Energy with effect from 01st November, 2022. The Ministry has one Economic Adviser, one Deputy Director General and three Joint Secretaries as on 31.12.2022. Various programmes are being implemented by the Ministry through State Nodal Agencies (SNAs) and channel partners.

2.4 INSTITUTIONS UNDER THE MINISTRY

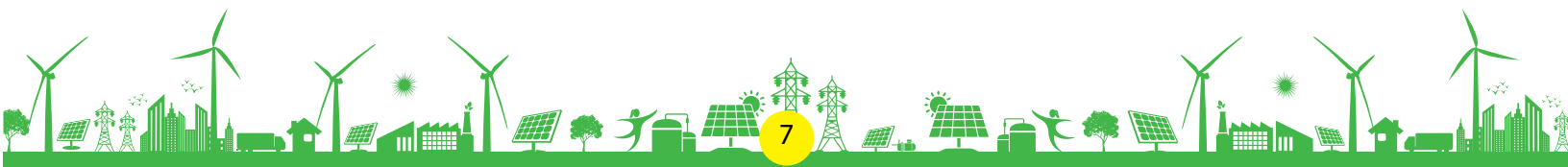
To support the Ministry, there are five institutions consisting of three autonomous bodies i.e. National Institute of Solar Energy (NISE), National Institute of Wind Energy (NIWE) and Sardar Swarn Singh National Institute of Bio Energy (SSS-NIBE) and two Public Sector Undertakings i.e. Indian Renewable 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 & Development in Solar energy sector. NIWE is located at Chennai, Tamil Nadu and serves as the technical focal point for Research & Development in Wind energy sector. SSS-NIBE is located at Kapurthala, Punjab and is focusing on Research & 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 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/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. A Director 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 of any woman working in this Ministry.
- iii. DARPG has undertaken a comprehensive reform for the Centralized Public Grievance Redress and Monitoring System (CPGRAMS) to make it more responsive to the need of the citizens. In this regard, DARPG has introduced several measures for strengthening CPGRAM, viz. monitoring dashboards for stakeholders facilities deeper analysis of grievance, universalization of CPGRAMS version 7.0 for auto-routing of grievances to last mile etc.
- iv. Time Frame for Redressal of the Grievance/petition is within a maximum period of 30 days.



CHAPTER 3

NATIONAL SOLAR MISSION

3.1 GRID CONNECTED SOLAR PROJECTS

The Government set the target of 100 GW of installed solar power capacity in the country by 2022 under the National Solar Mission (NSM). The target is planned to be achieved through various policy decisions and schemes such as Scheme for Development of Solar Parks and Ultra-mega Solar Power Projects, Central Public Sector Undertaking (CPSU) Scheme Phase-II (Government Producer Scheme), Production Linked Incentive scheme for 'National Programme on High Efficiency Solar PV Modules', Prime Minister Kisan Urja Suraksha Evam Utthaan Mahaabhiyan (PM-KUSUM), Rooftop Solar Programme etc.

3.1.1 Achievements

As on 31-12-2022, a cumulative solar power of 63.30 GW has been installed in the country. This includes 53 GW from ground-mounted solar, 8.08 GW from rooftop solar and 2.22 GW from off-grid solar. In addition to this, a capacity of around 51.13 GW is under implementation and 31.4 GW is under tendering stage. It is expected that the solar power projects of capacity around 15 GW will be commissioned during this Financial Year (FY) 2022-23.

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 State-wise cumulative solar installed capacity (as on 31-12-2022) 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.	States/UTs	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

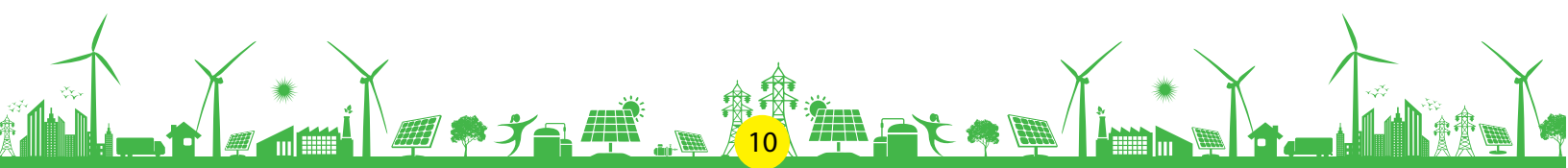
Sl. No.	States/UTs	Solar Potential (GWp) #
14.	Kerala	6.11
15.	Madhya Pradesh	61.66
16.	Maharashtra	64.32
17.	Manipur	10.63
18.	Meghalaya	5.86
19.	Mizoram	9.09
20.	Nagaland	7.29
21.	Odisha	25.78
22.	Punjab	2.81
23.	Rajasthan	142.31
24.	Sikkim	4.94
25.	Tamil Nadu	17.67
26.	Telangana	20.41
27.	Tripura	2.08
28.	Uttar Pradesh	22.83
29.	Uttarakhand	16.80
30.	West Bengal	6.26
31.	UTs	0.79
Total		748.98

Assessed by National Institute of Solar Energy

Table 3.2: State-wise Cumulative Solar Installed Capacity in the country (as on 31-12-2022)

Sl. No.	States/UTs	Cumulative Capacity till 31-12-2022 (MW)
1	Andaman & Nicobar	29.91
2	Andhra Pradesh	4524.72
3	Arunachal Pradesh	11.52
4	Assam	147.93
5	Bihar	192.88
6	Chandigarh	58.69
7	Chhattisgarh	944.22
8	Dadra & Nagar Haveli	5.46
9	Daman & Diu	41.01
10	Delhi	211.48

Sl. No.	States/UTs	Cumulative Capacity till 31-12-2022 (MW)
11	Goa	26.40
12	Gujarat	8500.74
13	Haryana	990.67
14	Himachal Pradesh	87.39
15	Jammu & Kashmir	48.90
16	Jharkhand	94.90
17	Karnataka	7885.56
18	Kerala	688.34
19	Ladakh	7.80
20	Lakshadweep	3.27
21	Madhya Pradesh	2774.78
22	Maharashtra	3646.13
23	Manipur	12.28
24	Meghalaya	4.15
25	Mizoram	8.02
26	Nagaland	3.04
27	Odisha	452.71
28	Puducherry	35.53
29	Punjab	1153.21
30	Rajasthan	16340.75
31	Sikkim	4.69
32	Tamil Nadu	6412.36
33	Telangana	4650.93
34	Tripura	16.67
35	Uttar Pradesh	2485.16
36	Uttarakhand	575.46
37	West Bengal	179.82
38	Others including NABARD	45.01
Total		63302.47



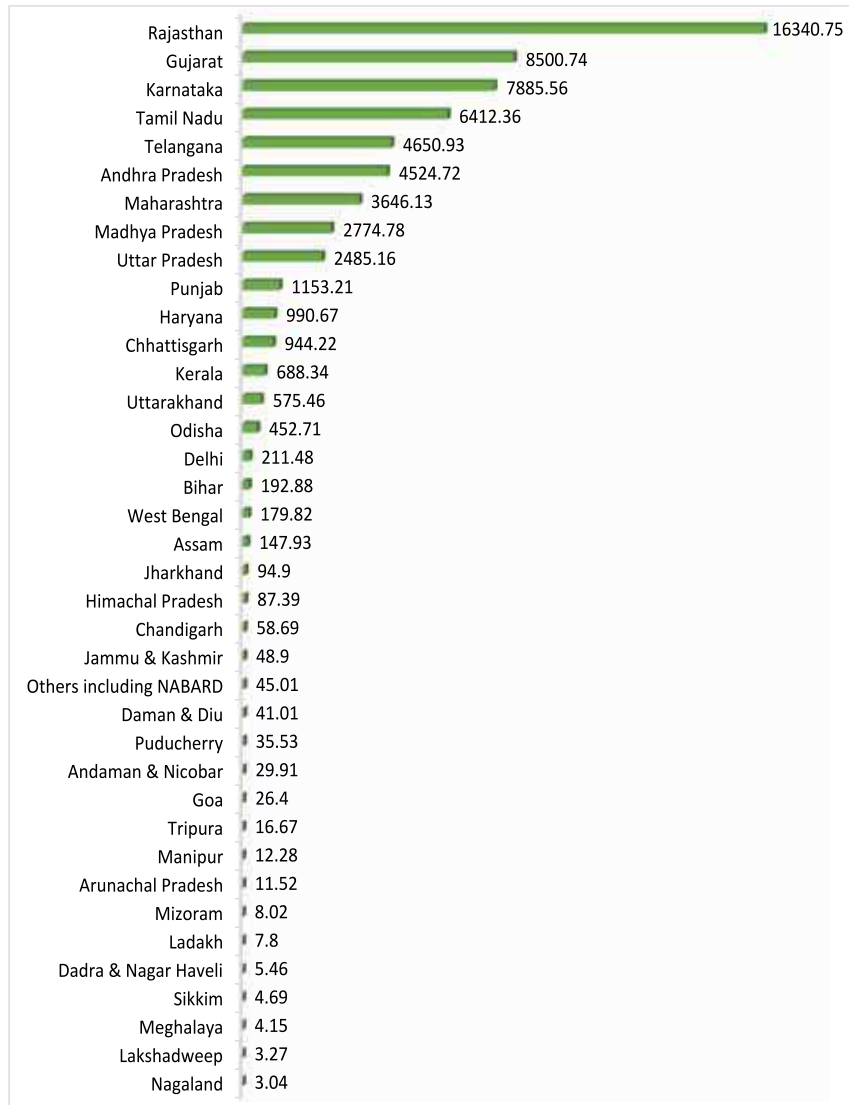


Fig. 3.1 State-wise cumulative solar capacity installed (in MW, as on 31-12-2022)

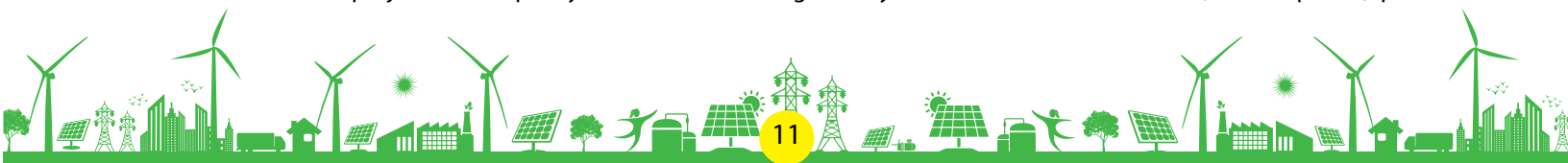
3.1.2 Expected achievements till 31.03.2023

It is expected that a capacity of around 15,000 MW will be installed under different solar programmes during the Financial Year 2022-23.

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

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 upto 2023-24.

Solar Park is a large chunk of land developed with all necessary infrastructures 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/UTs where there is shortage of non-agricultural land. Approximately 4 to 5 acres per MW of land is required for setting up of Solar Parks.

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 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).

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

3.2.1 Selection of Solar Power Park Developers

The 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 are selected in any of the eight modes as per the Solar Park Scheme. The various modes for selection of SPPD and eligibility of CFA under various modes are given at **Table 3.3**

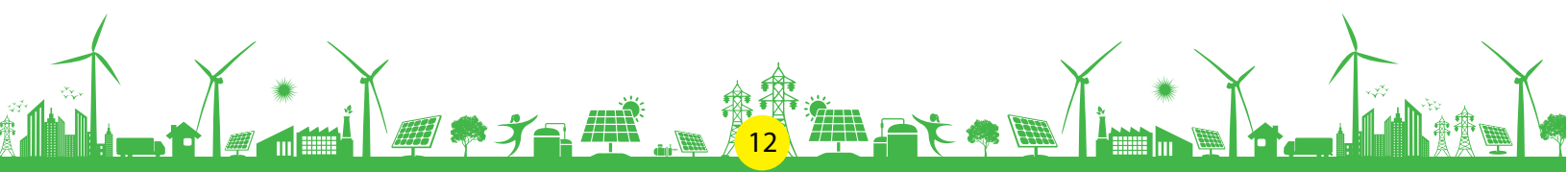
Table 3.3: Different Modes under which Solar Power Parks are developed

Mode	Brief Description	CFA Pattern
Mode-1	The 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 or 30 % of the project cost, whichever is lower, to SPPD for development of internal infrastructure, and
Mode-2	A 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	Rs. 8 lakh/MW or 30 % of the project cost, whichever is lower, to the CTU/STU for creation of external transmission infrastructure,
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 Sector 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 the Solar Power Park Developer (SPPD) for Renewable Energy Parks	Rs. 20 lakh/MW or 30 % of the project cost, whichever is lower, or external transmission infrastructure only,
Mode-8	CPSU/ state PSU/ Government organisation/ their subsidiaries or the JV of above entities can act as SPPD.	Rs. 20 lakh/MW or 30% of the project cost, whichever is lower, for internal infrastructure only.

3.2.2 Progress of Solar Park Scheme

The progress of Solar Park Scheme as on 31-12-2022 is given below:-

- I. **Capacity approved:** Based on the proposals received from the States, 57 Solar Parks of aggregate



capacity 39,285 MW have been approved to 13 States. These Solar Parks are at different stages of development. Few Solar Parks previously sanctioned 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. **Commissioned capacity of solar projects inside Solar Parks:** During 2022-23 (as on 31/12/2022), solar projects of capacity 116 MW have been commissioned inside various Solar Parks. So far, an aggregate capacity of 10,117 MW of solar projects have been commissioned inside various Solar Parks as given in the **Fig. 3.2**.

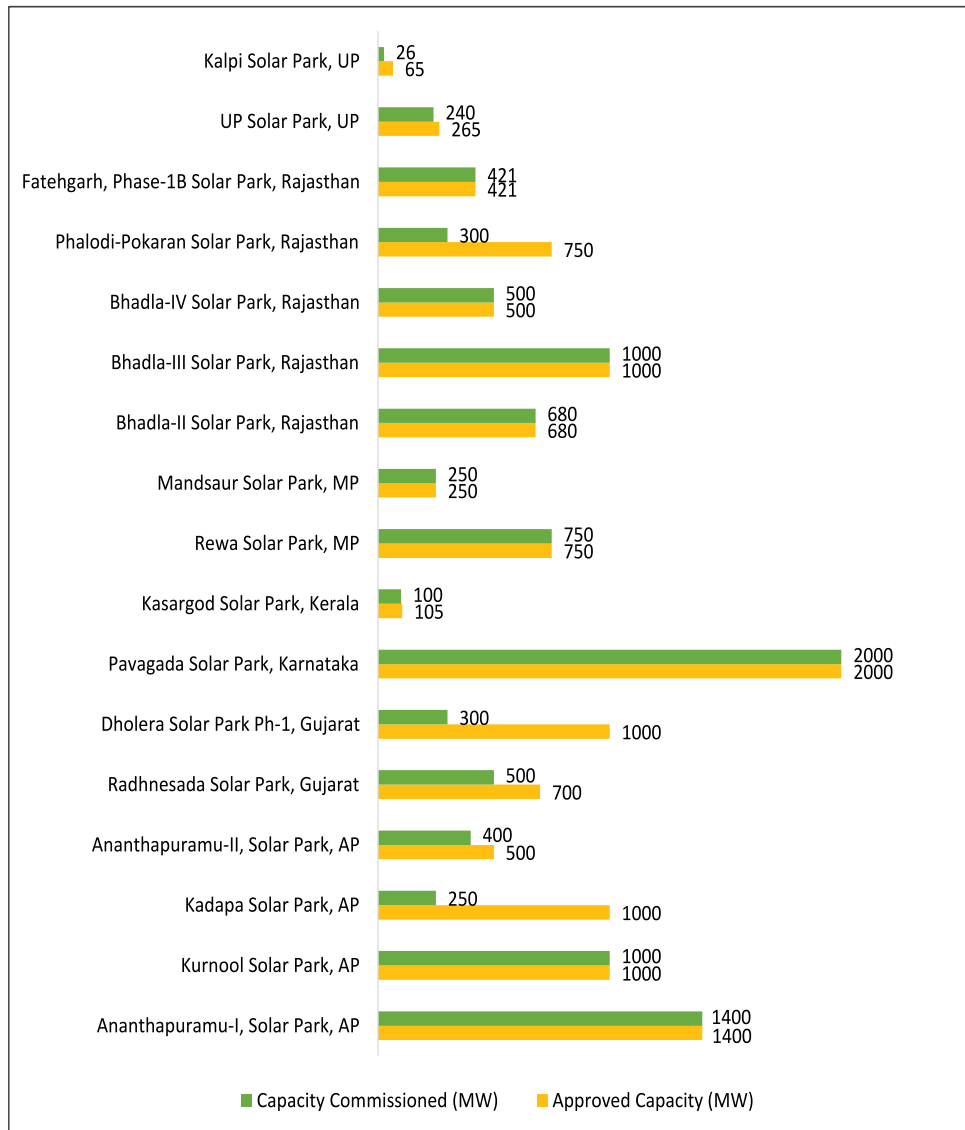


Fig. 3.2: Commissioned capacity of solar projects inside Solar Parks

3.2.3 Expected Achievements till 31.03.2023:

It is expected that solar projects capacity of around 1,000 MW will be installed during the FY 2022-23 under the Scheme. Thereby, cumulative capacity of over 11,000 MW would be commissioned inside various Solar Parks.

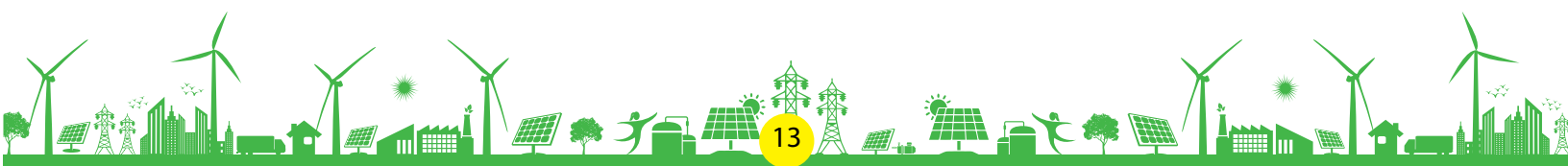


Table 3.4: List of Solar Parks as on 31-12-2022

S. No.	State	Solar Park	Approved Capacity (MW)
1	Andhra Pradesh	Ananthapuramu-I Solar Park	1400
2		Kurnool Solar Park	1000
3		Kadapa Solar Park	1000
4		Ananthapuramu-II Solar Park	500
5		Ramagiri Solar Park	200
6	Chhattisgarh	Rajnandgaon Solar Park	100
7	Gujarat	Radhnesada Solar Park	700
8		Dholera Solar Park	1000
9		NTPC RE Park	4750
10		GSECL RE Park	3325
11		GIPCL RE Park Ph-I	600
12		GIPCL RE Park Ph-II	1200
13	GIPCL RE Park Ph-III	450	
14	Himachal Pradesh	Kaza Solar Park	880
15		Kinnaur Solar Park	400
16	Jharkhand	SECI Floating Solar Park	100
17		Deogarh Solar Park	20
18		Palamu Solar Park	20
19		Garwha Solar Park	20
20		Simdega Solar Park	20
21		DVC Floating Solar Park Ph-I	755
22		DVC Floating Solar Park Ph-II	234
23	Karnataka	Pavagada Solar Park	2000
24		Kalaburgi Solar Park	500
25	Kerala	Kasaragod Solar Park	105
26		Floating Solar Park	50
27	Madhya Pradesh	Rewa Solar Park	750
28		Mandsaur Solar Park	250
29		Neemuch Solar Park	500
30		Agar Solar Park	550
31		Shajapur Solar Park	450
32		Omkareswar Floating Solar Park	600
33		Chhattarpur Solar Park	950
34		Morena Solar Park	1400
35		Barethi Solar Park	630
36	Maharashtra	Sai Guru Solar Park	500
37		Dondaicha Solar Park	250

S. No.	State	Solar Park	Approved Capacity (MW)	
38	Mizoram	Vankal Solar Park	20	
39	Odisha	Solar Park in Odisha	40	
40		Floating Solar Park Ph-I	100	
41		Floating Solar Park Ph-II	200	
42		Bhadla-II Solar Park	680	
43	Rajasthan	Bhadla-III Solar Park	1000	
44		Bhadla-IV Solar Park	500	
45		Phalodi-Pokaran Solar Park	750	
46		Fatehgarh Phase-1B Solar Park	421	
47		Nokh Solar Park	925	
48		Pugal Solar Park Ph-I	1000	
49		Pugal Solar Park Ph-II	450	
50		RVUN Solar Park	1310	
51		Uttar Pradesh	Solar Park in UP	365
52			Jalaun Solar Park	1200
53	Mirzapur Solar Park		100	
54	Kalpi Solar Park		65	
55	Lalitpur Solar Park		600	
56	Jhansi Solar Park		600	
57	Chitrakoot Solar Park		800	
Total			39285	

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

The administrative guidelines of the Scheme for solarisation of Konark sun-temple & Konark city has been issued on 19.05.2020 with support of total CFA of around Rs. 25.00 crores as a high visibility project. Odisha Renewable Energy Development Agency (OREDA) is the implementing agency for this scheme. The various components under the scheme are as follows:

- i. Off-Grid Components
 - a) Solar Trees - 50 No.
 - b) Street Lights - 200 No.
 - c) E-Rickshaws - 20 No.
 - d) Off grid Solar Power Plant for Temple Illumination - 50 kW
 - e) Charging stations - 2 No.
 - f) Drinking water kiosks - 40 No.
 - g) On grid Solar Power Plant in Govt. Establishments - 250 kW (Aggregate)

- ii. On-grid solar project - 10 MW

All Off- grid applications are now successfully commissioned and the 10 MW on grid solar project is under implementation.

3.4 SETTING UP OF GRID-CONNECTED SOLAR PV PROJECT OF CAPACITY 20 MW(AC)/50 MW(DC) WITH BATTERY STORAGE OF 50 MWh UNDER J&K PRIME MINISTER DEVELOPMENT PACKAGE (PMDP) – 2015

Ministry sanctioned this project of capacity 20 MWac/50 MWdc with battery storage of 50 MWh at Taru, Leh under J&K Prime Minister Development Package (PMDP) – 2015 on 08.11.2021 with a financial support of Rs. 250 crore.

The project is being implemented by SECI under EPC mode and the scheduled completion time of the project is 18 months from the date of award of work. SECI awarded the EPC contract to M/s. Tata Power Systems Limited through tendering on 11.08.2021. Accordingly, the scheduled completion date was 10.02.2023.

The completion timeline is now extended till 09.02.2024, as the soil strata are found non-conductive for mass piling (soil collapses heavily while boring) at considerable locations in the site.

3.5 ONE SUN ONE WORLD ONE GRID:

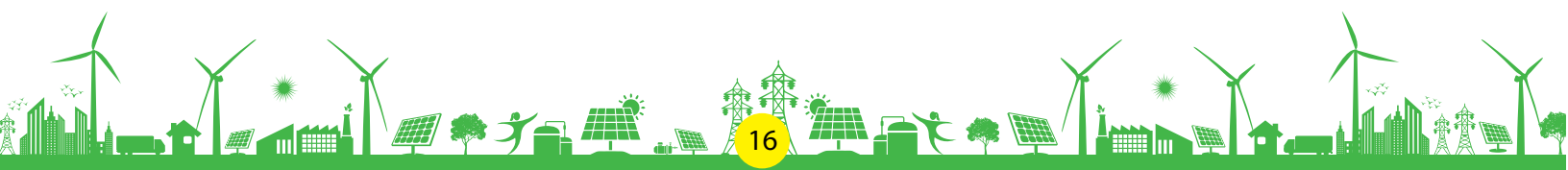
Hon'ble Prime Minister of India had called for connecting the global solar resources through the vision of 'One Sun One World One Grid' (OSOWOG) with the concept that 'The Sun Never Sets' and is always shining at some geographical location, globally, at any point of time.

MNRE is conducting a study for developing the long-term vision, implementation plan, road map and institutional framework for implementing the initiative of OSOWOG. The International Solar Alliance is the implementing agency of the study. The study is being conducted by a consortium of consultants; Électricité de France (EDF), Application Européenne de Technologies et de Services (AETS), and The Energy and Resources Institute (TERI). The inception report of the study was submitted in December,2021. The revised report for Phase-I of the study has been submitted on 31st October, 2022. The study is expected to be completed by May, 2023.

The Ministry in association with the Ministry of Power constituted a Task Force in November,2021 to identify and study the aspects (technical, operational, legal, regulatory, commercial and institutional) of grid interconnection in South Asia, South East Asia, Middle East (GCC), Africa, Europe etc.

3.6 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) The 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 of Rs. 8,580 crores, for self-use or use by Government/ Government entities, either directly or through Distribution Companies (DISCOMs).



- (ii) The Scheme is under implementation.
- (iii) The maximum permissible VGF has been kept at Rs. 0.70 cr./MW, the actual VGF to be given to a Government organizations under the Scheme is decided through bidding using VGF amount as a bid parameter to select project proponent. 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 this Scheme, the Government has so far sanctioned about 8.2 GW capacity of solar PV power plants to the following entities, out of which, as on 31.12.2022, about 1.5 GW capacity plants have been commissioned (**Table 3.5**).

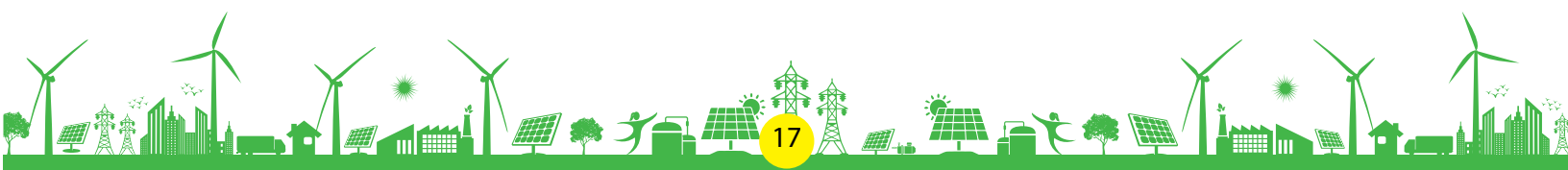
Table 3.5: Capacities allotted till 31.12.2022 under CPSU Scheme Phase – II

S. No.	Name of Government entity	Capacity of Solar PV power plants allotted under CPSU Scheme Phase-II (MW)
1	NTPC Limited	3682
2	The Singareni Collieries Company Limited	171
3	Delhi Metro Rail Corporation Limited	3
4	Assam Power Distribution Company Limited	30
5	NHDC Limited	25*
6	Nalanda University	5
7	Indore Municipal Corporation	100
8	SJVN Limited	1000
9	NLC India Limited	510
10	NHPC Limited	1000
11	IRCON International Limited	500
12	Solar Energy Corporation of India Limited	1200
	Total	8226*

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

3.7 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 launched a Scheme on 19th March, 2020.

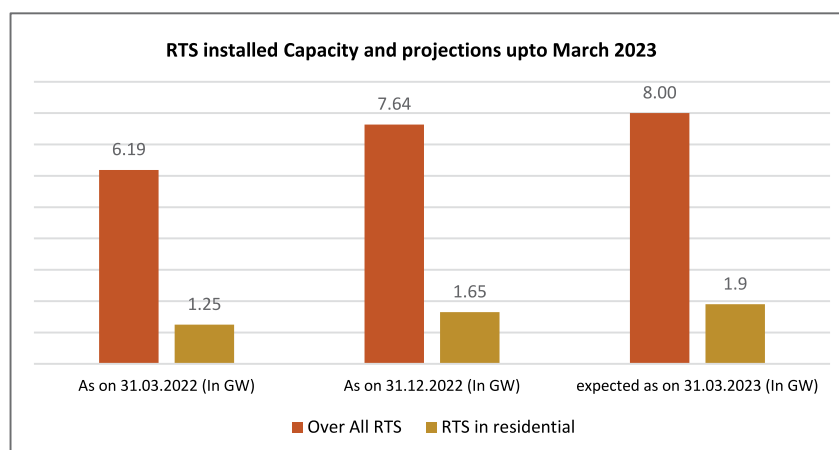


- (ii) The Scheme envisaged setting up of the RE installations including 6 MW grid-connected ground mounted solar PV power plant, 15 MWh battery energy storage system, 1297 nos. x 1KW Rooftop Solar PV Systems, 305 kW aggregate capacity of Rooftop Solar PV Systems on Govt. Buildings, smart meters, solar EV charging stations, etc. in Modhera, with an investment of around Rs. 76.66 crore, with up to 50% Central Financial Assistance (CFA) from Government of India through Ministry of New & Renewable Energy and balance 50% coming from Government of Gujarat.
- (iii) Gujarat Power Corporation Limited (GPCL), the scheme implementing agency, had issued awarded Letters of Intent (LoI)/ Letters of Award (LoA) for installations of aforesaid components.
- (iv) As on 31.12.2022, MNRE has released Rs. 16.25 crore as Central Financial Assistance (CFA) for this project.
- (v) The project has been completed and inaugurated by Hon'ble Prime Minister on 9th October, 2022.

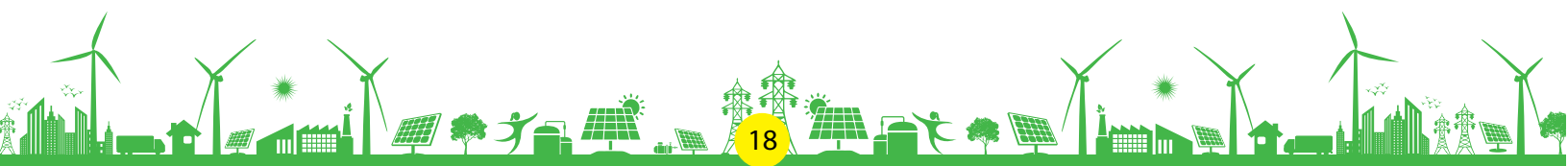
3.8 PHASE II OF THE GRID CONNECTED ROOFTOP SOLAR PROGRAMME

Ministry of New and Renewable Energy is implementing Rooftop Solar Programme Phase II wherein RTS capacity aggregating 4000 MW by 2022 was targeted in residential sector through provision of Central Financial Assistance (CFA) out of the overall target of 40000 MW by 2022. Considering the Covid-19 pandemic conditions and other factors the Programme period has been extended till 31.3.2026. For individual households, CFA upto 40% of the benchmark cost is provided for RTS plants upto 3 kW capacity and upto 20% for RTS plants of capacity beyond 3 kW and up to 10 kW. For Group Housing Societies/ Residential Welfare Associations (GHS/RWA), CFA is limited to 20% of the benchmark cost for RTS plants of capacity up to 500 kW used for supply of power to common facilities.

Based on the proposal received from various Electricity Distribution utilities of various States /UTs, Ministry of New and Renewable Energy has allocated 3.41 GW capacity of grid connected rooftop solar programme during the last three years including the current year up to 31.12.2022. Against the allocated 3.41GW capacity (**Table 3.6**), around 1.65 GW (**Table 3.7**) has been installed in various States/UTs. Overall 7.64 GW RTS installation have been reported by various State implementing agencies as on 31.12.2022 (**Table 3.7**) in various sectors e.g. residential, social, institutional, commercial, industrial, Govt. etc . with or without CFA support in the country. Reported installed capacity in financial year 2022-23 is 1.45 GW of which 0.4 GW has been installed in residential sector with CFA.



In addition, incentives upto 5% of the benchmark cost for RTS capacity addition beyond 10% and up to 15% of the base line RTS capacity; and incentives upto 10% of the benchmark cost for RTS capacity addition beyond 15% of the base line RTS capacity is being provided to the electricity distribution companies



(DISCOMs). The incentives are provided to DISCOMS for achieving RTS capacity addition in all sectors in a financial year above the baseline capacity as on 31st March of the previous year.

CFA/incentives of Rs. 1323.57 crore has been released to various implementing agencies in FY 2022-23 as on 31.12.2022 of which Rs. 1282.77 crore has been released under phase II and remaining amount of Rs. 40.81 crore has been released towards settlement of projects under phase I of the programme.

Table 3.6: Allocated capacity under the phase II of the rooftop solar programme

S.No.	States/UTs	Net allocated capacity (MW)
1	Andaman & Nicobar	1.00
2	Andhra Pradesh	8.00
3	Arunachal Pradesh	0.00
4	Assam	3.75
5	Bihar	25.00
6	Chandigarh	35.00
7	Chhattisgarh	19.00
8	Dadar & Nagar Haveli and Daman & Diu	0.00
9	Goa	20.00
10	Gujarat	1,937.08
11	Haryana	51.50
12	Himachal Pradesh	15.00
13	J&K	220.00
14	Jharkhand	28.38
15	Karnataka	33.00
16	Kerala	360.90
17	Ladakh	0.00
18	Lakshadweep	0.00
19	Madhya Pradesh	58.20
20	Maharashtra	133.50
21	Manipur	2.00
22	Meghalaya	10.00
23	Mizoram	1.50
24	Nagaland	3.80
25	NCT of Delhi	35.50
26	Odisha	20.00
27	Puducherry	5.00
28	Punjab	33.40
29	Rajasthan	100.00
30	Sikkim	2.00
31	Tamil Nadu	10.00

S.No.	States/UTs	Net allocated capacity (MW)
32	Telangana	71.42
33	Tripura	1.00
34	Uttar Pradesh	121.20
35	Uttarakhand	22.00
36	West Bengal	20.00
Total	36 States/UTs	3,408.13

Table 3.7: Rooftop Solar Installed capacity as on 31.12.2022

S. No.	States/UTs	Capacity installed under phase II in residential sectors with CFA as on 31.12.2022 (MW)	Overall RTS system installed in all sectors with and without CFA as on 31.12.2022 (MW)
1	Andaman & Nicobar	0	4.15
2	Andhra Pradesh	0.44	164.78
3	Arunachal Pradesh	0	0.22
4	Assam	0.19	30.36
5	Bihar	2.04	22.07
6	Chandigarh	18.05	50.69
7	Chhattisgarh	0.50	50.98
8	Dadar & Nagar Haveli and Daman & Diu	0	0.39
9	Goa	0.1	23.46
10	Gujarat	1,355.61	2182.46
11	Haryana	26.40	418.15
12	Himachal Pradesh	0.78	19.31
13	J&K	0.34	22.3
14	Jharkhand	0.97	35.29
15	Karnataka	0.10	371.72
16	Kerala	94.35	381.10
17	Ladakh	0	0
18	Lakshadweep	0	0
19	Madhya Pradesh	22.30	229.85
20	Maharashtra	12.17	1385.15
21	Manipur	0.17	4.95
22	Meghalaya	0	0.21
23	Mizoram	0.19	1.55
24	Nagaland	0	0.1
25	NCT of Delhi	2.67	201.05
26	Odisha	0.00	19.81

S. No.	States/UTs	Capacity installed under phase II in residential sectors with CFA as on 31.12.2022 (MW)	Overall RTS system installed in all sectors with and without CFA as on 31.12.2022 (MW)
27	Puducherry	0.00	34.55
28	Punjab	16.92	244.40
29	Rajasthan	36.27	810.08
30	Sikkim	0	2.67
31	Tamil Nadu	0.75	361.79
32	Telangana	25.76	281.72
33	Tripura	0	4.78
34	Uttarakhand	10.76	63.29
35	Uttar Pradesh	23.70	163.34
36	West Bengal	0	53.04
Total	36 States/UTs	1651.53	7639.76

3.9 SIMPLIFIED PROCEDURE ON ROOFTOP SOLAR

To simplify implementation process, Ministry has developed a National Portal (solarrooftop.gov.in) for installation of RTS projects in residential sector. With the launch of National Portal for Rooftop Solar (www.solarrooftop.gov.in) on 30.7.2022, it has become simple and easy for a residential consumer to apply and get the rooftop solar installed. The residential consumers from any part of the country can apply on the National Portal. The consumers have the choice to select any vendor registered with the local distribution company, solar modules of quality and efficiency, solar inverter and other balance of plants and equipment. The rate of rooftop solar plant is decided mutually by vendor and the consumer. The subsidy is fixed and same for the entire country. DISCOMs role is limited to issuing technical feasibility approval, installation of net-meter and inspection of the system. After installation and inspection of the system, subsidy is released directly in the bank account of the consumer. The entire process of registration of the application to release of subsidy in the bank account of the consumer, having following steps, can be tracked online on the Portal:

- (i) The consumer has to register using the mobile number and e-mail and activate the account,
- (ii) Log-in and submit the application, which is automatically forwarded to local distribution company for technical feasibility approval as per the prevailing regulations of the State,
- (iii) Once the technical feasibility approval is given, it is automatically reflected in the Portal and an e-mail sent to the consumer,
- (iv) The consumer can get the rooftop solar system installed from any of the registered vendor and submit the details on the online Portal for inspection and installation of net-meter.
- (v) The DISCOM officials inspect the installation and install net-meter.
- (vi) After the net-meter is installed and details uploaded by DISCOM, the consumer submits bank account details for release of subsidy.
- (vii) The subsidy is released directly into the bank account of the consumer. The rate of subsidy is common for all the consumers in the country.

The process of registration of vendors with the distribution company has also been made simple, they have to just submit a declaration along with a performance bank guarantee of Rs. 2.5 lakh and they will get registered. These vendors also get access for providing their information and rates on the National Portal

so that any consumer willing to install rooftop solar can contact them and get the rooftop solar installed through mutually agreed rates. To protect the interest of consumers, apart from mandating the vendors to get registered at the DISCOM, the vendor also has to maintain the rooftop solar system for at least 5 years. In case of any issue, the consumer can also lodge grievance on the Portal. The subsidy pattern under the National Portal is given below:

a) Individual residential consumers:

Rooftop Solar Plant Capacity	Applicable Subsidy for General Category States	Applicable Subsidy for North Eastern States and Hilly States/ UT
Up to 3 kW	Rs. 14588/- per kW	Rs. 17662/- per kW
Above 3 kW and up to 10 kW	Rs. 14588/- per kW for first 3 kW and thereafter Rs.7294/- per kW	Rs. 17662/- per kW for first 3 kW and thereafter Rs.8831/- per kW
Above 10 kW	Rs. 94822/- fixed	Rs. 114803/- fixed

b) Resident Welfare Associations/Group Housing Societies: Rs.7294/- per kW for a maximum capacity of 500 kW.

Since the launch (on 30.07.2022) of National portal (solarrooftop.gov.in), RTS applications has been received for around 0.191 GW capacity of which 0.013 GW has been installed as on 31.12.2022.

3.10 PRADHAN MANTRI KISAN URJA SURAKSHA EVAM UTTAHAN 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.

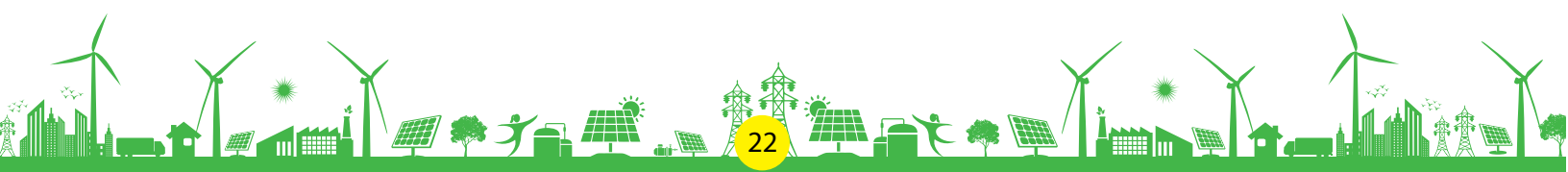
Component-C: Solarisation of 15 Lakh existing Grid-connected Agriculture Pumps.

ii. The Scheme was expanded during FY 2020-21 with an increase targeted solar capacity addition of 30.8 GW and recently granted an extension till 31.03.2026. The total central financial support provided under the scheme is Rs. 34,422 crore including service charges of 2% on eligible CFA to implementing agencies. Revised physical targets are given in **Table 3.8**.

Table 3.8: PM KUSUM Programme Components

Component	Approved Capacity	Creation of RE Capacity targeted (GW)
Component A	10 GW	10.0
Component B	20 lakh pumps	9.6
Component C	15 lakh pumps	11.2
Total		30.8

iii. Under **Component A**, solar power plants of capacity up 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 are 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 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, is provided. The State Government gives a subsidy of at least 30%; and the remaining upto 40% is provided by the farmer. Bank finance may be made available for meeting 30% of the cost and 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 is provided by MNRE and balance will be invested by the State Government (in Capex mode) or developer (in RESCO mode). Higher CFA of 50% is provided for North Eastern States, Sikkim, Jammu & Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Lakshadweep, and A&N Islands.
 - vii. While extending the Scheme till 31.03.2026 with following modifications have also been made:
 - a) Under Component-B and Component-C of the Scheme, Central Financial Assistance (CFA) will be available for pump capacity up to 15 HP to the individual farmers in the North-eastern States, UTs of Jammu & Kashmir and Ladakh, States of Uttarakhand and Himachal Pradesh and Island UTs of Andaman & Nicobar and Lakshadweep, and for each farmer in the cluster/ community irrigation projects in high water table areas in all the States/ UTs, subject to the restriction of 10% of the total allocation. For the remaining quantity the current provision will prevail, unless superseded.
 - b) The condition of domestic content requirement for solar cells has been waived off for the feeder solarization projects under Component-C for which work is awarded to the implementing company by 20.06.2023.
 - viii. The Scheme will have substantial environment impact in terms of savings of CO₂ emissions. All three components of the Scheme combined together are likely to result in saving of about 32 million tonnes of CO₂ 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.
 - ix. Under Component-B and Component-C, it is mandatory to use indigenously manufactured solar modules with indigenously manufactured solar cell and therefore, the scheme opens up opportunities for local manufacturing of solar cells and modules to the tune of 20.8 GW.
 - x. 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, FY 2020-21 and FY 2021-22. State-wise capacity sanctioned and progress under the three components of the scheme till 31.12.2022 is given in **Table 3.9**.

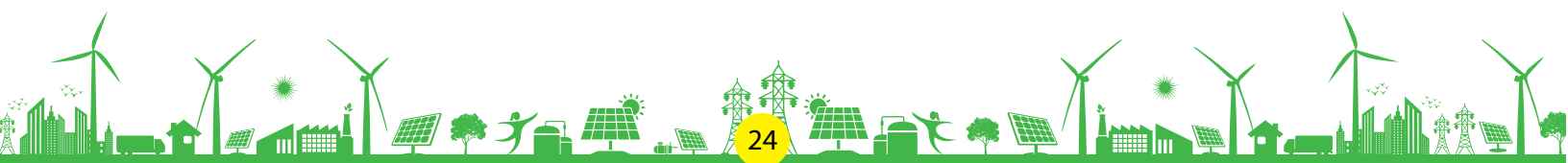
Table 3.9: State-wise Sanctioned Capacities under the Components of PM KUSUM Scheme

S. No.	States/ UTs	Component-A (MW)		Component-B (Nos)		Component-C (Nos)		
		Sanctioned	In-stalled	Sanctioned	In-stalled	Sanctioned (IPS)	Sanctioned (FLS)	In-stalled
1	Arunachal Pradesh	2	0	200	91	0	0	0
2	Assam	10	0	5000	0	1000	0	0
3	Chhattisgarh	30	0	25000	0	0	330500	0
4	Bihar	0	0	0	0	0	160000	0
5	Gujarat	500	0	8082	1283	7000	300500	0
6	Goa	50	0	200	0	0	11000	0
7	Haryana	65	2.25	252655	40216	0	65079	0
8	Himachal Pradesh	50	19.7	1580	478	0	0	0
9	Jammu & Kashmir	20	0	5000	462	0	0	0
10	Jharkhand	50	0	16717	8922	1000	10000	0
11	Karnataka	0	0	10314	314	0	337000	0
12	Kerala	40	0	100	0	45100	3200	30
13	Ladakh	5	0	1600	0	0	0	0
14	Madhya Pradesh	500	4	57000	6787	0	270000	0
15	Maharashtra	500	0	200000	37721	0	250000	0
16	Manipur	0	0	150	28	0	0	0
17	Meghalaya	5	0	535	35	0	10000	0
18	Mizoram	0	0	2700	0	0	0	0
19	Nagaland	5	0	165	0	0	0	0
20	Odisha	500	0	5741	1138	40000	10000	0
21	Puducherry	7	0	0	0	0	0	0
22	Punjab	220	0	63000	12128	186	125000	0
23	Rajasthan	1200	62.5	158884	54195	10764	100000	1144
24	Tamil Nadu	424	0	6200	2468	20000	10000	0
25	Telangana	500	0	400	0	0	0	0
26	Tripura	5	0	6021	1174	2600	0	0
27	Uttar Pradesh	225	0	36842	12773	0	400000	0
28	Uttarakhand	0	0	1838	307	200	0	0
29	West Bengal	0	0	0	0	23700	0	0
	Total	4886	88.45	807124	180520	151550	2392279	1174

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

3.11 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. Cumulative numbers/capacity of the off-grid solar applications installed in various States as on 31.12.2022 is given in **Table 3.10**.

Table 3.10: Cumulative systems installed upto 31.12.2022

SPV Systems	Cumulative upto 31.12.2022
Lanterns and Study Lamps (No.)	1,01,82,598
Home Lights (No.)	17,23,479
Street Lights (No.)	9,44,802
Solar Pumps (No.)	5,01,673
SPV Plants (MWp)	217

- iii. State-wise details of the solar off-grid applications installed till 31.12.2022 are given in **Table 3.11**.

Table 3.11: State-wise Cumulative Capacity installed under Off-grid SPV Programme

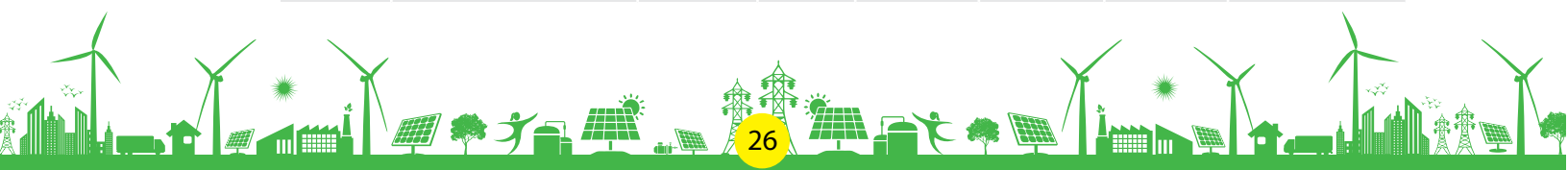
S. No.	Agencies	Solar Home Light (Nos)	Solar lamp (Nos)	Solar Street Light (Nos)	Solar Pump (Nos)	Solar Power Plant (kW)	Grid-connected solar power plants under PM-KUSUM (MW)
1	Andhra Pradesh	22972	77803	16460	34045	3815.595	0
2	Arunachal Pradesh	35065	218551	25008	113	963.2	0
3	Assam	46879	647761	29538	45	1605	0
4	Bihar	12303	1735227	54147	2813	6905	0
5	Chhattisgarh	42232	3311	4538	119282	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	12805	13576.6	0
9	Haryana	56727	93853	34625	42153	2321.25	2.25
10	Himachal Pradesh	22592	33909	98800	484	1905.5	19.70
11	Jammu & Kashmir	144316	51224	39076	501	8129.85	0
12	Jharkhand	9450	790515	14344	13592	3769.9	0
13	Karnataka	52638	7781	5694	7734	7854.01	0
14	Kerala	41912	54367	1735	848	16268.39	0
15	Madhya Pradesh	7920	529101	16808	25138	3654	4
16	Maharashtra	3497	239297	10420	49036	3857.7	0
17	Manipur	24583	69722	32767	68	1580.5	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)
18	Meghalaya	14874	97360	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	19109	10689	2321.515	0
22	Punjab	8626	17495	43758	16710	2066	0
23	Rajasthan	187968	225851	8934	108644	30449	58.50
24	Sikkim	15059	45200	504	0	850	0
25	Tamil Nadu	298641	16818	41419	7927	13052.6	0
26	Telangana	0	142000	2458	424	7450	0
27	Tripura	32723	364012	15517	1325	867	0
28	Uttar Pradesh	235909	2351205	302532	41423	10638.31	0
29	Uttarakhand	91595	165071	43803	333	4059.53	0
30	West Bengal	145332	17662	18203	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	8459119	944802	501673	216862.67	84.45

iv. The Capacity installed in various States during FY 2022-23 (as on 31.12.2022) is given in the **Table 3.12.**

Table 3.12: Capacity installed under Off-grid SPV Programme during Financial Year 2022-23

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	0	0	91	0	0
3	Assam	0	0	208	0	0	0
4	Bihar	0	0	1716	0	0	0
5	Chhattisgarh	0	0	89	57312	0	0
6	Gujarat	0	0	0	824	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)
7	Goa	0	0	0	0	0	0
8	Haryana	0	0	0	8252	0	2.25
9	Himachal Pradesh	0	0	300	253	0	5.20
10	Jammu & Kashmir	0	0	250	359	0	0
11	Jharkhand	0	0	0	2205	0	0
12	Karnataka	0	0	0	0	0	0
13	Kerala	0	0	0	30	0	0
14	Madhya Pradesh	0	0	135	91	0	4.00
15	Maharashtra	0	0	0	35295	0	0
16	Manipur	0	0	420	0	0	0
17	Meghalaya	0	0	0	0	0	0
18	Mizoram	0	0	0	0	0	0
19	Nagaland	0	0	0	0	0	0
20	Odisha	0	0	630	381	0	0
21	Punjab	0	0	250	5631	0	0
22	Rajasthan	0	0	265	31870	0	37.00
23	Sikkim	0	0	0	0	0	0
24	Tamil Nadu	0	0	298	1281	0	0
25	Telangana	0	0	0	0	0	0
26	Tripura	0	0	340	753	0	0
27	Uttar Pradesh	0	0	4571	5931	0	0
28	Uttarakhand	0	0	80	307	0	0
29	West Bengal	0	0	309	0	0	0
30	Andaman & Nicobar	0	0	0	0	0	0
	Total	0	0	9861	150866	0	48.45

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

- i. Phase-III of Off-grid and Decentralized 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 till the closure of programme are given in **Table 3.13**.

Table 3.13: Status of Off -Grid & Decentralized 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	13,959	-	-	-	-
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	56,610	-	-
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	21,900	-	-
15	Telangana	-	-	2,00,000	1,42,000	-	-
16	Tripura	12,000	11,000	3,00,000	3,00,000	-	-
17	Uttarakhand	19,665	15,150	-	-	-	-
18	Uttar Pradesh	-	-	21,122	21,122	-	-
	Total	1,74,575	1,46,537	11,15,156	9,71,001	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. Centralized tendering was done through Energy Efficiency Services Ltd. (EESL), for procurement of solar streetlights and solar study lamps.

3.13 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 1.50 lakh solar street lights. Out of this, 1,37,226 nos. of solar street lights have been installed till the closure of programme.

3.14 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.

3.15 DECENTRALIZED RENEWABLE ENERGY (DRE) LIVELIHOOD APPLICATIONS FRAMEWORK

Ministry issued a Framework on 14.02.2022 for the Promotion of Decentralized Renewable Energy (DRE) Livelihood Applications with the objective to facilitate the development of an enabling ecosystem for widespread access to DRE for promoting sustainable livelihoods in the country including in rural and remote areas. First Meeting of Inter-Ministerial Coordination Committee for the Promotion of DRE Livelihood Applications was held on 10.06.2022.

3.16 GREEN ENERGY CORRIDOR

3.16.1 Intra-State Transmission System Green Energy Corridor (InSTS GEC) Phase-I

- i. The InSTS GEC scheme with total target of 9700 ckm intra-state transmission lines and 22600 MVA sub-stations was approved by the Cabinet Committee on Economic Affairs (CCEA) in 2015. The InSTS GEC scheme is currently under implementation by the State Transmission Utilities (STUs) of 8 RE rich States, i.e. Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan & Tamil Nadu. The project cost is Rs. 10,141.68 crore with funding mechanism consisting of 40% central grant by MNRE (Rs. 4056.67 crore), 40% loan from KfW Germany (EUR 500 Million) and 20% equity by the STUs.
- ii. The projects are being set up for evacuation of approx. 24 GW of RE power in the above 8 States, of which approx. 16.4 GW RE has been commissioned and connected to the grid through the projects setup under InSTS GEC. As on 31.12.2022, a total of 8759 ckm of transmission lines have been constructed and 19868 MVA of substations have been charged. Out of the 8 States, 3 have completed all the projects, viz. Rajasthan, Madhya Pradesh and Tamil Nadu. As on 31.12.2022, a total grant of approx. Rs. 2419 crore has been disbursed to the States. Further, additional Rs. 117 crore is anticipated to be disbursed to the states up to March 2023, taking the cumulative grant disbursement to Rs. 2536 crore.

3.16.2 Intra-State Transmission System Green Energy Corridor Phase-II

- i. The InSTS GEC-II scheme with total target of 10750 ckm intra-state transmission lines and 27500 MVA sub-stations was approved by the CCEA in January 2022. The InSTS GEC-II scheme is currently under implementation by the State Transmission Utilities (STUs) of 7 States, i.e. Gujarat, Himachal Pradesh, Karnataka, Kerala, Rajasthan, Tamil Nadu and Uttar Pradesh. The scheduled commissioning timeline for the projects under this scheme is March 2026.
- ii. The project cost is Rs. 12031.33 crore with central financial assistance from MNRE of Rs. 3970.34 crore (i.e. 33% of project cost). The projects are being set up for evacuation of approx. 20 GW of RE power in the above 7 States. Currently, the states are preparing the packages and are in process of issuing tenders for implementing the projects.

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 41.93 GW (as on 31st December, 2022) of which 1.85 GW was added during January to December, 2022. The number of units generated from wind power projects during January to November, 2022 were 66.05 billion units.

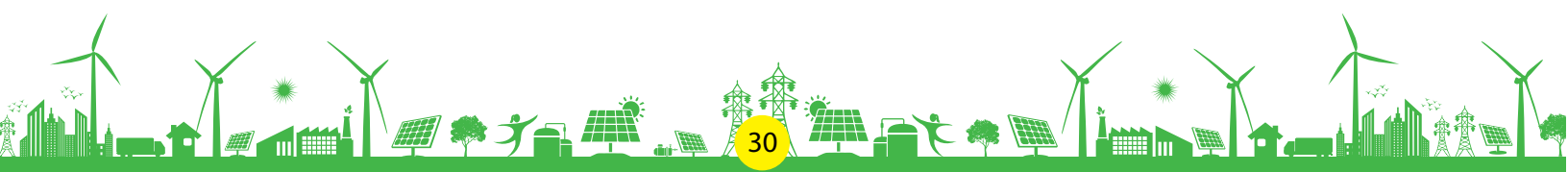
4.1.2 Potential of Wind Energy in India

Wind is an intermittent and site-specific source of energy and therefore, an extensive Wind Resource Assessment is essential for the selection of potential sites. Over a period of time, the Ministry, through National Institute of Wind Energy (NIWE), has installed 993 wind-monitoring stations all over the country as on 31.12.2022 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 695.50 GW in the country at 120 meter respectively, above ground level. Most of this potential exists in eight windy States as given in **Table 4.1.**

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

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
8	Telangana	24.83
	Total (8 windy States)	676.55
	Other States	18.95
	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 120 m above ground level is given below in **Fig. 4.1.**



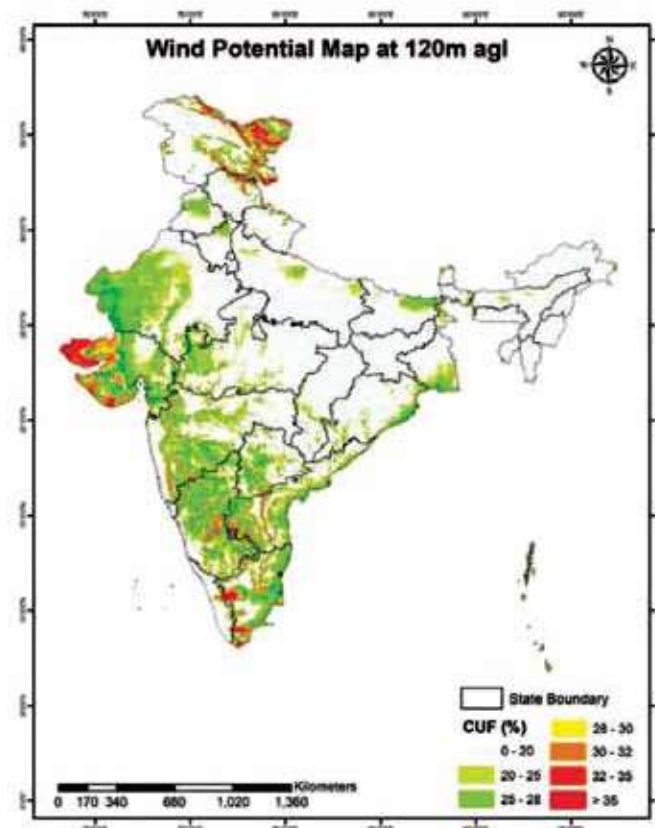


Fig. 4.1: Wind Potential Map at 120 Meters above ground level

4.1.3 Installed capacity of Wind Power in the country

The installed capacity of grid-interactive wind power in the country as on 31.12.2022 is 41.93 GW and state-wise installed capacity (in MW) is shown in **Table 4.2**.

Table 4.2: State wise Wind Power installed capacity as on 31.12.2022

S. No.	State	Installed Capacity (MW)
1	Andhra Pradesh	4096.65
2	Gujarat	9866.62
3	Karnataka	5269.65
4	Kerala	62.50
5	Madhya Pradesh	2844.29
6	Maharashtra	5012.83
7	Rajasthan	4681.82
8	Tamil Nadu	9963.02
9	Telangana	128.10
10	Others	4.30
	Total (MW)	41929.78

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	68640
9	2022-23 (upto December, 2022)	59532

4.1.4 Technology development and manufacturing base for Wind Power

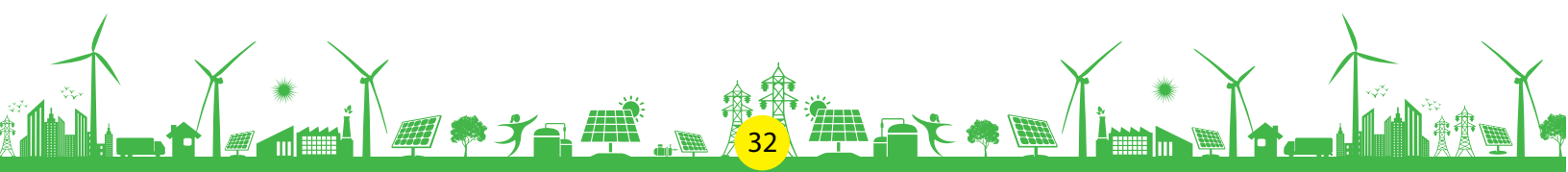
The Wind Turbine Generator technology has evolved and state-of-the-art technologies are available in the country for the manufacture of wind turbines. Around 75% localization has been achieved with strong domestic manufacturing capacity for wind energy turbines and its components in the country. All the major global players in this field have their presence in the country and over 35 different models of wind turbines are being manufactured by more than 14 different companies, through (i) joint ventures under licensed production (ii) subsidiaries of foreign companies, and (iii) Indian companies with their own technology. The unit size of the largest machine has gone up to 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 Utilisation 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 PSA, whichever is later.



4.1.6 Status of tenders for Wind Power Projects

To enable DISCOMs of the non-windy States to fulfill their Wind 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 twelve tranches. Further, NTPC and the states of Gujarat, Maharashtra and Tamil Nadu have also auctioned wind power capacities.

- Cumulative commissioned capacity till 31/12/22: 41.93 GW
- Capacity under implementation: 12.93 GW
- Total ongoing bids: 1.2 GW

Total (a+b+c): 56.06 GW

The details of tenders auctioned for Wind Power are shown in **Table 4.4**.

Table 4.4: Details of tenders auctioned for Wind Power

S. 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	760.1	Central	2.64
3.	SECI-III	2000	0	2000	950.2	Central	2.44
4.	SECI-IV	2000	0	2000	721.9	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	274.4	State	2.85
8.	SECI-V	1190	0	1190	256.5	Central	2.76
9.	NTPC	1150	1150	0	0	Central	2.77
10.	SECI – VI	1200	125	1075	916.3	Central	2.82
11.	SECI – VII	480	0	480	118.3	Central	2.79
12.	GUVNL Ph.-II	202.6	0	202.6	162.6	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	27	Central	2.77
16.	SECI XI	1200	0	1200	0	Central	2.69
17.	SECI XII	1200	0	1100	0	Central	2.89
18.	GUVNL Ph.-III	1000	0	1000	0	State	2.84
	Total	17632.5	1374.9	16257.6	5706.7		

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, inter alia, 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 2030,
- 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,
- Notification of Promoting Renewable Energy through Green Energy Open Access Rules 2022,
- Notification of Late Payment Surcharge and related matters Rules 2022.

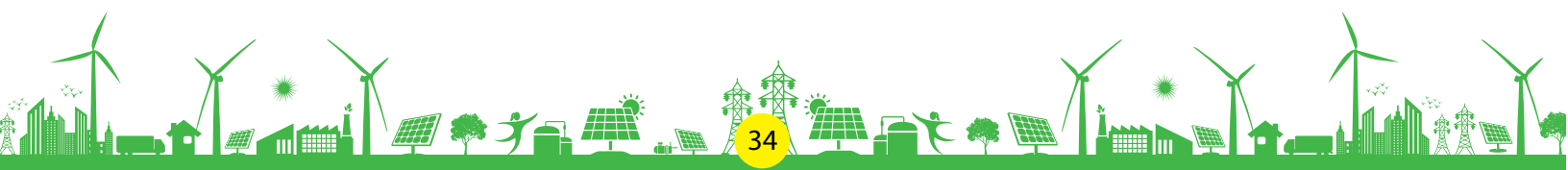
In addition to the above, the following steps have been taken specifically for promoting wind energy:

- Declaration of trajectory for Wind Renewable Purchase Obligation (Wind RPO) up to the year 2030,
- 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's mainland 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

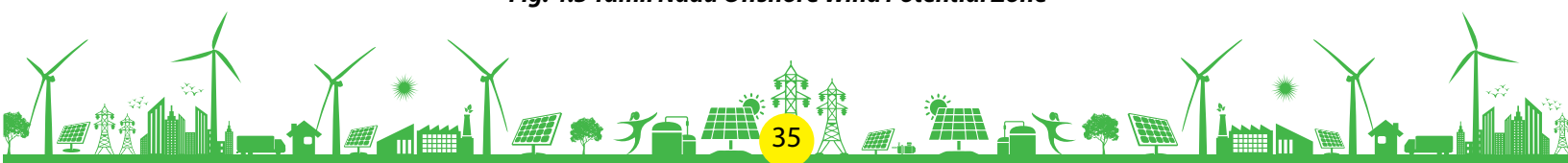
- » Based on the preliminary assessment from satellite data and data available from other sources, potential zones in Gujarat and Tamil Nadu have been identified for exploitation of offshore wind energy. Initial assessment of offshore wind energy potential within the identified zones has been estimated 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 Offshore Wind potential

1) Offshore measurements off Gujarat and Tamil Nadu 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. 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 Khambhat and Gulf of Mannar off Tamil Nadu 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.

4.1.11 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. The preliminary Detailed Project Report (DPR) Preparation for the test centre is in process by NIWE.

4.1.12 Strategy for Offshore Wind Energy Development in India

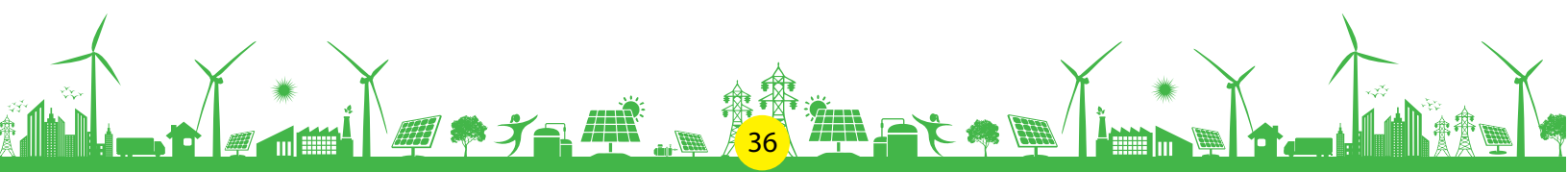
Ministry issued the “Strategy Paper on the Establishment of Offshore Wind Energy Projects in India” after consultation with various stakeholders. It also includes following three business models for development of offshore wind projects in Economic Exclusive Zone (EEZ) of the country:

Model-1: This model will be followed for those demarcated offshore wind zones for which MNRE/NIWE has already carried out detailed studies/surveys. Initially, identified Zone B3 (365 Sq.km) off the coast of Gujarat will be considered under this model. The project will be developed through offshore wind bids.

Model-2: This model will be followed for offshore windy sites for which detailed studies/surveys will be carried out by the prospective developers (without any exclusivity on the seabed) and project will be developed through offshore auctions or captive/ bilateral agreements/power exchange.

Model-3: This model will be followed for offshore windy sites for which detailed studies/surveys will be carried out by the prospective developers (with exclusivity on the seabed) and projects will be developed for captive use or through bilateral agreements or power exchange.

The strategy paper also indicates offshore wind auction trajectory of 37 GW capacity by 2030.



4.1.13 Global Wind Day Celebration – 2022

The Global Wind Day 2022 and the Silver Jubilee Celebration of NIWE were organized under the aegis of Azadi Ka Amrit Mahotsav (AKAM) ceremony at MNRE, New Delhi on 15.06.2022 in collaboration with Indian Renewable Energy Development Agency (IREDA). The celebration was inaugurated by Shri R. K. Singh, Hon'ble Union Minister for Power and New and Renewable Energy, wherein Secretary, MNRE, Joint Secretary, MNRE and Director General, NIWE were present. The Hon'ble Minister appreciated the role of NIWE in the development of wind energy sector and distributed IREDA-NIWE awards to all the winners. The celebration was attended by about 150 wind energy professionals.



Fig 4.4 : Global Wind Day Celebrations

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 fulfilment 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:

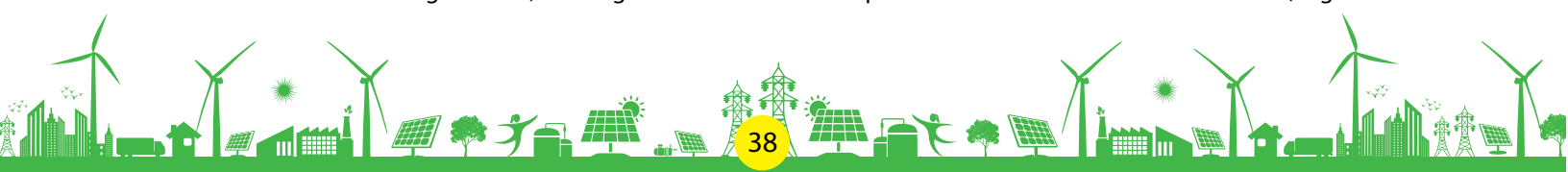
- i. In order to implement the National Wind-Solar Hybrid Policy, a scheme for setting up of 2500 MW Inter State Transmission System (ISTS) connected Wind-Solar Hybrid projects was sanctioned on 25.05.2018. The Solar Energy Corporation of India (SECI) was the nodal agency for implementation of the scheme 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, 09.03.2022 and 02.11.2022. 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 5420 MW capacity have been awarded through e- reverse auction (as shown in **Table 4.5**) of which 1440 MW has been commissioned till December, 2022.

Table 4.5: Details of tenders auctioned for Wind-Solar Hybrid Power Projects

Sl. No.	Bid	Capacity Awarded (MW)	Capacity Commissioned (MW)	Min.Tariff (Rs./kWh)
1.	SECI Hybrid - I	840	840	2.67
2.	SECI Hybrid -II	600	600	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
6.	SECI Hybrid -V	1170	0	2.53
	Total	5420	1440	

4.2.4 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 as amended from time to time. 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 352 nos. of CCDC have been issued during 1.1.2022 to 31.12.2022.

4.3 BIOMASS POWER

4.3.1 Ministry has been promoting Biomass Power with an aim to recover energy from biomass such as surplus agricultural residues, wood produced from energy plantation, wood waste from industrial operations, agro based industrial residue, forest residue, weeds, palm leaves, coconut shells and husk etc.

4.3.2 Biomass Potential available in the country

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

4.3.3 Programme for promoting installation of Biomass based projects

The Ministry has notified Biomass Programme on 2nd November, 2022 with a budget outlay of Rs.158 crores under the umbrella of National Bioenergy Programme (Phase-I) for duration of FY 2021-22 to FY 2025-26 with an objective to harness the available biomass potential in the country. This programme has a provision of Central Financial Assistance (CFA) for setting up of Biomass Briquette/Pellet manufacturing plants and Biomass (non-bagasse) based cogeneration projects in the country. The details of CFA under this programme are as follows:

- a. Briquette/Pellet manufacturing plants: Rs.9.00 lakhs/TPH (Maximum CFA- Rs.45.00 Lakh per project).
- b. Non-Bagasse Cogeneration Projects: Rs.40 Lakhs/ MW (Maximum CFA- Rs. 5.00 crore per project).

4.3.4 Achievements

More than 800 Nos. of Biomass IPP and Bagasse/non bagasse cogeneration-based power plants with aggregate capacity of 10209 MW have been installed in the country mainly in the states of Maharashtra, Uttar Pradesh, Karnataka, Tamil Nadu, Andhra Pradesh, Chhattisgarh, West Bengal and Punjab up to December 2022. This includes 7562 MW from Bagasse Cogeneration Sector, 1871 MW from Biomass IPP Sector and 776 MW from biomass (non-bagasse) cogeneration sector.

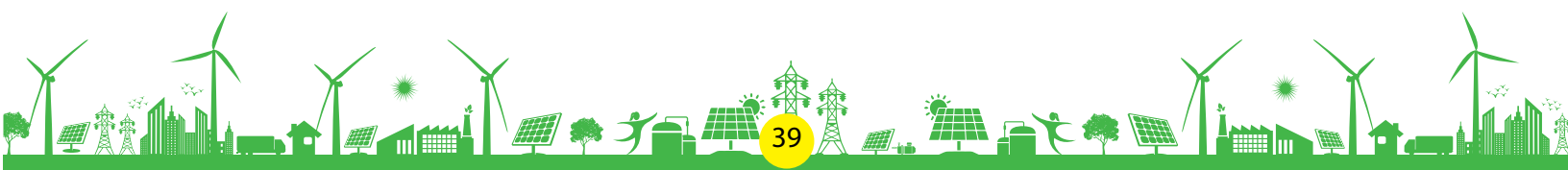
4.4 SMALL HYDRO POWER

4.4.1 The Ministry of New and Renewable Energy (MNRE) is vested with the responsibility of developing hydro power projects of capacity up to 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 \leq 0.1 MW

Mini Hydel $>$ 0.10 MW to \leq 2.00 MW

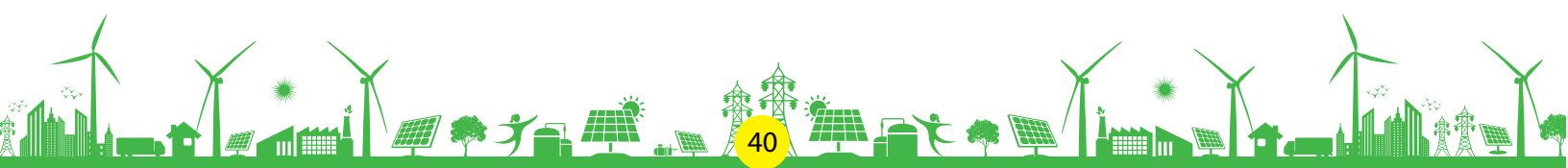
Small Hydel $>$ 2.00 MW to \leq 25.00 MW



4.4.2 The estimated potential of small/mini/micro Hydel projects in the country is 21133.61 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. An aggregate capacity of 4935.65 MW been achieved as on 31st December, 2022 through 1167 Small Hydro Power projects. In addition, 102 projects of about 538.05 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 31.12.2022)

S. No.	States/UTs	Total Potential		Projects Installed						Projects under Implementation	
		Nos.	Total Capacity (MW)	Upto 2021-22		2022-23		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	2	2.40
2	Arunachal Pradesh	800	2064.92	156	131.11	1	2	157	133.11	5	4.65
3	Assam	106	201.99	6	34.11	0	0	6	34.11	0	0
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	21	89.39	0	0	21	89.39	3	23.91
8	Haryana	33	107.4	9	73.5	0	0	9	73.5	0	0
9	Himachal Pradesh	1049	3460.34	199	954.11	3	15.6	202	969.71	44	244.84
10	UT of Jammu & Kashmir	103	1311.79	19	144.68	1	2.0	20	146.68	7	44.15
11	UT of Laddakh	199	395.65	28	39.64	2	1.15	30	40.79	6	8.10
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	38	242.52	1	24	39	266.52	3	37.5
15	Madhya Pradesh	299	820.44	13	99.71	1	24	14	123.71	2	7.6
16	Maharashtra	270	786.46	72	381.08	0	0	72	381.08	8	9.30
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	1	5	19	41.47	1	3.5
20	Nagaland	98	182.18	12	30.67	1	1	13	31.67	2	3.4
21	Odisha	220	286.22	12	106.63	1	9	13	115.63	3	56.5
22	Punjab	375	578.28	59	176.1	0	0	59	176.1	3	1.75
23	Rajasthan	64	51.67	10	23.85	0	0	10	23.85	0	0
24	Sikkim	88	266.64	17	52.11	1	3	18	55.11	0	0



S. No.	States/UTs	Total Potential		Projects Installed						Projects under Implementation	
		Nos.	Total Capacity (MW)	Upto 2021-22		2022-23		Total		Nos.	Capacity (MW)
				Nos.	Capacity (MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)		
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	103	218.82	0	0	103	218.82	4	47
31	West Bengal	179	392.06	24	98.5	0	0	24	98.5	0	0
Total		7133	21133.61	1154	4848.9	13	86.75	1167	4935.65	102	538.05

4.4.3 For the year 2022-23, a target of commissioning of 100 MW small hydro projects was set, against which 13 projects of aggregate capacity of 86.75 MW have been synchronized to the grid by 31st December 2022 (**Table 4.7**). Actual physical achievement from 01.01.2022 to 31.12.2022 and estimated physical achievement from 01.01.2023 to 31.03.2023 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 4.55 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 2022-23 (upto 31.12.2022)

S. No.	Name of Project	Capacity	Agency/State	Date of Commissioning
1	Khajalong	2.00	Department of Hydro Power Development (DHPD)	Apr-22
2	Tsutsung Yongki SHP	1.00	Department of New & Renewable Energy, Nagaland	May-22
3	Bargarh Head Regulator SHP	9.00	M/s Kakatiya Industries Pvt. Ltd.	May-22
4	Poringalkuthu SHP	24.00	Kerala State Electricity Board Ltd.	May-22
5	Chatten SHP	3.00	Sikkim Power Development Corporation	Jun-22
6	Tlawva	5.00	P&E Department, Government of Mizoram	Sep-22
7	Chanju-II (out of 19.80MW)	6.60	M/s Cosmos Hydro Power Pvt. Ltd.	Sep-22
8	Sirmore SHP	24.00	M/s Sirmour Small Hydro Power Pvt. Ltd.	Oct-22

S. No.	Name of Project	Capacity	Agency/State	Date of Commissioning
9	Matayeen SHP	0.55	Kargil Renewable Energy Development Agency (KREDA)	Nov-22
10	Henache SHP	0.60	Ladakh Renewable Energy Development Agency (LREDA)	Nov-22
11	Ani SHP	5.00	M/s Growel Energy Co. Ltd.	Dec-22
12	Beas Kund Top SHP	4.00	M/s Gopal Hydrogen Pvt. Ltd.	Dec-22
13	Rayil SHP	2.00	M/s Gousia Road Construction Co.	Dec-22

Table 4.8: Actual physical achievement from 01.01.2022 to 31.12.2022 and estimated physical achievement from 01.01.2023 to 31.03.2023.

Actual physical achievement from 01.01.2022 to 31.12.2022	Estimated physical achievement from 01.01.2023 to 31.03.2023
95.75 MW	13.25 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" (Waste to Energy Programme) aimed at generation of biogas, BioCNG/ Power/producer of syngas from urban, industrial and agricultural bio-wastes/residues.

For the continuation of the above Programme for the period FY 2021-22 upto FY 2025-26, the Ministry has issued guidelines under the Phase-I of the umbrella of National Bioenergy Energy Programme on 02.11.2022 with an allotment of Rs. 600 crores. The Waste to Energy Programme provides Central Financial Assistance (CFA) for setting up of Waste to Energy projects for generation of Biogas/ BioCNG/ Power/producer of syngas from urban, industrial and agricultural bio-wastes/residues.

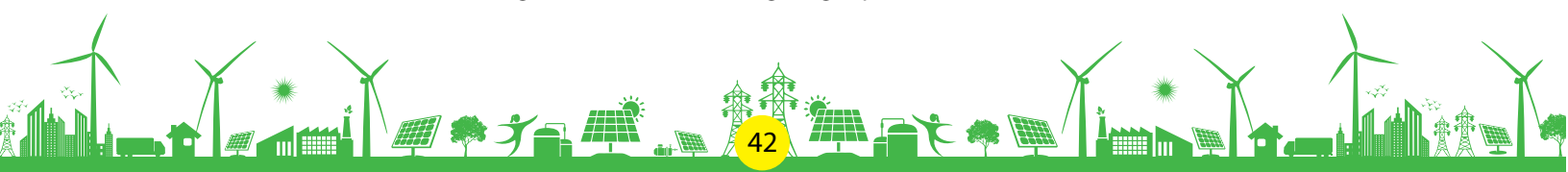
4.5.2 Objectives of the Scheme

The objective of the Programme is to support the setting up of Waste to Energy projects for generation of Biogas/ BioCNG/ Power/producer of syngas from urban, industrial and agricultural bio-wastes/residues.

4.5.3 Subsidy/Grant/Incentive provided under the Scheme

The CFA pattern for Waste to Energy projects are as follows:

- a. **Biogas generation:** Rs 0.25 crore per 12000 cum/day (Maximum CFA- Rs.5.00 crore/project)
- b. **BioCNG/Enriched Biogas/Compressed Biogas generation:** (Maximum CFA- Rs.10 crore/project)
 - i. BioCNG generation from new Biogas plant- Rs 4.0 Crore per 4800 Kg/day;
 - ii. BioCNG generation from existing Biogas plant- Rs 3.0 Crore per 4800 Kg/day;
- c. **Power generation based on Biogas:** (Maximum CFA- Rs. 5.00 crore/project)
 - i. Power generation from new biogas plant: Rs 0.75 Crore per MW
 - ii. Power generation from existing biogas plant: Rs 0.5 crore / MW



- d. **Power generation based on bio & agro-industrial waste (other than MSW through incineration process):** Rs.0.40 crore/MW (Maximum CFA - Rs.5.00 Crore/Project)
- e. **Biomass Gasifier for electricity/ thermal applications:**
 - i. Rs. 2,500 per kWe with dual fuel engines for electrical application
 - ii. Rs. 15,000 per kWe with 100% gas engines for electrical application
 - iii. Rs. 2 lakh per 300 kWth for thermal applications.

4.5.4 This programme also supports other Government of India initiatives such as Galvanizing Organic Bio-Agro Resources Dhan scheme of Department of Drinking Water and Sanitation, and the Sustainable Alternative Towards Affordable Transportation (SATAT) of Ministry of Petroleum and Natural Gas (MoPNG). Enhancing production and availability of Compressed Bio-gas (CBG) as an alternative and affordable clean fuel for cooking and transportation sector is envisaged under these initiatives.

4.5.5 Progress during the calendar year 2022

- i. **Physical Achievement:** During the calendar year 2022, the capacities added in respect of various output products are given in **Table 4.9**.

Table 4.9: Progress of Product Output and Capacity Addition during Calendar Year (CY) 2022 (till 31.12.2022)

S. No.	Output Product	No. of plants	Capacity Addition in CY 2022	States
1	Bio-CNG/CBG	22	1,36,828 kg/day	Haryana, Gujarat, Uttar Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu, Punjab, Telangana and West Bengal
2	Power	10	59.78 MWeq	Andhra Pradesh, Bihar, Haryana, Uttar Pradesh, Maharashtra and Delhi

- ii. **Biourja Application Portal:** The Ministry of New and Renewable Energy has revamped the Biourja Application Portal (www.biourja.mnre.gov.in) to facilitate submission and processing of applications for grant of CFA for Bioenergy projects. All communication with developers in respect of their applications is envisaged through this portal.

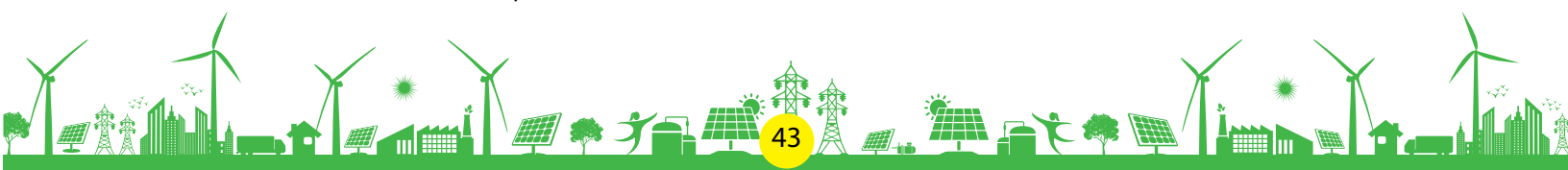
4.5.6 Cumulative Physical Achievement: As on 31.12.2022, the total installed capacity is 522.42 MWeq including 248.14 MW capacity of Grid-interactive Waste to Power projects, 274.28 MWeq capacity Off-grid Waste-to-Energy projects. The generation details as well as the output till 31.12.2022 is given in **Table 4.10**.

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

S. No.	Output product	Cumulative capacity
1	Biogas	7,71,008 m3 per day
2	Bio-CNG/CBG	2,64,467 kg per day
3	Power (Grid & Offgrid)	401.79 MWeq

4.5.7 Estimated achievement for the period January-March, 2023:

During January- March, 2023, total capacity of 9.96 MWeq is expected to be installed from Waste to Energy and Power Generation plants.



CHAPTER 5

NATIONAL GREEN HYDROGEN MISSION

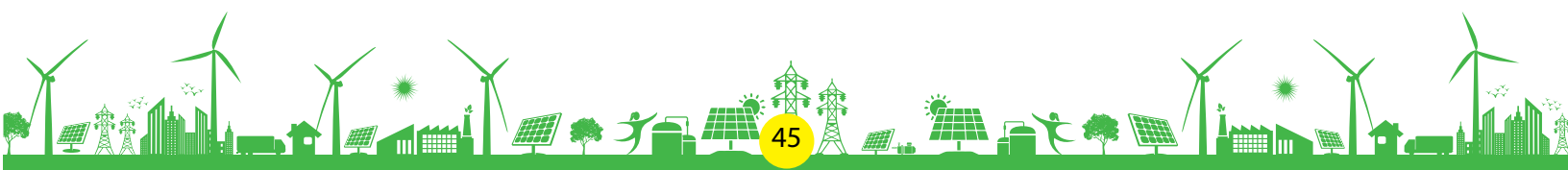
- 5.1** The Union Cabinet has approved the National Green Hydrogen Mission, with an outlay of Rs. 19,744 crore in its meeting held on 4th January, 2023.
- 5.2** The Mission will result in the following likely outcomes by 2030:
- Development of green hydrogen production capacity of at least 5 MMT (Million Metric Tonne) per annum with an associated renewable energy capacity addition of about 125 GW in the country
 - Over Rs. 8 lakh crore in total investments
 - Creation of over 6 lakh jobs
 - Cumulative reduction in fossil fuel imports of over Rs. 1 lakh crore
 - Abatement of nearly 50 MMT of annual greenhouse gas emissions
- 5.3** The Mission will facilitate demand creation, production, utilization and export of Green Hydrogen. Under the Strategic Interventions for Green Hydrogen Transition Programme (SIGHT), two distinct financial incentive mechanisms – targeting domestic manufacturing of electrolysers and production of Green Hydrogen – will be provided under the Mission. The Mission will also support pilot projects in emerging end-use sectors and production pathways. Regions capable of supporting large scale production and/or utilization of Hydrogen will be identified and developed as Green Hydrogen Hubs.
- 5.4** An enabling policy framework will be developed to support establishment of Green Hydrogen ecosystem. A robust Standards and Regulations framework will be also developed. Further, a public-private partnership framework for R&D (Strategic Hydrogen Innovation Partnership – SHIP) will be facilitated under the Mission; R&D projects will be goal-oriented, time bound, and suitably scaled up to develop globally competitive technologies. A coordinated skill development programme will also be undertaken under the Mission.
- 5.5** All concerned Ministries, Departments, agencies and institutions of the Central and State Governments will undertake focussed and coordinated steps to ensure successful achievement of the Mission objectives. Ministry of New and Renewable Energy (MNRE) will be responsible for overall coordination and implementation of the Mission.
- 5.6** The initial outlay for the Mission will be Rs. 19,744 crore, including an outlay of Rs. 17,490 crore for the SIGHT programme, Rs. 1,466 crore for pilot projects, Rs. 400 crore for R&D, and Rs. 388 crore towards other Mission components. MNRE will formulate the scheme guidelines for implementation of the respective components.
- 5.7** **Quad Workshop on Regulations, Codes and Standards for Clean Hydrogen**
- The Ministry of New and Renewable Energy (MNRE), Government of India, organised the Quad Workshop on Regulations, Codes and Standards (RCS) for Clean Hydrogen on 29th July, 2022 as part of efforts under the Quad Clean Energy Pillar and the Quad Clean Hydrogen Strategic Initiative to strengthen ongoing initiatives and identify new cooperation opportunities in the clean hydrogen sector.

5.8 Kick-off meeting of the Indo-German Green Hydrogen Task Force

First meeting of the Indo-German Green Hydrogen Task Force was held on 20th September, 2022. The meeting saw participation of industry stakeholders from both India and Germany. Four sub-groups have been created targeting different aspects of green hydrogen value chain, with industry participation in each.

5.9 Working Group on Regulations and Standards: National Green Hydrogen Mission

A Working Group has been constituted under the chairmanship of Secretary, MNRE for development of Regulations, Codes and Standards (RCS) framework for Green Hydrogen. The Working Group involves representatives from stakeholder ministries, industry and institutions. Four meetings of the Working Group have already been held, last meeting was on 15th September, 2022. Three sub-groups have been constituted under the Working Group, to undertake mapping of national and international standards, identify gaps, and recommend standards and regulations for adoption.



CHAPTER 6

RENEWABLE ENERGY FOR RURAL APPLICATIONS

6.1 The Ministry of New & Renewable Energy (MNRE) has been implementing Biogas Schemes for dissemination and deployment of biogas plants in remote, rural and semi-urban areas of the country up to 31.03.2021. These erstwhile biogas schemes i.e. New National Biogas and Organic Manure Programme (NNBOMP) and Biogas Power Generation (Off-grid) and Thermal energy application Programme (BPGTP) have been amalgamated into the Biogas Programme and were approved for continuation under the umbrella National Bioenergy Programme (NBP) on 02.11.2022 for the period from 01.04.2021 to 31.03.2026.

The objectives of the Biogas Programme are to support setting up of biogas plants for clean cooking fuel, lighting, meeting thermal and decentralized power generation needs of users which ultimately results in Green House Gas (GHG) emission reduction, improved sanitation, facilitate management and utilization of biogas plant produced slurry as an organic enriched Solid Biogas Fertilizer, Women Empowerment and creation of Rural Employment etc.

6.2 ACHIEVEMENTS UNDER THE NATIONAL BIOGAS PROGRAMME

The State/UT-wise installed small biogas plants, are given in **Table 6.1**.

Table 6.1: The State/UT- wise achievements for family type/ small biogas plants, under the New National Biogas and Organic Manure Programme.

States/ UTs	Cumulative number of small biogas plants installed as on 31.03.2022
Andhra Pradesh	268598
Arunachal Pradesh	3621
Assam	139414
Bihar	130072
Chhattisgarh	60250
Goa	4234
Gujarat	435638
Haryana	64013
Himachal Pradesh	47718
Jammu & Kashmir	3201
Jharkhand	7890
Karnataka	512755
Kerala	153666
Madhya Pradesh	379154
Maharashtra	931313
Manipur	2128

States/ UTs	Cumulative number of small biogas plants installed as on 31.03.2022
Meghalaya	11156
Mizoram	5857
Nagaland	7953
Odisha	271752
Punjab	187145
Rajasthan	72886
Sikkim	9044
Tamil Nadu	224037
Telangana	316727
Tripura	3744
Uttar Pradesh	441180
Uttarakhand	365188
West Bengal	1216
Andaman & Nicobar	97
Chandigarh	169
Dadar & Nagar Haveli	681
Daman & Diu	0
Delhi	578
Lakshadweep	0
Puducherry	17541
Total	5080616

6.3 STATUS OF IMPLEMENTATION OF THE BIOGAS PROGRAMME

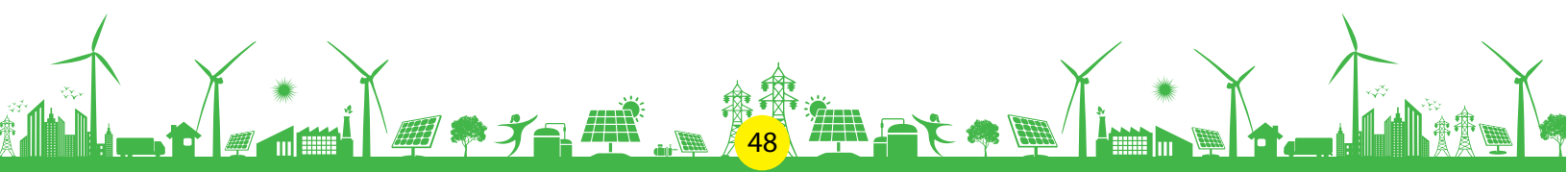
With the announcement of the biogas programme on 2nd November, 2022, a target of setting up 22500 small biogas plants has been allocated to the States/ UTs for the FY 2022-23. During the month of November, 2022, a national seminar in the presence of Shri R.K Singh, Honourable Union Minister for Power, New and Renewable Energy on National Bioenergy Programme was conducted for highlighting the salient features and implementation mechanism of Biogas programme. For ease of application, centralized management of biogas beneficiary's requests, monitoring of installation, and maintenance on installed biogas plants etc, the Ministry has developed and launched the national biogas web portal (www.biogas.mnre.gov.in).

The Biogas Programme is being implemented through the Agriculture Farmers Welfare 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) etc. For inclusion of simple, cost effective and portable pre-fabricated designs of small biogas plants under the Biogas Programme of MNRE, the Ministry has approved the specifications and parameters for three designs of flexi domestic biogas plant. For implementation of biogas programme, the Sardar Swaran Singh National Institute of Bio-Energy (SSS-NIBE), Kapurthala has been nominated as the Central Nodal Agency (CNA) for managing the fund flow.

6.4 SUBSIDY AND OTHER CENTRAL FINANCIAL ASSISTANCE UNDER BIOGAS PROGRAMME

The details of Central Financial Assistance (CFA) for different components under this programme are as follows:

- a) For small biogas plants (1-25 cubic meter/day plant capacity): Rs. 9800/- to Rs. 70,400/- per plant based on size of the plant in cubic meter; and
- b) For Power generation and thermal application (capacity ranging from above 25 to 2500 cubic meter biogas generation per day), (3 to 250 kWe Power Generation capacity per day): Rs. 35,000/- to Rs. 45,000/- per kilowatt for power generation and Rs. 17,500 /- to Rs. 22,500/- per kilowatt equivalent for thermal applications (25 - 2500 cubic meter/day plant capacity). The eligible CFA would be 20% higher than Standard CFA for NER States, SC/ST beneficiaries and for biogas plant installed in Registered Gaushalas.



CHAPTER 7

RENEWABLE ENERGY RESEARCH AND TECHNOLOGY
DEVELOPMENT PROGRAMME

7.1 INTRODUCTION

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, subsystems, 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 the total energy mix in the country.

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 up to 50% to 70% to industry. The 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 RESEARCH DEVELOPMENT AND DEMONSTRATION (RD&D) FOCUS

The RD&D efforts are continued with emphasis on cost reduction, reliability and efficiency improvement of renewable energy systems, components, and Balance of System (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 for 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

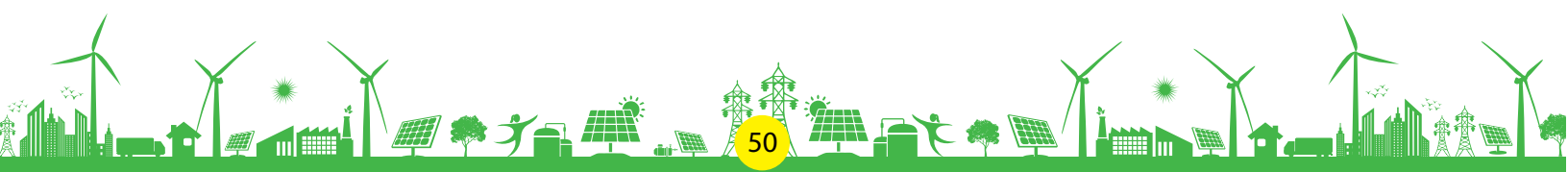
Highlights of the progress achieved under the Solar R&D (SPV) R&D projects funded by the MNRE are given below:

A. Phase II of the Ministry's flagship project in solar photovoltaics is being implemented at IIT Bombay - National Centre for Photovoltaic Research and Education (NCPRE)

Listed below is the progress achieved by NCPRE related to efficiencies of solar cells such as AI-BSF, PERC, TOPCon, Perovskites, energy storage, power electronics, capacity building, international collaboration, PS system reliability, patents and spinoffs:

Education and Training:

- 7 New full semester courses: NCPRE has developed 7 new, full-semester courses: (i) EE 757: Crystalline silicon solar cells: Theory and practice; (ii) EE 765: Reliability and failure analysis of electronic devices; (iii) EE 770: Design and Evaluation of Photovoltaic Power Plants; (iv) EE 790: Solar Photovoltaics: Photons to Farms; (v) EE 791: Power Electronic Converters for Renewable Energy; (vi) EN 640: Solar Photovoltaics: Fundamentals, Technologies and Applications; and (vii) EN 703: Advanced Concepts in Solar PV
- Short-term courses and workshops: NCPRE trained a total of 547 participants from academia and industry over the course of 8 short-term courses (ranging from basic to advanced) and 6 workshops of 3-4 days' duration.



- Photovoltaic Users Mentorship Programme (PUMP) was conceptualized by NCPRE as part of Phase II to provide hands-on training, access to NCPRE facilities, and mentoring to researchers and faculty/students from various institutions that enables them to collaborate on implementation of R&D projects. A total of 478 participants from various states and regions attended 4 familiarization workshops and 38 were given hands-on training. **Of 82 research proposals that were received under PUMP, 60 proposals were selected for implementation, out of which 38 are completed and 2 are ongoing.**



Fig. 7.1: Participants at PUMP familiarization workshop

Progress on Developing Solar cells with High Efficiencies

- Aluminium Back Surface Field Solar Cells: Standard Al-BSF Solar cells with 19.4% champion cell efficiency were fabricated on a large area (156 mm X 156 mm), pseudo-square, mono Si wafers.
- PERC: PERC cells are the workhorse of the PV industry. **NCPRE fabricated** large area (156mm X 156mm) PERC solar cells with 18.4% efficiency using a Made-in-India Laser ablation system. NCPRE has also experimentally compared 7 different processes for the growth of ultra-thin SiO₂ (< 2 nm) for the passivation of the Silicon surface.
- TOPCon: An industrial pathway for transitioning from PERC to p-type wafer-based TOPCon with efficiencies up to 24.4% was identified using extensive, calibrated TCAD simulations.

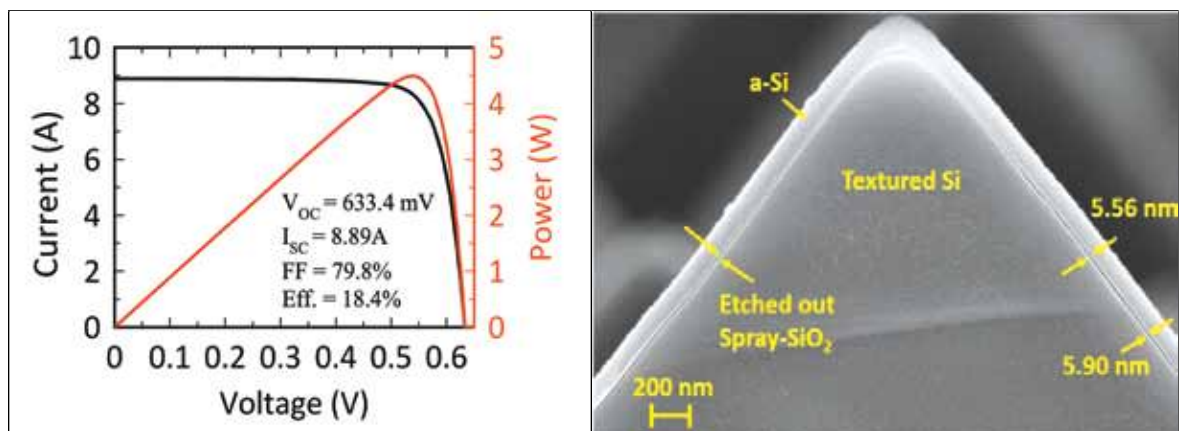


Fig.7.2: Current-voltage characteristics of the 6'' x 6'' PERC solar cells fabricated at NCPRE.

Fig.7.3: Cross section SEM image of spray SiO₂ film, demonstrating the conformal deposition of the spray coated film over the pyramids on the front side of the solar cell.

International collaboration: NCPRE has partnered with NISE, PTB Germany and Fraunhofer Institute for Solar Energy (ISE) Freiburg in round-robin measurements to establish secondary solar cell characterization capabilities, and has demonstrated measurements matching measurements at ISE, within internationally accepted variations.

Progress on Perovskites - Next Generation Thin Film Materials and Devices: Perovskite solar cells have sparked significant interest in recent years with rapid increases in efficiency achieved by academic institutions around the world. MNRE funding on perovskites' research in the country has yielded significant breakthroughs related to higher efficiencies and addressing challenges around commercialization (outlined below).

- Progress in halide Perovskite solar cell efficiencies: Tandem cells made of silicon and perovskite can convert the broad energy spectrum of sunlight into electrical energy more efficiently than the respective single cells. The NCPRE hybrid perovskite solar cell lab has been successful in demonstrating the **4-T terminal silicon perovskite tandem solar cells with 23% efficiency (Fig a)**. **Fig b and c** demonstrate the configuration of the top (transparent halide PSC with 16% efficiency, 0.82 cm² active area) cell, and **Fig. d and e** depict the bottom cells (mono-crystalline Al-BSF with PCE of 7%) of this 4-T terminal silicon perovskite tandem solar cell.

NCPRE has further combined its transparent perovskite solar cell with a bi-facial silicon solar cell manufactured by an industry partner to achieve a 4-terminal tandem efficiency of 25%. NCPRE believes that the overall silicon-perovskite tandem cell efficiency number should exceed the **PCE > 30%** at NCPRE with ongoing advancement efforts.

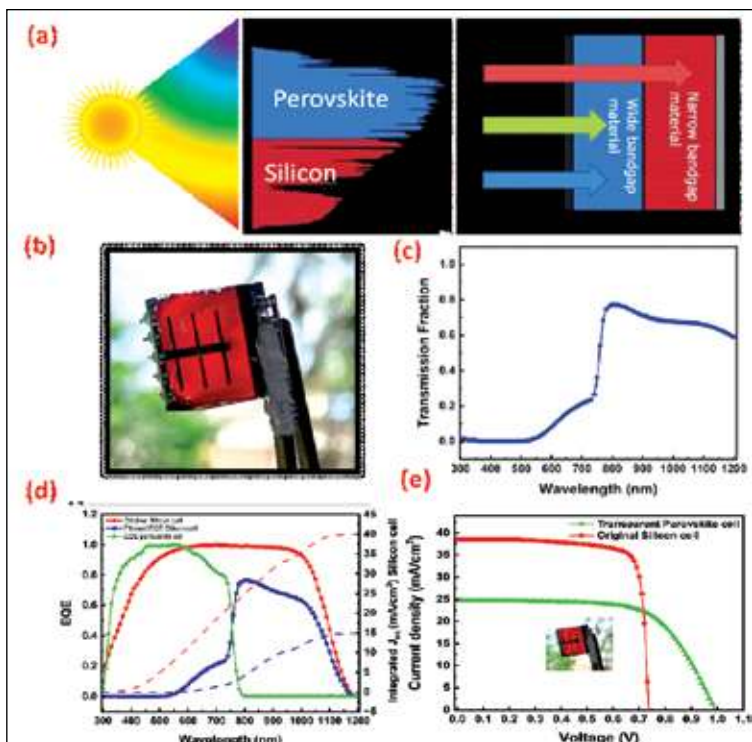


Fig.7.4: (a) Schematic of solar spectrum being utilized by the perovskite and silicon absorber for 4-T tandem solar cell applications. (b) Actual image of NIR-transparent perovskite solar cell. (c) transmission spectrum of complete NIR transparent PSC. (d) IPCE of Silicon (red line), PSC (green line) and filtered silicon cell (blue line). (e) J-V characteristics of AM 1.5 illuminated solar cells (PSCs: green and Silicon: red curve)

Patents filed and technology transfer to local industry:

- SubSem+ (Sublimation System for Semiconductors plus metal/inorganic evaporator): NCPRE has developed a SubSem+ system (**Fig.7.5**) for multi-layer thin film optoelectronic device fabrication. It is a controlled and clean fabrication process, suitable for organic and perovskite semiconductor optoelectronic devices.



Fig. 7.5: Schematic of in-house developed cluster tool for making highly reproducible perovskite optoelectronic devices.

- 2nd IP and technology transfer under process: NCPRE has fabricated a large area cell based on highly efficient hybrid lead organic-inorganic halide perovskite-based NIR transparent solar cells. This is applicable to any other solar cell materials, such as all inorganic halide perovskites or organic solar cells, or colloidal quantum dot solar cells absorber layer.
- NCPRE has been awarded patents for novel fabrication processes which includes (i) Indian patent no. 391027 granted for deposition of ultra-thin SiO₂ and Al₂O₃ using spray coating, and an Indian patent (no. 404618) granted for a novel post-deposition treatment of the SiN_x anti-reflective coating developed to reduce background plating. NCPRE has developed Nickel/Copper/Tin light-induced plated contacts on Al-BSF solar cells.

Drawing on the work under Phase 2, NCPRE researchers published a paper “Recent developments in solar manufacturing in India”, in the journal Solar Compass in May 2022 which has attracted a lot of interest from various stakeholders interested in PV manufacturing in India.

Energy Storage: The project has leveraged MNRE funded State-of-the-art Battery Prototyping Lab at IIT-B to promote India’s self-sufficiency in the manufacturing of storage technologies. The focus of NCPRE’s work has been on indigenous technology development of high-energy lithium-ion and sodium-ion batteries, prototyping of second-generation battery chemistries, Li-ion battery modeling for large storage applications, and redox flow batteries. Details are listed below:

- Lithium-ion batteries: Key developments in this segment are given below:
 - a. The NCPRE Energy Storage Group has developed Nickel Manganese Cobalt (NMC) 111/graphite-based Li-ion pouch cells (15 Ah, 10 Ah) and 18650 (2.5 Ah) cells and NMC 532/graphite-based pouch cells of 220 Wh/kg.
 - b. Lithium-ion batteries (LIB) cells with 220Wh/kg energy density and 12V, 24V battery modules have been demonstrated for isolated home power applications/rural electrification.

- c. NMC-coated Lithium-ion Manganese oxide (LMO) with graphite battery, Lithium Ferro-phosphate (LFP)//Si-C battery, LFP//Lithium-Titanium Oxide (LTO) cells for long cycle life and high voltage have been developed.
- d. The group explored lithiation/delithiation (discharging and charging) in graphene-based anode material for Li-ion batteries.
- e. Achieved inkjet-printed thin film graphene electrode for flexible lithium-ion batteries. The next aim is to prepare screen-printed thin film solid polymer electrolyte base lithium-ion batteries.
- f. Conducted Li-ion battery modeling for large-scale storage options.
- g. Analyzed the impact of temperature on the performance and degradation of the battery energy system (BES) system and developed of a simple, cost-effective thermal management-based charging strategy for the safety of the BES system. This also includes a thermo-electrochemical model with a chemical degradation mechanism.
- Sodium-ion batteries:
 - a. The team has developed 2-3 Ah sodium-ion battery pouch cells from materials researched in the lab utilizing large-scale synthesized polyanionic (NVP) and layered oxide (NMN) cathode materials, and hard-carbon from biomass and Nickel Titanium Oxide (NTO) as anode materials. The team has also been able to demonstrate a 6 V pack from the pouch cells for household applications.
 - b. Optimization of Bi-phase Nickel Titanium Oxide (NTO) and Bi-phase NTO/Multi-walled carbon nanotubes (MWCNT) for high capacity has resulted in an excellent rate capability and capacity retention at higher current densities of 5C and 10C.
- Redox Flow Batteries:

Demonstration and scale-up of iron flow (30 mW/cm^2) and vanadium flow (80 mW cm^2) batteries. In the case of an iron flow battery, an iron-tungsten redox flow battery was developed with a maximum current and a power density of 160 mA cm^{-2} and 49.43 mW cm^{-2} , respectively. A 25-two-cell stack assembly with a power density of 380 mW cm^2 was demonstrated in the case of a vanadium redox flow battery.
- Start-ups/Spin-offs:

In a significant achievement, a startup named Voltrez Technology Inc. was established by NCPRE to work on ultra-safe lithium dendrite-free batteries for electric vehicles. The start-up has developed 15-18 Ah pouch cells and a pack of 48 V, 1 kWh, which has been demonstrated in a scooter.

Apart from these above technologies, NCPRE is also working on GenX Lithium sulfur (LiS) and all-solid-state Li and Na batteries.

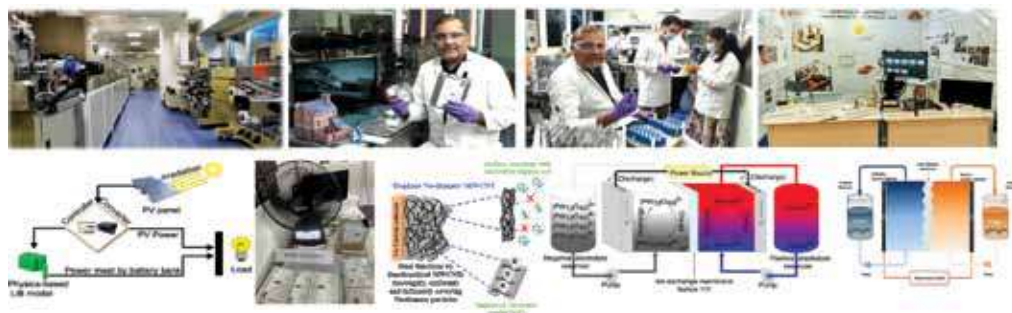
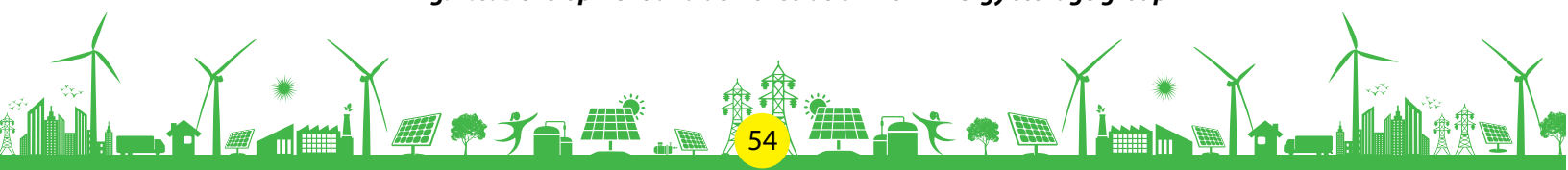


Fig. 7.6: Development and demonstration from Energy storage group



- Power Electronics:** Wide Band Gap-based Medium Voltage Converter for String Solar PV Inverters have been developed capable of handling high power levels and operating at a high switching frequency. NCPRE introduced a new system (shown in **Fig. 7.7**), where the low-frequency transformer is replaced by a medium frequency transformer resulting in a more compact/lighter system.

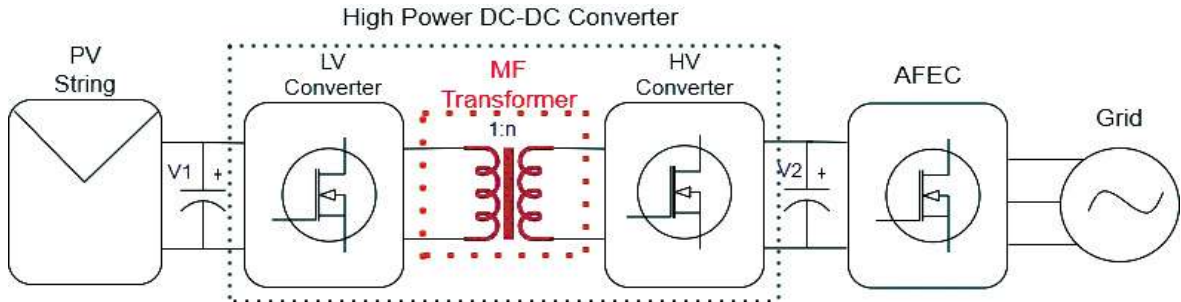


Fig. 7.7: System architecture of the solar PV inverter with medium frequency transformer.

The reduced size for the same power rating means a higher temperature rise making thermal design crucial. NCPRE has developed an optimized algorithm such the system's operating temperature is within a limit and meets the criteria of power density and efficiency. NCPRE has also designed a control mechanism that reduces switching losses by 5.5% when the converter is operating at low power levels and/or at low grid voltages.

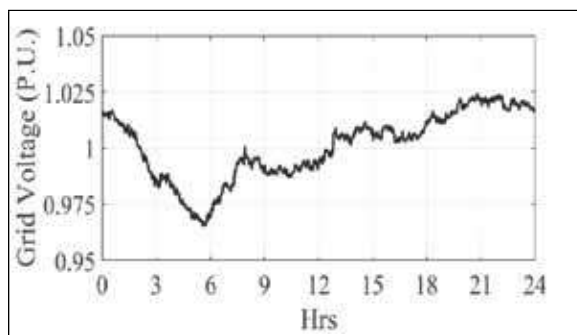


Fig. 7.8: Grid voltage variation for a day (data measured at IIT-B.)

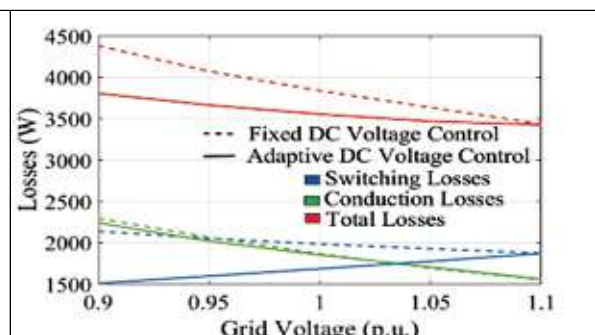


Fig. 7.9: Loss comparison of conventional and proposed control

Breakthrough work on PV System Reliability:

- Industry collaboration on accelerated tests for anti-soiling coatings: Influenced by NCPRE's work in this space, two start-ups companies operating in the area of commercial anti-soiling coatings - Trinano Technologies and Exposum - have collaborated with NCPRE to test the performance of anti-soiling coatings to environmental stresses.
- Data-driven quantification of the impact of hailstorms on PV: Researchers at NCPRE have developed a methodology deploying data analytics to quantify the risk to Photovoltaic plants from hailstorms. This work has underlined the need for an improved hail impact test in IEC 61215 Standard which is being taken up by IEC WG2. The paper "Data-Driven Approach for Quantifying the Risk of Hail Impact on Photovoltaic Plants" by NCPRE was selected as one of the top papers in PV for oral presentation at the IEEE ICEE conference 2022.
- Indian representation at IEA PVPS Task 13 'Reliability and Performance of Photovoltaic Systems' for the first time: On the back of NCPRE's work on PV reliability through the All India Surveys, standards development, it was invited to participate at the IEA PVPS Taskforce 13.

B. National Primary Standard Facility for Solar Cell Calibration – CSIR-NPL

Photovoltaic measurement uncertainty has financial implications for the project developers. To develop the measurement system with the lowest uncertainty and to provide the best possible measurements for reference solar cell devices in the country, CSIR-NPL in collaboration with Physikalisch-Technische Bundesanstalt (PTB, one of the WPVS labs), Germany, is working to establish a primary reference solar cell (PRC) measurement facility at NPL, based on “Laser-based - Differential Spectral Responsivity Primary Reference (LDSR) Solar Cell Measurement System”. Significant achievements of the project are outlined below:

- i. Demonstration of the LDSR System at PTB achieved the lowest measurement uncertainty of 0.35% (ISTC, $k=2$) for the World PV Scale Standard (WPVS) standard reference solar cells. This marks a significant step towards India’s technological self-reliance for photovoltaic performance measurements. The two reference solar cells are WPVS labelled RS82 (c-Si non-linear) and 070-2016 (c-Si linear) shown in **Fig.7.10(a) and (b)**. Standard measurement procedures were applied to assess the differential spectral responsivity of the WPVS cells.
- ii. Assessment of performance of L-DSR measurement system at NPL through international round-robin inter-comparison mechanism (involving facilities of NREL-USA, PTB-Germany) of the WPVS standard reference solar cells. Every PV device calibration method and each individual facility can lead to different measurement uncertainties, which need to be identified and quantified to assign the correct measurement uncertainty to the calibration value (CV) of the PV device under test (DUT). The intention of this intercomparison was the final assessment of these facilities (NPL, PTB, NREL) with regards to calibration at standard test conditions (STC).

This round-robin mechanism of an international intercomparison of measurement systems available at different facilities (CSIR-NPL, NREL (the U.S.), and PTB (Germany)) reaffirmed NPL’s system performance with the uncertainty of 0.35% at $k=2$ in the ISTC of WPVS solar cells. This is the current state-of-the-art measurement with the lowest uncertainty among the four established WPVS laboratories in the world.

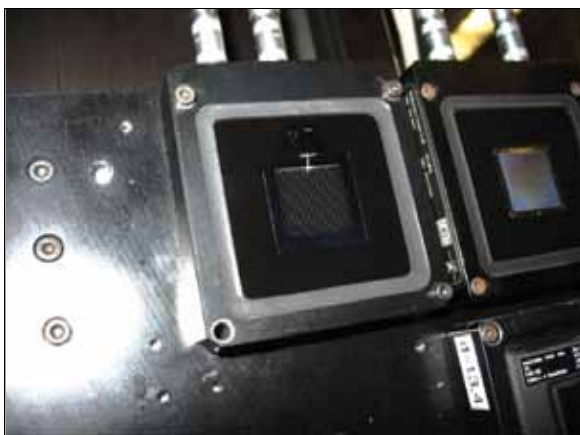


Fig. 7.10(a): WPVS reference solar cells used to assess the performance of the system - RS82, c-Si non-linear cell and

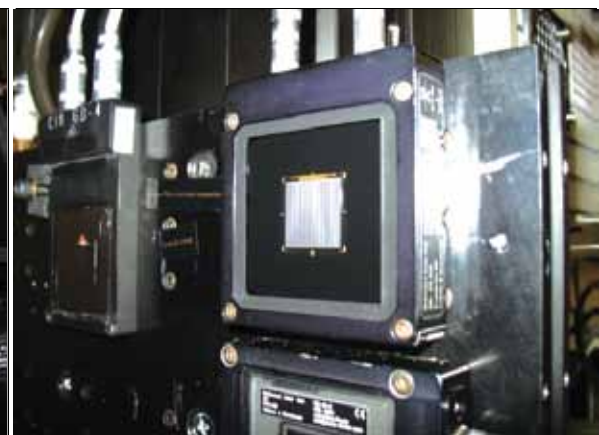


Fig. 7.10(b): WPVS reference solar cells used to assess the performance of the system-070-2016, c-Si linear cell

- Another significant development has been the installation of infrastructure for the LDSR facility at CSIR-NPL. As part this, an area of 100 m² (class 10000 clean room) has been earmarked and modified for required changes for facility installation as per IEC and standard and STC conditions. **Fig. 7.11 (a) and (b).**

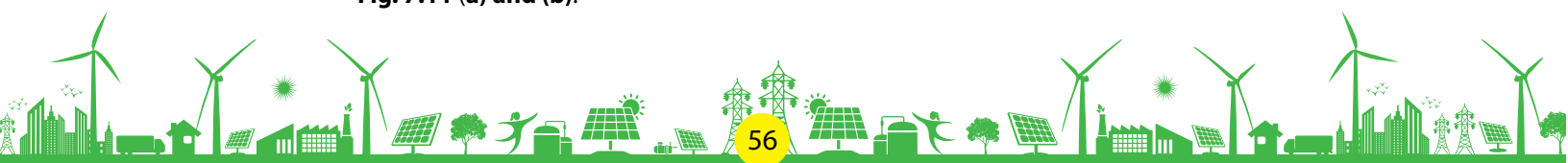




Fig. 7.11(a): Clean-room prepared for installation of the LDSR facility at CSIR-NPL



Fig. 7.11(b): Required infrastructure to be installed in the LDSR facility to achieve Class 10000 specifications of the clean-room

C. Design and Development of High-Efficiency Solar Water Pumping Systems, NISE, Gurugram

The main objective of the project is to increase the 'Overall Wire to Water Efficiency' of the 'Solar Water Pumping Systems (SWPS)' up-to 45% (from the existing level of around 38%-40%), creation of a state-of-the-art testing facility for solar water pumping systems. Key highlights of the project this year are listed below:

- i. Accreditation of the state-of-the-art testing and R&D facility for solar water pumps: The testing and R&D facility developed by NISE is a first of its kind which can test solar water pumps up to 50 HP capacity. The facility (shown in **Fig.7.12**) has been offered NABL accreditation this year.



Fig.7.12: Solar Water Pump Facility for up to 50 hp capacity

- ii. Test protocols and specifications: Test protocols have been prepared for solar water pumps up to 50hp capacity. The development of a framework of guidelines for solar-based micro-pumps for 0.1hp is underway. Also, a joint report was prepared in collaboration with the industry on ways to increase the daily water output of a solar water pumping system using bifacial PV modules.
- iii. Enhancing efficiency & water output of solar water pump controllers: Tests are being performed in NISE's SWP lab to identify parameters that affect the solar water pump controller efficiency. Work is ongoing 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 (e.g., bifacial modules) on system performance.

- iv. Designing and testing micro-irrigation system: The design of a light and portable micro-irrigation system is also underway.

D. Project on Flexible Perovskite Solar Cells and Intermediate Module led by IIT-Bombay

The research group of Prof. Shaibal K. Sarkar at IIT Bombay has demonstrated significant improvement in enhancing scalability and high throughput manufacturing of halide perovskite devices.

- i. Rapid Annealing Process of Metal Oxide Layers for Efficient Fabrication of Perovskites: The group has optimized a process of rapid annealing of the metal oxide charge transport layers on the perovskite layer which takes only a few seconds, instead of hours - this breakthrough lays the groundwork for bulk fabrication of perovskite devices. **Fig. 7.13(a)** depicts the current-voltage characteristic (I-V curve) of the representative indicating an efficiency of 21.3%.

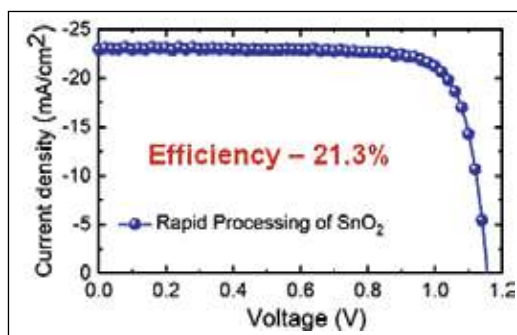


Fig. 7.13 (a)

- ii. Perovskite Mini modules: The group has also made a series of connected mini modules with an efficiency of 19.5% in a 16 cm² area. **Fig. 7.13 (b)** shows the physical picture of the four series connected mini-module and the current versus voltage (I-V curve) characteristics of the module.

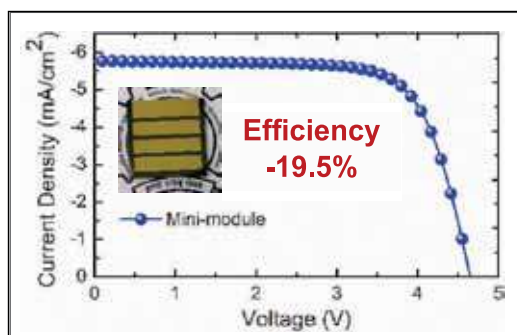
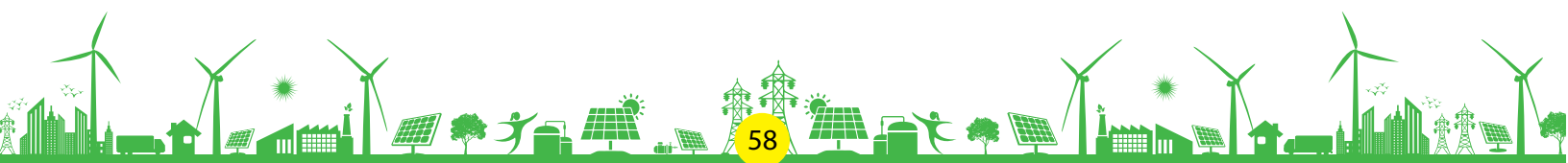


Fig. 7.13 (b)

- iii. Improved Operational Stability of Perovskites: The low stability of perovskites has been a challenge in scaling up production. The group at IIT-B has demonstrated improvement in the stability of perovskite devices through atomic layer deposition (ALD-based) interfacial modification. The devices with the coating showed better shelf-life stability of more than 3000 hours maintaining above 80% of their initial performance in continuous operation while also delivering the maximum power to the connected load **Fig. 7.13(c)**.



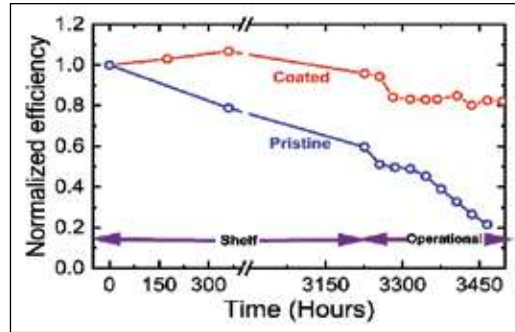


Fig. 7.13 (c)

- iv. ~23% efficiency in conventional device configuration: In the conventional device configuration, the group has consistently improved the quality of the perovskite layer and reached ~23% device efficiency in the small area (shown in Fig.7.13(d)). The process of device quality improvement without any added cost to the technology is still under development.

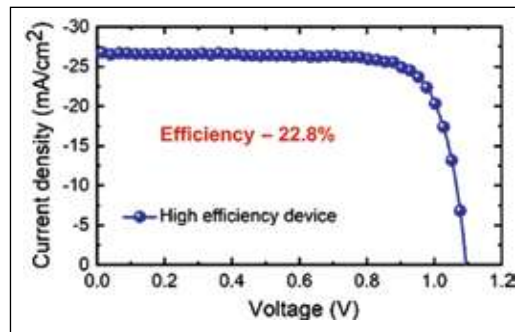


Fig. 7.13 (d)

E. Development of high efficiency (21%/ 19%) PERC type of c-Si/mc-Si solar cell, jointly implemented by NISE and BHEL-ASSCP, Gurugram.

PERC is considered the workhorse of the solar PV industry at present. In this project, BHEL has the responsibility of PERC cell processing while NISE has the responsibility of device simulation as well as complete characterization of solar cells. Following are the highlights achievements of this year:

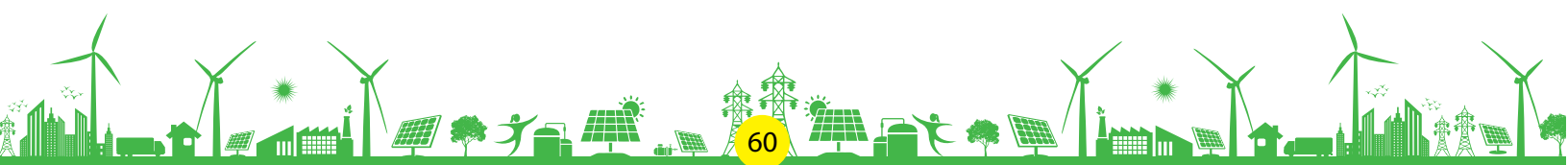
- i. Optimization of the following individual processes has been completed: (i) **Diffusion**: Emitter thickness and doping profile; (ii) **PECVD**: Mono and bilayer, sandwiched layer of SiO_x for front passivation, a combination of AlO_x, SiON_x & SiN_x for the dielectric stack (iii) **Laser**: Pattern optimization using different laser beams and patterns, laser damage assessment carried out; and (iv) **Metallization & Printing**: screens designed using Griddler s/w, optimization of paste done to minimize Kirkendall void at LBSF utilizing Si-doped paste from Toyo as well as Boron doped paste from Giga, stress analysis carried out for metallization laying to study wafer bow).
- ii. Avg. efficiency of 21% achieved for PERC solar cell at BHEL, along with maximum efficiency of 21.72%. However, to achieve benchmark efficiency, BHEL ASSCP has taken the help of M/s Tata Power for single-side etching to achieve revised efficiency of ~22% in a batch (IV curve enclosed), for champion cells with η :22.17%,.
- iii. BHEL has successfully established texturing process for DWS mono wafers with the help of MSIT Kolkata.

- iv. A Class 100000, the state-of-the-art clean room has been established at NISE utilizing the capital funds of NISE (outside the project funds) to house the sophisticated test equipment under a single roof. All test equipment has been commissioned at NISE and is being utilized for fine-tuning various process parameters for achieving benchmark efficiency.
- v. **Publications:** Singh, D., Agrawal, H., Pant, B.K. et al. "Qualitative Damage Assessment of Laser Contact Opening and Microstructural Evolution at the Rear Contact of a PERC Mono Crystalline Si Solar Cell upon Co-Firing with Si Doped Al Paste." J. Inst. Eng. India Ser. D (2022). <https://doi.org/10.1007/s40033-022-00418-x>.
- vi. **Patents filed:**
 - Filed on 25/01/2022 - "A novel approach to understand the process of phosphorous diffusion in industrial solar cell using POC13 as a dopant source."
 - Filed on 05/07/2022; Diary No. 14437/2022-CO/SW; "Python program for laser ablation in dash pattern for development of PERC cells."



Fig. 7.14: PERC Solar cell development facility at BHEL ASSCP Gurugram

- (a) Diffusion furnace installed at BHEL ASSCP (capable of processing POC13 & BBr3 diffusion along with dry and wet oxidation),
- (b) PECVD installed at BHEL ASSCP (capable of processing depositing dielectric stack at rear side (AlO_x with capping layer of SiON_x/SiNx) and front side ARC),
- (c) Laser system installed at BHEL ASSCP (capable of laser ablation by utilizing various regimes (Nano, Pico & Femto seconds) using IR, Green and UV lasers)



7.5.2 Solar Thermal

Development of high-efficiency receiver for supercritical CO₂ integrated with static focus parabolic dish

The project aims to design and develop (i) a prototype hybrid volumetric receiver and tubular cavity receiver; (ii) a Laboratory-scale High Flux Solar Simulator (HFSS) with a concentrator system (the first such system in the country); and (iii) test facility for a high-pressure receiver with fixed focus Scheffler concentrator (developed unique testing procedure along with computational simulation).

In terms of project progress,

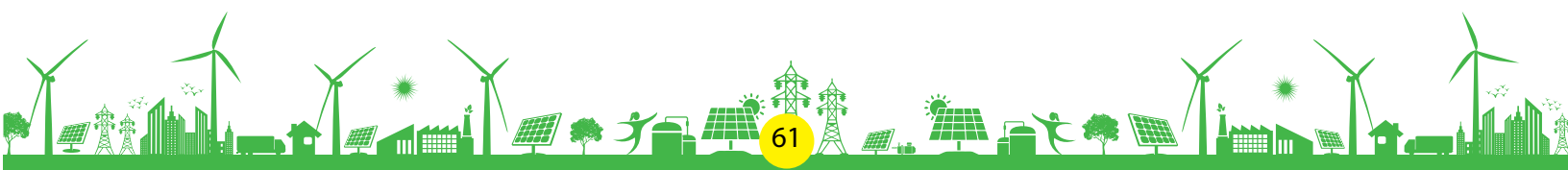
- IISc has developed a unique testing procedure along with computational simulation for a high-pressure receiver with fixed focus Scheffler concentrator
- The High Flux Solar Simulator (HFSS) is the first of its kind in India. The lab-scale unit developed by IISc though is smaller than the ones developed internationally (e.g., in Germany), but can be scaled up for industrial purposes.
- Worldwide, there is no commercially available high-pressure high-temperature solar receiver for s-CO₂ which is why IISc has been engaged by DST to draw upon this project's learnings to indigenously design a pilot MW-scale solarized s-CO₂ plant (funded by DST). IISc has developed the DPR for the project.
- IISc has also collaborated with BHEL in receiver design and testing. BHEL also contributed towards high-temperature ceramic materials used for fabricating the volumetric receiver and thermal storage system.

7.6 R&D IN WIND ENERGY

a. **Met-Ocean Measurements (Wave, Tide, Current, Water Level etc.) at Gulf of Khambhat and Gulf of Mannar for Fostering the Growth of Offshore Wind in the country” – laying the foundation of offshore wind.**

The objective of the project is to carry out an assessment of wind resources, along with environmental, and oceanographic parameters, and notify potential subzones/ blocks for fostering the growth of Offshore wind development.

The project has led to indigenisation and development of integrated floating buoy LiDAR in country which will expedite the met ocean measurements along the 7600 km coastline in cost-effective manner. This is the first of its kind project in India using integrated floating buoy LiDAR for offshore wind resource assessment. The study will enhance the stakeholder confidence in carrying out the Offshore wind measurement using integrated buoy LiDAR technology across the 7600km coastline of India. Work is underway to identify the zones with higher capacity utilization factor (CUF) for offshore installations. capacity building for deployment of integrated floating LiDAR buoy for offshore wind resource assessment.



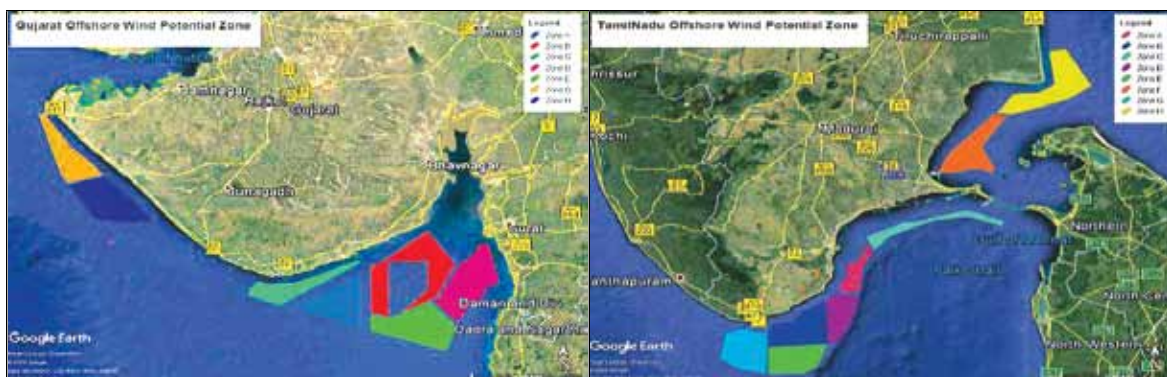


Fig.7.15 (a): Gujarat Offshore Wind Potential Zone

Fig.7.15 (b): Tamil Nadu Offshore Zone

b. Integrated Wind and Solar Resource Assessment through Mapping and Measurements (IWSRA)

The outcome of the research will provide useful inputs in the revision of Policies/Schemes in Renewable Energy Hybrid policy and help identify the potential sites for meeting the estimated renewable energy target. Progress achieved this year is outlined below:

- NIWE has developed the following maps: (i) 120 m wind potential map; (ii) Wind–solar hybrid map, for solar and wind energy stakeholders to effectively implement grid-connected wind-solar hybrid projects. NIWE would also validate the maps with integrated wind and solar and remote sensing in-situ ground measurements by using Model Output Statistics (MOS) bias correction techniques to enhance the accountability of the maps.
- The project has led to capacity building of the developers in developing suitable lands for wind solar hybrid installation.
- The data analysis report from integrated Wind Solar Monitoring stations (for 11 sites annual report and 9 sites interim report), has been submitted to the ministry.
- Possibilities are currently being explored for deploying RSDs such as SODARs and LiDARs for uncovered sites by doing away with the mast measurement which are costly and time-consuming.
- Publications: J. Bastin, Rajesh Katyal, R. Vinod Kumar & P. Yuvasri Lakshmi (2021): Inter Annual Variability of wind speed in India, International Journal of Ambient Energy.

7.7 R&D IN WASTE TO ENERGY

The Ministry has sanctioned two new waste-to-energy projects this year.

(i) Densification of agro-waste and assessment for its application in the gasifier, SSS National Institute of Bio Energy (NIBE), Kapurthala.

The project is to develop a comprehensive database for the fuel efficiency of agro-waste briquettes for their potential use in gasifiers. The project is in the initial stage and has partially achieved its objectives of characterizing agro-waste for the briquetting process. The key agro-waste used is shown in **Fig. 7.16**. The project aims to cover the techno-economic study of briquettes for their application in gasifiers.

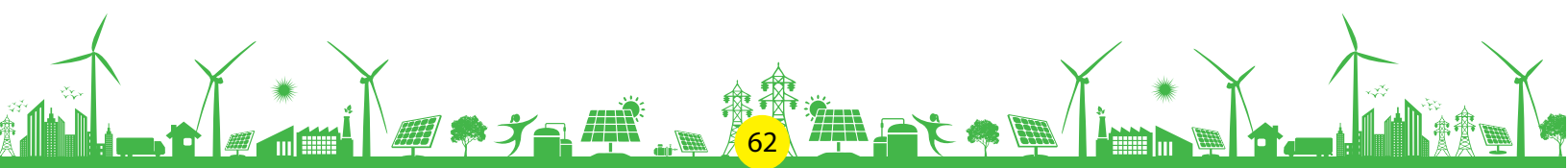




Fig. 7.16: Characterisation of agro-waste for gasification

(ii) Biomass Gasification through Plasma Pyrolysis Technology for Chemicals Production, IIT-Roorkee.

The project aims at the fabrication and commissioning of a laboratory-scale plasma reactor with feed, and gas recovery, synthesis of producer gas from waste sugarcane bagasse and rice/wheat husk using the plasma reactor, optimization of gasification process. The project is currently in the initial stages of implementation.

7.8 R&D IN GREEN HYDROGEN

a. Generation using Biomass Gasification for Fuel Cell Application (HBGF) by Indian Institute of Science (IISc)

The project has led to the development of a Pressure Swing Absorption (PSA) system for gas separation. In a breakthrough this year, the team from IISc reported to have produced hydrogen from biomass using a two-step innovative process. The first step involves the conversion of biomass into syngas after which a low-pressure gas separation unit is deployed to extract pure hydrogen.

b. Green Hydrogen Mobility Projects at Leh

The project has been sanctioned to NTPC Ltd. for producing green hydrogen (80 kg/day) using solar power and to compress, store and dispense green hydrogen safely into Fuel Cell Buses (5 nos.) which will run hydrogen buses in intra city routes (Leh, Ladakh)

7.9 MAJOR ACTIVITIES UNDERTAKEN DURING CURRENT FY 2022-23

- i. An R&D Portal has been developed for digitisation of the R&D Programme (URL: <https://mnre-research.com/home>) and a notification of Call for Proposals During May-August 2022 was issued. The Ministry received 1489 no. of Proposals under the call through online R&D portal which are under consideration.
- ii. Under Indo-German technical cooperation, Government of India (MNRE) and Government of Germany had signed an Implementation Agreement with GIZ to implement the project titled "Innovative Solar" (IN-Solar). Under this project, GIZ has initiated a project titled I-SUN (India-Solar Usage in New Applications). The main objective of this project is to create improved conditions for use of innovative, low competition areas for use of land for the expansion of photovoltaic including:
 - to identify new and innovative solar technologies/solar areas with reduced competition for use of land and resources

- to demonstrate new and innovate solar applications including for green hydrogen production on a selected basis under Indian conditions
- to provide policy advice to strengthen Indian technology leadership, application -oriented research, and know-how transfer

Under the project, following activities are being carried out:

- (a) Ministry of New and Renewable Energy with GIZ team has shortlisted the following 7 New and Innovative Solar PV applications for further proliferation:

Agri PV	Floating PV
Canal Top PV	Building Integrated PV – BIPV
Urban PV	Rail PV
Road PV	

At present the potential of the above mentioned New and Innovative Solar Applications (NISA) has been accessed across India by developing a GIS based online atlas (Solar Technology Application Atlas of India - STAAI), that serves as a web-based knowledge portal and an online interactive calculator for various NISAs. The process of potential estimation and finalization of new solar potential in under approval and soon be finalised and published by MNRE.

- (b) MNRE has also invited application for pilot demonstration of new and innovative solar applications. Out of 83 proposals received for pilot demonstration of which following 3 proposals were selected for pilot scale implementation with partial equipment support from GIZ:
- Vertical Bifacial panel installation on the via duct of Metro (Rail PV) by Delhi Metro Rail Corporation (DMRC)
 - Building integrated Solar system (BIPV) installation by Zig-Zag Solar and Spark Renewables
 - Green Hydrogen Production in Ladakh by Solar Energy Corporation of India (SECI)

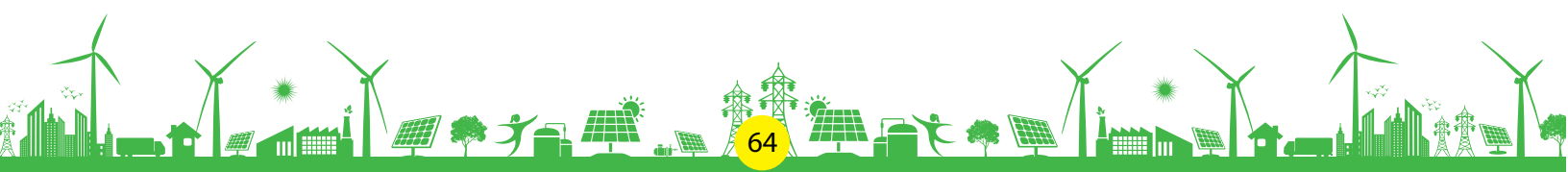
These projects are under implementation.

7.10 R&D PROJECTS UNDER IMPLEMENTATION

Given below is a list of R&D projects under implementation during FY 2022-23:

Solar PV

Sl. No.	Title of the Project	Name of the PI and Institution
1	National Centre for Photovoltaic Research and Education (NCPRE) Phase-II	Indian Institute of Technology Mumbai
2	National Primary Standard facility for cell calibration	National Physical Laboratory (NPL), Delhi
3.	Development of high efficiency (21%/19%) PERC type of c-Si/mc-Si solar cell	BHEL-ASSCP, Gurugram and National Institute of Solar Energy, Gurugram
4.	Flexible Perovskite Solar Cells and Intermediate Module	Indian Institute of Technology Bombay, Powai, Mumbai
5	Design and Development of 'High Efficiency Solar Water Pumping Systems	Director General, National Institute of Solar Energy (NISE)



Sl. No.	Title of the Project	Name of the PI and Institution
6	Design and Development of high performance super capacitors for solar applications (Solar Lantern, Solar Home Light)	Uttaranchal University Dehradun and Indian Institute of Technology, (IIT-Roorkee)
Solar Thermal		
7	Development of high efficiency receiver for supercritical CO ₂ integrated with static focus parabolic dish	World Renewal Spiritual Trust (WRST), Bombay

Wind Energy

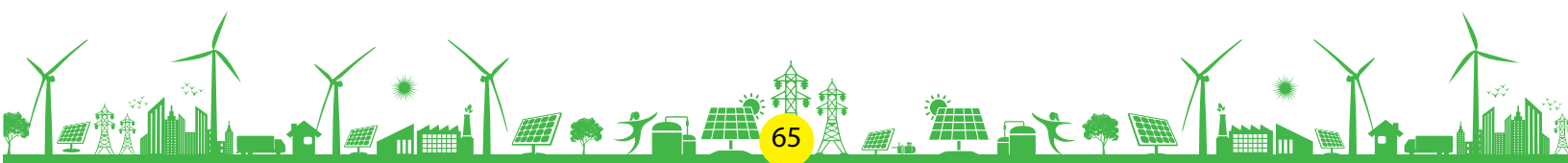
Sl. No.	Title of the Project	Name of the PI and Institution
1	Integrated Wind and Solar resource Assessment	National Institute of Wind Energy Chennai
2	Met-Ocean Measurements (Wind, Wave, Tide, Current, Water Level, etc.,) at Gulf of Khambhat and Gulf of Mannar	National Institute of Wind Energy Chennai

Waste to Energy

Sl. No.	Title of the Project	Name of the PI and Institution
1	Biomass Gasification through Plasma Pyrolysis Technology for Chemicals Production	IIT Roorkee
2	Densification and co-firing of agro-waste for power generation through gasification	SSS-NIBE

Hydrogen Energy

S. No.	Name of Project	Implementing Agency
1.	Hydrogen generation using biomass gasification for fuel cell application (HBGF)	IISc Bangalore
2.	Development of design methodology for light weight high pressure hydrogen storage composite cylinder for vehicular applications	CMERI, Durgapur
3.	Hierarchical composite nano-structure photo-catalysts for efficient water splitting under solar light irradiation	Yogi Vemana University & CECRI, Karaikudi
4.	Design & development of 20kW Low Temperature Polymer Electrolyte Membrane Fuel Cell (LTPEMFC) with high indigenous content	ARCI-CFCT, Chennai
5.	Setting Up of a Centre of Excellence on Hydrogen Energy at National Institute of Solar Energy (NISE), Gwal Pahari, Haryana	NISE, Gurgaon
6.	Studies on novel semiconductors towards increasing the efficiency of Photo-electro-chemical (PEC) water splitting for hydrogen generation	Dayalabagh Educational Institute, Agra



7.11 ENERGY STORAGE

Renewable Energy sources are variable and intermittent in nature and as integration of high volumes of Renewables into Grid, there would be a challenge in-terms of grid security, stability & safety. Grid scale Energy Storage Systems (ESS) would help in smothering the renewable generation output and thereby improving the power quality, helping grid stability. This will also result in reduction of transmission network congestion and making better use of network infrastructure. The Solar Energy Corporation of India Ltd (SECI), a CPSU under the Ministry, is promoting ESS coupled with renewable energy projects as given below:

7.11.1 In Developer Mode

- i. 500 MW/1000 MWh ISTS connected Standalone Battery Energy Storage System (BESS) Project at Fatehgarh-III substation in Rajasthan. The project is under implementation.
- ii. 1200 MW ISTS-Connected RE Projects with assured Peak Power Supply (Pumped storage capacities of 450 MW and storage of 150 MWh). The project is under implementation.
- iii. 4 MW Floating SPV Project with 1 MW/2 MWh BESS on Kalpong Dam, Diglipur in the UT of Andaman and Nicobar. The project is under implementation.

7.11.2 In CAPEX Mode

- i. 100 MW (AC) Solar PV Power Plant (160 MWp DC capacity) along with 40 MW/120 MWh BESS at Rajanandgaon, Chhattisgarh: SECI has awarded the project to EPC contractor and the project is under implementation.
- ii. 20 MW (AC) Solar PV Power Plant (50 MWP DC) with 20 MW/50 MWh Battery Energy Storage System at Taru, Leh, UT of Ladakh, under the Prime Minister's Development Package (PMDP) scheme. The project is under implementation.
- iii. 1.95 MWp SPV Project with 2.15 MWh BESS in four islands (Kavaratti, Agatti, Bangaram and Thinkarra), Lakshadweep. The project is under implementation.

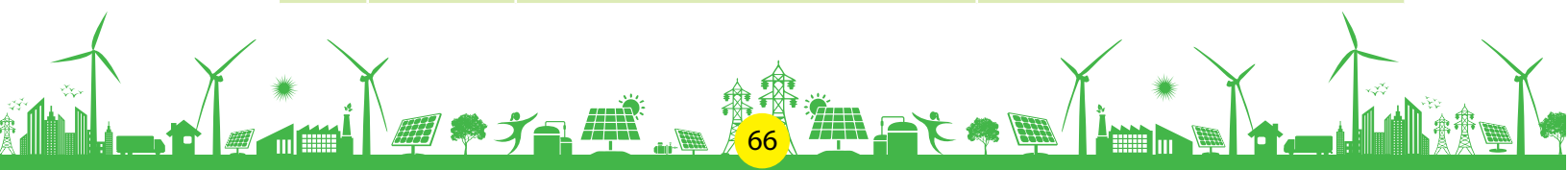
7.12 STANDARDS & QUALITY CONTROL IN RENEWABLE ENERGY SECTOR

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



Sl. No	Programme	Product and Standard Title	Standards
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
		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

7.12.2 Quality Control in SPV Power Projects

7.12.2.1 Quality Control Order (QCO)

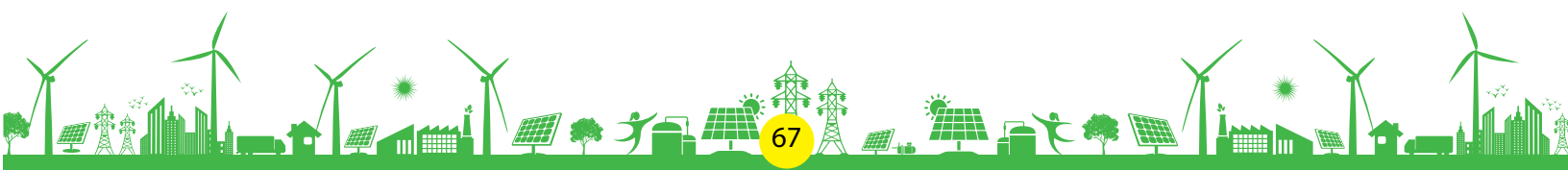
The technical regulation for quality control of SPV Systems, Components and Devices as per Quality Control (Requirement for Compulsory Registration under BIS Act) Order 2017, which was notified by MNRE vide Government of India Gazette Notification No. 2561 dated 5th September, 2017 was implemented as 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 extended up to 31.12.2022 during the year 2022-23.

The modification/updation of this Quality Control Order 2017 with revised versions of Indian Standards, BIS Act 2016, BIS (Conformity Assessment) Regulations 2018 and new Conformity Assessment Scheme for SPV Inverter is under consideration.

7.12.2.2 BIS Registration of Products

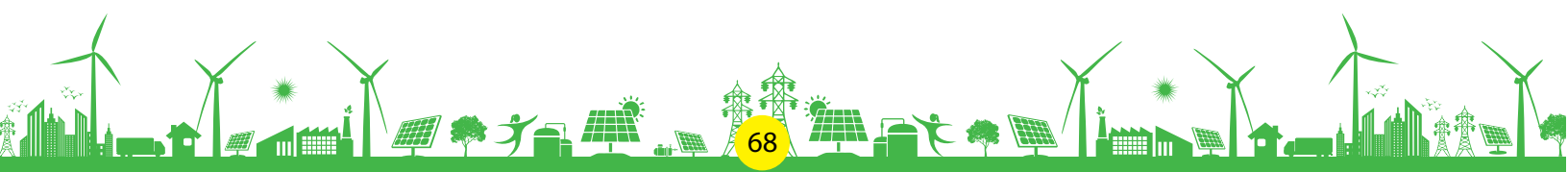
The nos. of registration granted by Bureau of Indian Standards (BIS) for SPV Modules, SPV inverters and Storage Battery as per standards specified in MNRE Quality Control Order till 23/09/2022 is given in **Table 7.2**. Out of 447 nos. manufacturers who were granted registration for SPV Products, 246 Nos. are domestic manufacturers (55%). The MNRE has decided that only SPV Products 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 Products but also domestic manufacture of SPV Products 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 23.09.2022**

SI No.	Product Name	Indian Standards	Domestic	Foreign
1	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	206	155
2	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	0	5
3	Power Invertors for use in Photovoltaic Power Systems	IS 16221 (Part 2): 2015 / IEC 62109-2: 2011	11	1
4	Utility-Interconnected Photovoltaic Inverters	IS 16221 (Part 2):2015/IEC 62109-2 :2011 & IS 16169 :2014/IEC 62116 :2008	21	40
5	Storage Batteries for Solar Photovoltaic Application	IS 16270: 2014	8	0



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 The total estimated potential of renewable energy in the North Eastern Region from Solar, Small Hydro and Bio-energy is around 65.83 GW, 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 Region of India

Sl. No.	States	Small Hydro Power (MW)	Bio-Energy		Solar (MW)	Total (MW)
			Biomass Power (MW)	Waste To Energy (MW)		
1	Arunachal Pradesh	2064.92	8		8650	10723
2	Assam	201.99	212	8	13760	14182
3	Manipur	99.95	13	2	10630	10745
4	Meghalaya	230.05	11	2	5860	6103
5	Mizoram	168.90	1	2	9090	9261
6	Nagaland	182.18	10		7290	7482
7	Sikkim	266.64	2		4940	5209
8	Tripura	46.86	3	2	2080	2132
	Total	3261.49	260	16	62300	65838

8.3 The state wise status of Renewable Energy capacity installed, as on 31.12.2022, in the North-Eastern Region is given in **Table 8.2**.

Table 8.2: State-wise installed capacity of Renewable Power in North East Region as on 31.12.2022.

S. No.	States	Small Hydro Power (MW)	Bio Power (MW)	Solar Power (MW)	Total Capacity (MW)	Capacity Addition during 2022-23 (MW)
1	Arunachal Pradesh	133.11	0.00	11.52	144.63	2.29
2	Assam	34.11	2.00	147.93	184.04	29.99
3	Manipur	5.45	0.00	12.28	17.73	0.03
4	Meghalaya	32.53	13.80	4.15	50.48	0.00
5	Mizoram	41.47	0.00	8.02	49.49	5.12
6	Nagaland	31.67	0.00	3.04	34.71	1.00
7	Sikkim	55.11	0.00	4.69	59.80	3.01
8	Tripura	16.01	0.00	16.67	32.68	1.78
	Total (MW)	349.46	15.80	208.30	573.56	43.22

8.4 SMALL HYDRO POWER (SHP) PROGRAMME

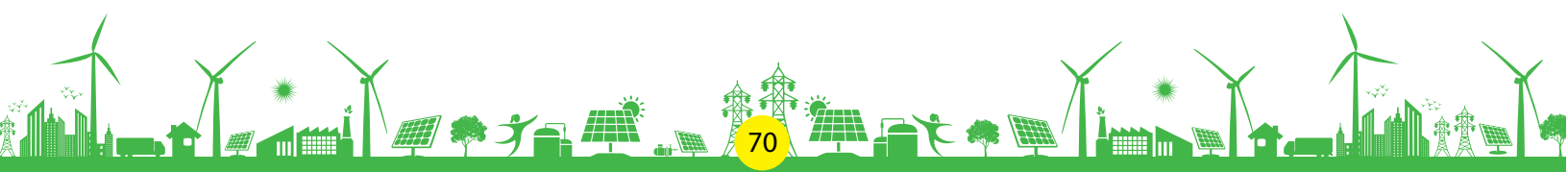
North Eastern (NE) States have a fairly good potential to develop small hydro power projects. Among the NE States, Arunachal Pradesh has the highest potential followed by Sikkim, Meghalaya and Mizoram. MNRE has been giving special emphasis for the development of small hydro projects in the NE region. Small Hydro Power Projects can provide energy almost uninterrupted without any major maintenance or dependence on weather. The region, which often faces 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 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 31.12.2022)

Sl. No.	States	Total Potential (MW)	Total Installed Capacity (MW)
1	Arunachal Pradesh	2064.92	133.11
2	Assam	201.99	34.11
3	Manipur	99.95	5.45
4	Meghalaya	230.05	32.53
5	Mizoram	168.90	41.47
6	Nagaland	182.18	31.67
7	Sikkim	266.64	55.11
8	Tripura	46.86	16.01
	Total	3261.49	349.46

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

Sl. No.	Name of the project	Capacity (MW)	Implementing Agency
Arunachal Pradesh			
1	Tirrunallah in Longding District	0.10	Department of Hydro Power Development
2	Fure in Kurung Kumey	0.05	Department of Hydro Power Development
3	Pakhankha in Changlang District	0.50	Department of Hydro Power Development
4	Kush SHP	2.00	Department of Hydro Power Development
5	Taksang Chu SHP in Tawang District	2.00	Hydro Power Development Corporation of Arunachal Pradesh
Meghalaya			
6	Ganol SHP West Garo Hills District	22.50	Meghalaya Power Generation Corporation Limited
7	Riangdo SHP in West Garo Hills District	3.0	Meghalaya Power Generation Corporation Limited



Sl. No.	Name of the project	Capacity (MW)	Implementing Agency
Mizoram			
8	Kawlbem in Champhai District	3.50	Power & Electricity Deptt., Government of Mizoram
Nagaland			
9	Ponglefo SHP in Kiphire District	1.00	Department of Power, Government of Nagaland
10	Duilumroi SHP in Peren District	2.40	Department of Power, Government of Nagaland

8.5 PM'S PACKAGE FOR ARUNACHAL PRADESH

Hon'ble Prime Minister of India on his visit to Arunachal Pradesh on 31-01-08 announced a package of Rs. 550.00 Crores for illumination/electrification of Villages located in Border Districts of Arunachal Pradesh lying along the international borders of China, Bhutan and Myanmar through a mix of grid-connected/ decentralized small/mini/micro Hydel Projects and Solar Photovoltaic Systems. Under the package, the Ministry of New and Renewable Energy installed Solar Photovoltaic Home Lighting Systems in 5758 households and has so far implemented 112 Small/Mini/Micro Hydel projects to provide grid quality electricity to remote border villages.

Benefits from the package

- The Package has resulted in improving the overall living conditions of the people living in the remote border districts of Arunachal Pradesh and has also resulted in enhanced livelihood activities.
- School going children now have better studying conditions in their homes.
- With the provision of power in the area, the pressure on wood has reduced considerably and this will ultimately result in saving the forests.
- The projects installed under the PM Package has been able to reduce the negative effect of global warming by way of reducing the emission of equivalent CO₂ that otherwise would have been emitted to the atmosphere in the absence of these power projects which run on Renewable Sources of Energy.

8.6 SOLAR PARKS

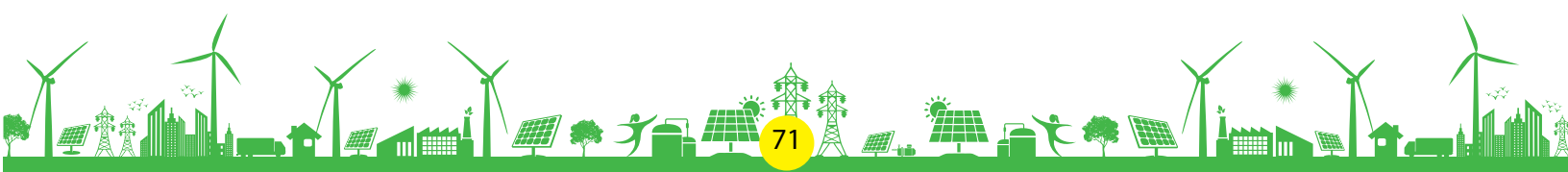
Ministry is implementing a Scheme for "Development of Solar Parks and Ultra Mega Solar Power Projects" with an objective to set up at least 50 Solar Parks with an aggregate capacity of 40,000 MW of solar power projects. All the States and Union Territories are eligible for getting benefit under the scheme.

As on 31-12-2022, Ministry have approved 57 Solar Parks in 13 States including one Solar Park in NER under the Solar Park Scheme. The details of the Solar Park in NE Region are given in **Table 8.5**.

Table 8.5: Solar Park currently under implementation in the NE Region States (as on 31.12.2022)

S. No.	State	Capacity	Name of the Solar Power Parks Developer	Location
1	Mizoram	20 MW	Power & Electricity Department	Vankal, Champhai District, Mizoram

The park is under implementation and is likely to be commissioned by March, 2023.



8.7 PHASE II OF THE GRID CONNECTED ROOFTOP SOLAR PROGRAMME IN NE REGION

Ministry of New and Renewable Energy is implementing Rooftop Solar Programme Phase II wherein RTS capacity aggregating 4000 MW by 2022 was targeted in residential sector through provision of Central Financial Assistance (CFA) out of the overall target of 40000 MW by 2022. Considering the Covid-19 pandemic conditions and other factors the Programme period has been extended till 31.3.2026. For individual households, CFA upto 40% of the benchmark cost is provided for RTS plants upto 3 kW capacity and upto 20% for RTS plants of capacity beyond 3 kW and up to 10 kW. For Group Housing Societies/ Residential Welfare Associations (GHS/RWA), CFA is limited to 20% of the benchmark cost for RTS plants of capacity up to 500 kW used for supply of power to common facilities.

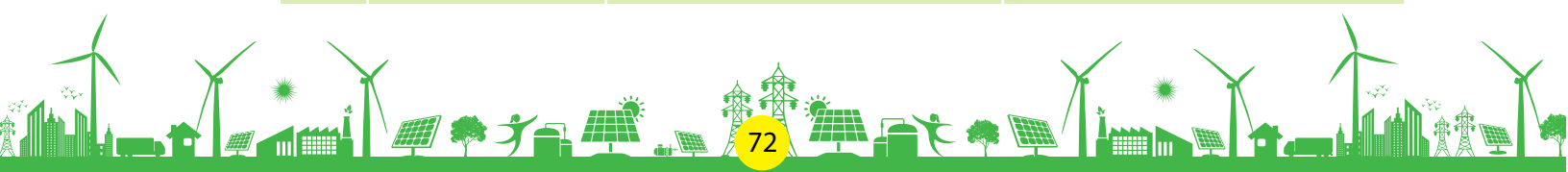
Based on the proposals received from various Electricity Distribution utilities of North Eastern (NE) Region, the Ministry of New and Renewable Energy has allocated 24.05 MW net capacity of grid connected rooftop solar programme during the last three years including the current year up to 31.12.2022. Against the allocated 24.05 MW capacity as given in **Table 8.6**, around 0.564 MW as given in **Table 8.7** has been installed in various NE States. Overall 44.85 MW RTS installation have been reported by various State implementing agencies of NE States as on 31.12.2022 as given in **Table 8.7** in various sectors e.g. residential, social, institutional, commercial, industrial, Govt. etc. with or without CFA support in the country. Reported installed capacity in financial year 2022-23 is 1.719 MW in NE States out of which 0.071 MW has been installed in residential sector with CFA.

Table 8.6: Details of State-wise allocated capacity under the phase II of the rooftop solar programme

S. No.	States	Net allocated capacity (MW)
1	Arunachal Pradesh	0.00
2	Assam	3.75
3	Manipur	2.00
4	Meghalaya	10.00
5	Mizoram	1.50
6	Nagaland	3.80
7	Sikkim	2.00
8	Tripura	1.00
Total	8 States	24.05

Table 8.7: Details of State-wise Rooftop Solar Installed capacity as on 31.12.2022

S. No.	States	Capacity installed under phase II in residential sectors with CFA as on 31.12.2022 (MW)	Overall RTS system installed in all sectors with and without CFA as on 31.12.2022 (MW)
1	Arunachal Pradesh	0	0.22
2	Assam	0.19	30.37
3	Manipur	0.18	4.95
4	Meghalaya	0	0.21
5	Mizoram	0.19	1.55
6	Nagaland	0	0.10
7	Sikkim	0	2.67
8	Tripura	0	4.78
Total	8 States	0.56	44.85



In addition, incentives upto 5% of the benchmark cost for RTS capacity addition beyond 10% and up to 15% of the base line RTS capacity; and incentives upto 10% of the benchmark cost for RTS capacity addition beyond 15% of the base line RTS capacity is being provided to the electricity distribution companies (DISCOMs). The incentives are provided to DISCOMS for achieving RTS capacity addition in all sectors in a financial year above the baseline capacity as on 31st March of the previous year.

Incentives of Rs. 3.1628 crore has been released to Assam Power Distribution Company Limited (APDCL) in FY 2022-23 as on 31.12.2022.

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.

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

Table 8.8: Projects where installations have been completed under Off-grid and Decentralized Solar PV Applications Scheme Phase-III

States	Completed 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, 89,319 nos. of Solar Street Lights have been installed and 8,07,879 nos. of Solar Study Lamps have been distributed in North Eastern States till the closure of the programme.

Under the **Atal Jyoti Yojana (AJAY) Phase-II**, 11,995 solar street lights are being installed in Lok Sabha constituencies of the North Eastern States including Sikkim till the closure of the programme. Solar street lights sanctioned till 31.03.2020 are being installed.

Details of all SPV systems and standalone SPV power plants in the North Eastern States as on 31.12.2022 are given in **Table 8.9**.

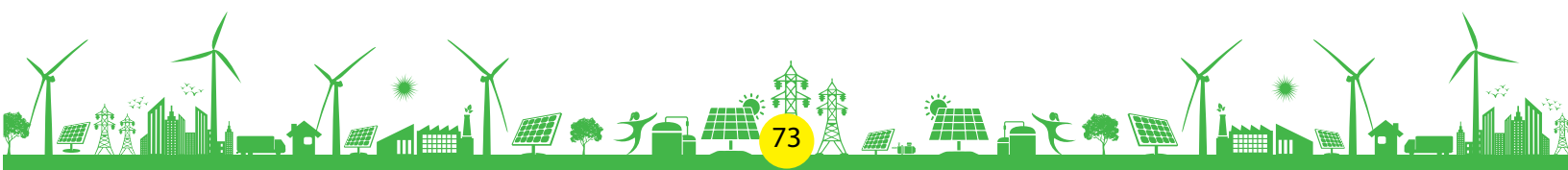


Table 8.9: SPV Systems and Stand-alone Power Plants in the North-Eastern States (as on 31.12.2022)

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	113	963.2
2	Assam	46879	647761	29538	45	1605
3	Manipur	24583	69722	32767	68	1580.5
4	Meghalaya	14874	97360	5800	54	2004
5	Mizoram	12060	155217	20325	37	3894.6
6	Nagaland	1045	30766	16045	3	1506
7	Sikkim	15059	45200	504	0	850
8	Tripura	32723	364012	15517	1325	867
	Total	182288	1628589	145504	1645	13270.3

8.9 BIOGAS PROGRAMME

The Biogas Programme is being implemented in the North Eastern Region States for providing clean gaseous fuel mainly for cooking, lighting, meeting the decentralized power generation needs of users and production of organic manure to rural and semi-urban households in the North Eastern Region States through State Government Nodal Departments/ State Nodal Agencies. MNRE has allocated targets to the State Nodal Agencies/ Departments for implementing the Biogas Programme in the States of Assam, Arunachal Pradesh, Manipur Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura during the year 2022-23, after notification of the Scheme on 02.11.2022. Under the Biogas Programme, 20% of additional CFA over and above the standard CFA is applicable for all the biogas plants installed in NE Region.

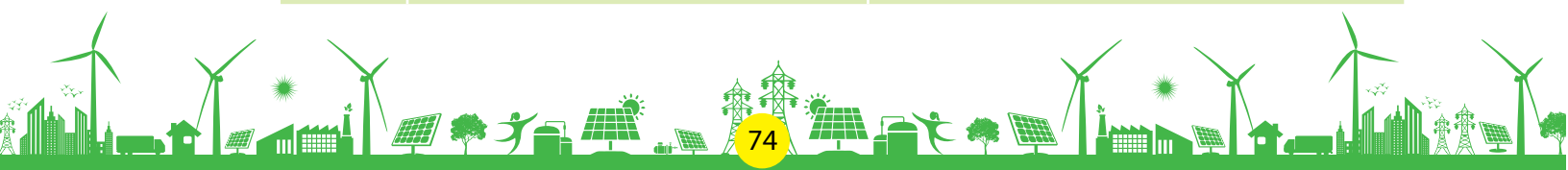
A Biogas Development and Training Centre for all the NER States for providing training and technical support under the Biogas Programme is functional at Department of Mechanical Engineering, Indian Institute of Technology, Guwahati, Assam.

8.10 STATUS OF WIND RESOURCE ASSESMENT 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 Region at 50 meter level is estimated to be 406 MW. The State-Wise break-up is given in **Table 8.10**.

Table 8.10: 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 NE 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 31.12.2022, a total of 95 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 8.11**.

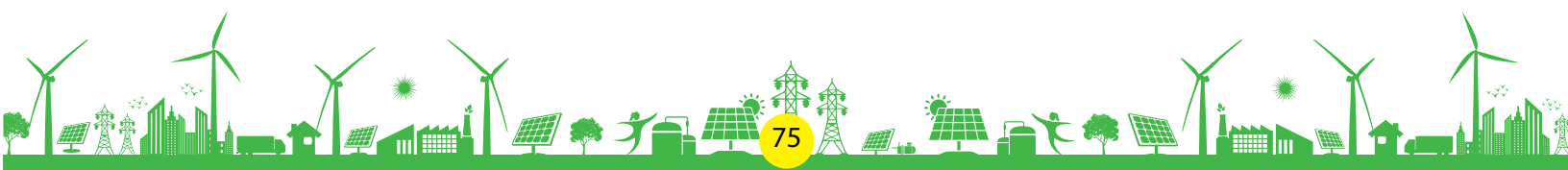
Table 8.11: Status of Wind Resource Assessment Stations set up and closed down

States	No. of Stations installed & Commissioned	Level of Wind Resource Assessment stations
Arunachal Pradesh	15	25 m & 50 m
Assam	18	25 m & 50 m
Tripura	11	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	95	

In addition, Wind Resource Assessments are also carried out at NE region using the existing Telecommunication towers. As on 31.12.2022, a total 80 of telecom towers of heights ranging from 25m to 80m were utilised for this purpose and the requisite data collection from all these telecom towers were also completed. The details are given in **Table 8.12**.

8.12: Telecom Towers utilised as Wind Resource Assessment Stations

States	No. of Stations installed & Commissioned	Level of Wind Resource Assessment stations
Meghalaya	15	28 m - 50 m
Mizoram	5	25 m - 35 m
Tripura	6	27 m - 53 m
Arunachal Pradesh	5	30 m - 50 m
Nagaland	7	30 m - 50 m
Manipur	9	45 m - 60 m
Assam	33	25 m - 80 m
Total	80	



CHAPTER 9

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

9.1 The Government of India is implementing the Production Linked Incentive (PLI) Scheme for National Programme on High Efficiency Solar PV Modules, for achieving manufacturing capacity of Giga Watt (GW) scale in High Efficiency Solar PV modules with outlay of Rs. 24,000 crore. Under this Scheme, the Government of India will give Production Linked Incentive to the selected solar PV module manufacturers for five years post commissioning, on manufacture and sale of High Efficiency Solar PV modules.

9.2 AIMS AND OBJECTIVES

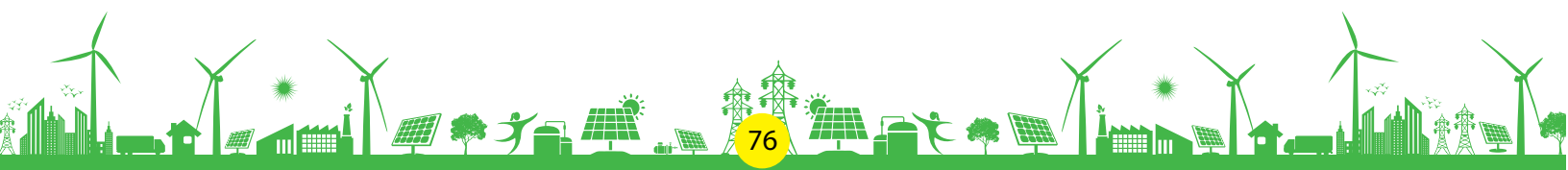
Aims: The scheme aims to promote manufacturing of high efficiency solar PV modules in India and thus reduce import dependence in the area of Renewable Energy. The **objectives** of the scheme include the following:

- 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 yield 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 The PLI Scheme is being implemented in two tranches as follows:

9.3.1 Tranche-I:

- i. The Union Cabinet approved the Production Linked Incentive (PLI) Scheme for National Programme on High Efficiency Solar PV Modules, for achieving manufacturing capacity of Giga Watt (GW) scale in High Efficiency Solar PV Modules) on 7th April, 2021. The outlay for this PLI Scheme was initially Rs. 4,500 crore (Tranche I) and the Ministry of New and Renewable Energy (MNRE) issued the Scheme Guidelines for Production Linked Incentive Scheme on 'National Programme on High Efficiency Solar PV Modules' on 28th April, 2021.
- ii. Under this tranche, Indian Renewable Energy Development Agency Limited (IREDA), the implementing agency on behalf of MNRE for the PLI Scheme (Tranche I), issued the Bid Documents for selection of manufacturers for setting up manufacturing capacities for High Efficiency Solar PV Modules. In response, 18 bids corresponding to a Solar PV manufacturing capacity of 54,809 MW were received and Letters of Award were issued by IREDA on 11.11.2021 / 02.12.2021 to three successful bidders for setting up of 8,737 MW capacity of fully integrated Solar PV Module manufacturing units within PLI scheme outlay of Rs. 4,500 crore. The aforesaid 8,737 MW solar PV manufacturing capacity is scheduled for commissioning by around end of year 2024.

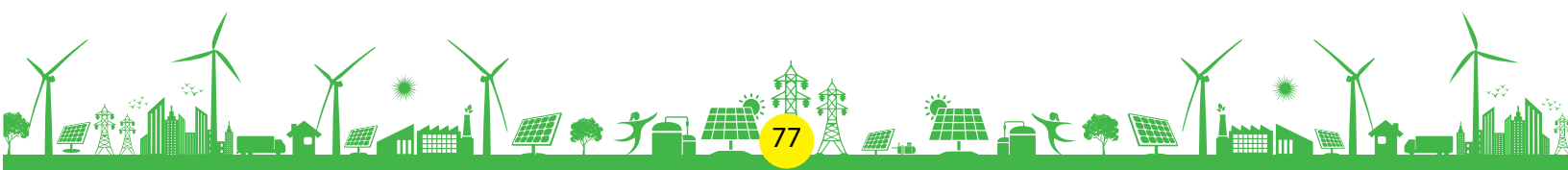


9.3.2 Tranche-II:

- i. Subsequent to the Union Cabinet approval dated 21.09.2022, Ministry of New and Renewable Energy, on 30.09.2022, has issued Scheme Guidelines for implementation of Tranche-II of the PLI Scheme for High Efficiency Solar PV Modules, with an outlay of Rs. 19,500 crore.
- ii. Under this tranche, Solar Energy Corporation of India (SECI), the implementing agency on behalf of MNRE for the PLI Scheme (Tranche-II), had issued the tender document for selection of Solar PV manufacturers under Tranche-II of PLI Scheme for High Efficiency Solar PV Modules on 18.11.2022. It is expected that the letters of award will be issued to the successful bidders by April 2023.
- iii. Time allowed for commissioning for solar PV manufacturing units under P+W+C+M (manufacturing of polysilicon, ingots-wafers, cells & modules), W+C+M (manufacturing of ingots-wafers, cells & modules) and C+M (manufacturing of cells & modules) categories will be 36 months, 24 months and 18 months respectively from the date of issuance of letter of award.

9.4 OUTCOME/BENEFITS: The outcomes/benefits expected from the scheme are as follows:

- i. It is estimated that about 74,000 MW per annum manufacturing capacity of fully and partially integrated, solar PV modules would be installed.
- ii. The scheme will bring direct investment of around Rs.1,13,000 crore.
- iii. Creation of manufacturing capacity for Balance of Materials like EVA, Solar glass, Backsheet, etc.
- iv. Direct employment of about 2,21,000 and indirect employment of around 8,84,000 persons.
- v. Impetus to Research and Development to achieve higher efficiencies in Solar PV Modules.



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 is mandated for Solar R&D, solar component testing and certification, capacity building, and development of solar products and applications. NISE complements the requirements of MNRE to make India into a self-reliable renewal power-producing nation and accept the series of challenges that intervened amidst the implementation of the National Solar Mission (NSM). NISE also carry out research and development activities in the areas of green Hydrogen. The institute is situated at Gwal Pahari on the Gurugram-Faridabad Road, Haryana.

10.1.2. NISE has established itself as a leading Institute in the field of Solar Energy through Resource Assessment, Research & Development, Design, Development and Demonstration of Solar Energy Technologies for various applications such as, Testing, Certification and Standardization, Monitoring and Evaluation, Economic and Policy Planning, Human Resource Development and Active collaborations with prominent National & International organisations.

10.1.3. NISE is maintaining NABL accredited Solar Photovoltaic module testing laboratory, lighting system test laboratory, battery testing facility and solar water pumping system test rig and outdoor test facilities. The institute also has a 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 R&D projects undertaken by NISE during the year are given in **Table 10.1**.

Table 10.1: Details of ongoing R&D projects

Sl. No.	Project	Project objectives	Funding Agency
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.	To develop Passivated Emitter and Rear Contact (PERC) type solar cells with benchmark efficiencies in the country	MNRE
2.	Design, development and qualification of large area (156 mm x 156 mm), secondary reference solar cells	To develop a large area (156 mm x 156 mm) secondary reference solar to replace a conventional small area (20 mm x 20 mm) secondary reference solar cell	DST
3.	Performance Analysis of Bifacial Module in different climatic zones in India	To estimate the optimum fixed tilt for South-facing Bifacial module for 100 cities of different climatic zones in India	NISE

Sl. No.	Project	Project objectives	Funding Agency
4.	After lifetime reliability and performance analysis of PV modules	To study the reliability and performance analysis of mono-crystalline silicon PV module after its lifetime	NISE
5.	High-Efficiency Solar Water Pumping Systems	To increase the 'Overall Wire to Water Efficiency' of the Solar Water Pumping Systems (SWPS) up-to 45% (from the existing level of around 38%-40%)	MNRE
6.	Optimization of Solar Photovoltaic Based Water Pumping Performance with DC Motor	To carry out optimization studies for Solar Photovoltaic based water pumping with DC motor	SERB-TARE
7.	Atmospheric water generator using desiccants for generation of pure water from air	To develop a lab-scale prototype for generating water from air using desiccants	NISE
8.	Demonstration of Solar Powered Heat Pump with Thermal Energy Storage Backup for Space Heating and Cooling at NISE, Gurugram	To showcase the potential of a solar-powered heat pump for customized heating/ cooling solutions, with thermal energy storage for use during non-sunshine hours	
9.	Setting up of a Centre of Excellence on Hydrogen Energy at National Institute of Solar Energy, Gwal Pahari, Gurugram	<ul style="list-style-type: none"> To operate and maintain the existing PV based green hydrogen production cum dispensing station at NISE To augment the green hydrogen production capacity to 15 Nm³/hr from the existing 5 Nm³/hr Facilitating completion of field trials and demonstration of hydrogen fueled vehicles at NISE, and To create awareness programmes on different aspects of hydrogen energy 	MNRE

10.1.5 DEVELOPMENT OF HIGH EFFICIENCY (21%/ 19%) PERC TYPE OF C-SI/MC-SI SOLAR CELLS

The project is funded by MNRE and is taken up in collaboration with Bharat Heavy Electricals Limited Amorphous Silicon Solar Cell Plant (BHEL ASSCP), Gurugram. The project's main objective is to develop Passivated Emitter and Rear Contact (PERC) type solar cells with benchmark efficiencies in the country. During the year, several samples have been characterized by using optical microscopic, surface profilometry and electro-chemical capacitance voltage profilometer. Optical microscopy was also used to characterize laser ablation of Aluminum Oxide by green nano laser and textured top surface of full-grown solar cell, as shown in **Fig 10.1**. Surface profilometry has been used to measure stress in cells during different processing steps.

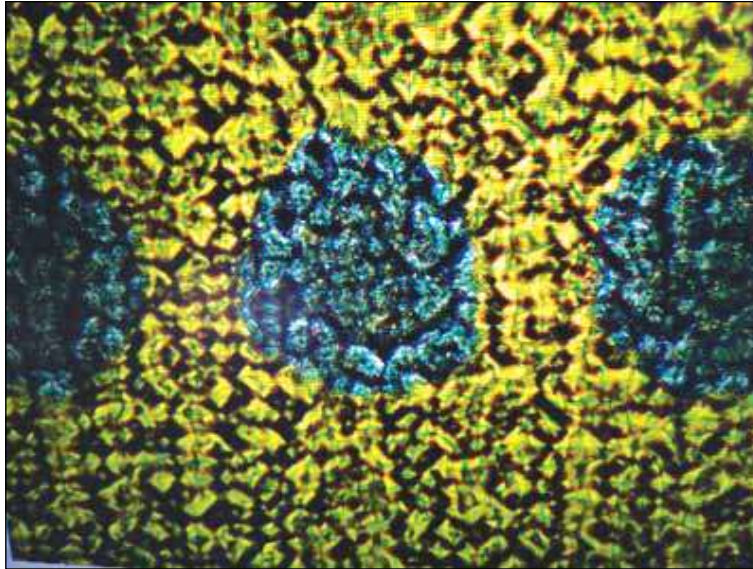


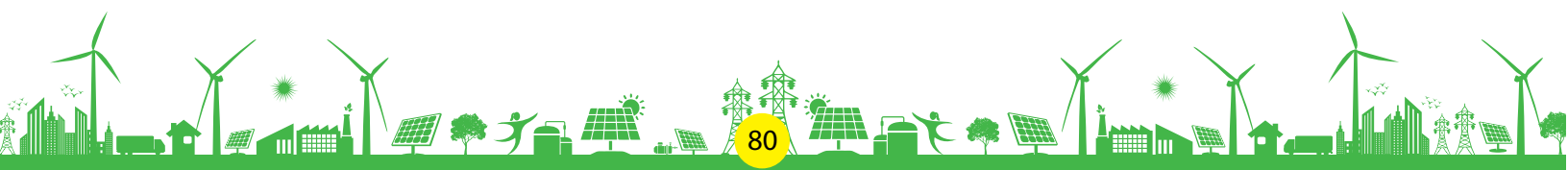
Fig 10.1: Laser ablation Aluminium Oxide

10.1.6 DESIGN, DEVELOPMENT AND QUALIFICATION OF LARGE AREA (156 MM X 156 MM) SECONDARY REFERENCE SOLAR CELLS

NISE is working on a DST-funded project for developing a large area (156 mm x 156 mm) secondary reference solar to replace a conventional small area (20 mm x 20 mm) secondary reference solar cell. This will reduce the influence of measurements in the inhomogeneity of solar simulators and thereby increase the accuracy of the output. During the year manpower recruitments in position of project scientist-I, project associate-II and technical assistant have been completed. One equipment, vacuum annealing furnace was procured and installed at NISE. Procurement process for remaining equipment is in process.

10.1.7 PERFORMANCE ANALYSIS OF BIFACIAL MODULE IN DIFFERENT CLIMATIC ZONES IN INDIA

The project aims to estimate the optimum fixed tilt for South-facing Bifacial module for 100 cities of different climatic zones in India. The optimum tilt varies from 23° in Alleppey (Kerala) to 43° Gilgit Baltistan (Jammu & Kashmir). The annual energy output of bifacial Module at optimal tilt was also studied for 100 cities of India using System Advisor Model (SAM) software. Pasighat, Arunachal Pradesh has the minimum annual energy output of 1427.8 kWh/kWp while Aksai Chin, Leh has the maximum annual energy output of 2325.7 kWh/kWp. It has been observed that optimal tilt is increasing with increasing latitude. The highest and lowest bifaciality gain value observed among the 100 cities of India was 11.73% for Itanagar, Arunachal Pradesh and 7.89% for Gwalior, Madhya Pradesh respectively.



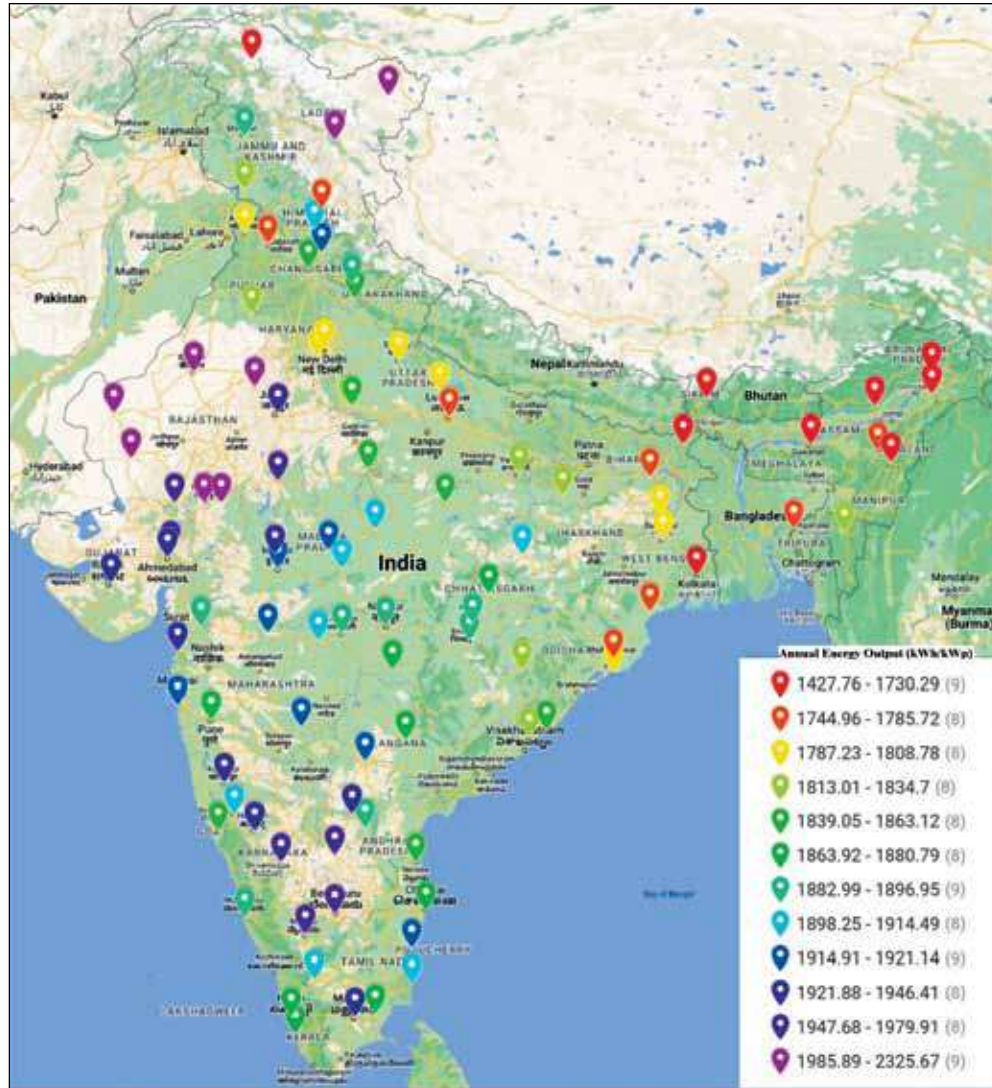


Fig. 10.2: Estimated Annual Energy Output (kWh/kWp) of Bifacial PV Power Plant for 100 cities in India

10.1.8 AFTER LIFETIME RELIABILITY AND PERFORMANCE ANALYSIS OF PV MODULES

In this study the reliability and performance analysis of mono-crystalline silicon PV module after its lifetime (as declared by manufacturer datasheet) has been performed on the modules installed in NISE campus during 1999-2000 and were still generating power. The modules show average power degradation of 0.95% per year. Visual inspection, indoor Current-Voltage (I-V) characterization at Standard Test Condition (STC), Electroluminescence (EL) imaging, Infrared (IR) thermal imaging, and insulation tests were performed for all of the PV modules. It has been observed that some of the module can be re-used after its lifetime with new power rating and some safety related tests. Expected energy output from the degraded module have been also estimated by using PVsyst based on the 'PAN' file created with the current power rating of the PV modules.

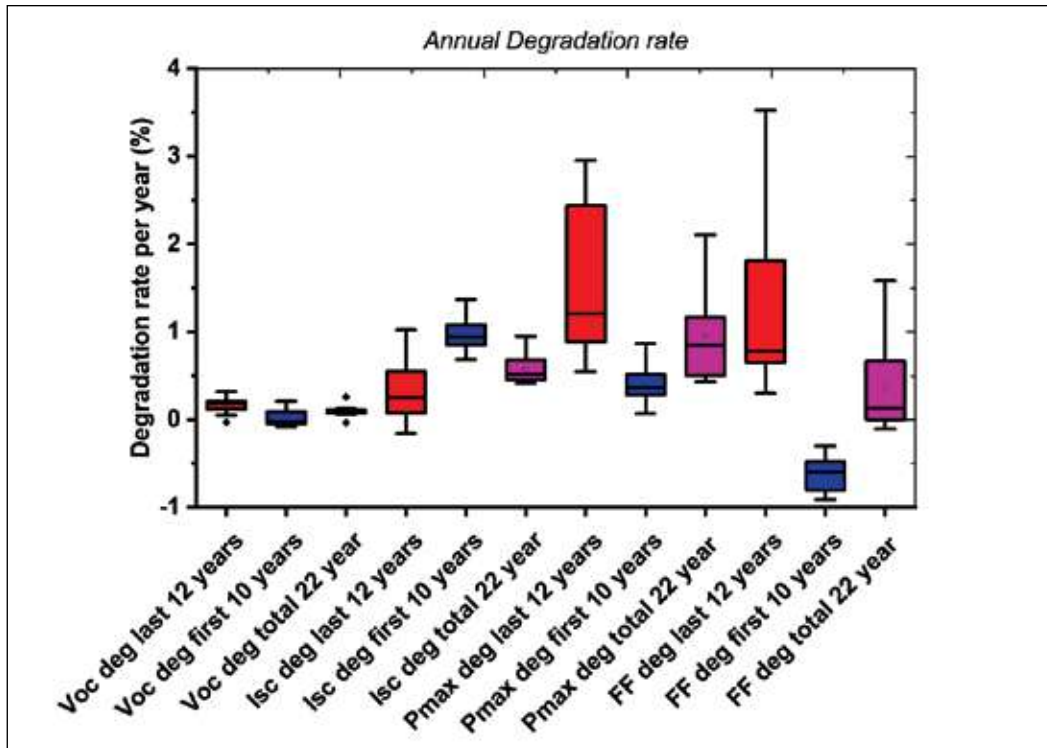


Fig. 10.3 Annual degradation rate of the electrical parameters of Mono-C-Si PV module

10.1.9 DESIGN AND DEVELOPMENT OF HIGH EFFICIENCY SOLAR WATER PUMP PROJECT

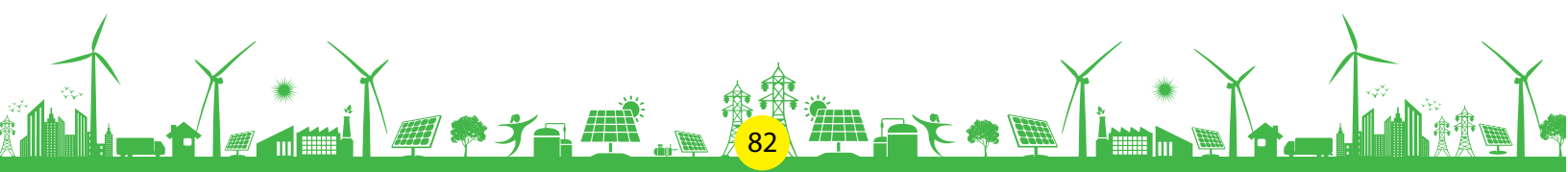
The main objective of this MNRE funded project is to increase the 'Overall Wire to Water Efficiency' of the Solar Water Pumping Systems (SWPS) up-to 45% (from the existing level of around 38%-40%) and creation of a state-of-the-art testing facility for SWP system. During the year, the following progress were achieved under the project:

- R&D and testing facility for SWP system of up to 50 hp capacity has been developed.
- Preparation of Test Protocols for SWPs of up to 50 hp capacity.
- Framework of guidelines for solar based micro pumps for 0.1 hp.
- A joint report was prepared in collaboration with industry on ways to increase daily water output of a solar water pumping system using bifacial PV modules.

10.1.10 OPTIMIZATION OF SOLAR PHOTOVOLTAIC BASED WATER PUMPING PERFORMANCE WITH DC MOTOR

The project was accepted in December 2021 in Science and Engineering Research Board – Teacher's Associateship for Research Excellence (SERB TARE) 2021 under Collaborative Research with Vel-Tech University, Chennai. Optimization studies for solar photovoltaic based water pumping with DC motor were carried out during the year:

- Preliminary readings from the performance test of solar pumping system under indoor and outdoor conditions were analyzed and processed towards the preparation of manuscript for journal submission.



- The characteristics of each component in solar based water pumping system were analyzed and found out to control or find the best operating condition of pump with reference to radiation level.
- Detailed layout for submersible pump test rig is under finalizing.

10.1.11 ATMOSPHERIC WATER GENERATOR USING DESICCANTS FOR GENERATION OF PURE WATER FROM AIR

Project aims to develop a lab-scale prototype for generating potable water from air using desiccants. The proposed model will use an evacuated solar air heater as heat source and desiccant shall be integrated in the system such that maximum surface area of desiccants is exposed to the air flow inside the solar air heater. This will help in improving the charging and discharging efficiency of the desiccant. During the year initial lab models were designed and developed for testing.

10.1.12 DEMONSTRATION OF SOLAR POWERED HEAT PUMP WITH THERMAL ENERGY STORAGE BACKUP FOR SPACE HEATING AND COOLING AT NISE, GURUGRAM

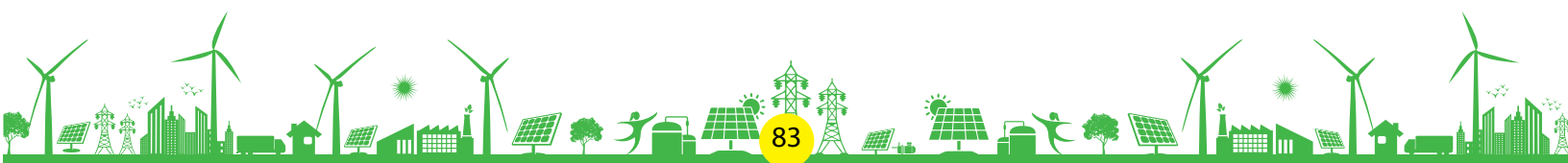
NISE has taken up a demonstration project to showcase the potential of a solar-powered heat pump for customized heating/ cooling solutions, with thermal energy storage for use during non-sunshine hours. NISE worked towards system designing, installation, commissioning, data collection and analysis of the system. A 3 TR heat pump unit was installed to provide space heating/ cooling for a conference room and an occupant room, totalling 150 m³ in the Aditya Bhawan building of NISE. The system is powered by a 10 kWp solar PV connected to a five hp solar variable frequency drive (VFD). A 10,000 L storage tank was also part of the system, which provides 350 MJ of storage capacity as hot/cold water. Three 2TR water cooler indoor units were installed, two in the conference room and one in the occupant room, to study the system's performance. During the year data collection and various analysis of the system was carried out.



Fig 10.4: (Left) Heat pump outdoor unit with thermal storage tank and (Right) indoor unit of heat pump

10.1.13 GREEN HYDROGEN

NISE has a dedicated Hydrogen Energy and Fuel Cell Division to carry out R&D in Hydrogen generation, dispensing and Fuel Cells. NISE campus has a solar PV-based green Hydrogen generation cum storage and dispensing facility that was set up under MNRE funded project. The facility comprises an alkaline electrolyser of 5 Nm³/hr Hydrogen production capacity, a two-stage reciprocating compressor to raise the pressure of Hydrogen up to 450 bar, a high-pressure Hydrogen storage tank of about 60 kg capacity and an H35 hydrogen dispenser which can dispense hydrogen at 350 bar to the vehicles @1 kg/min. This facility is powered by a 120 kWp SPV system installed on the roof of one of the buildings of NISE. This is India's first solar-based Green Hydrogen-generating facility.



During the year, augmentation of Hydrogen production capacity was undertaken by procuring an additional 10 Nm³/hr alkaline electrolyser, as shown in **Fig. 10.5**. NISE's total Hydrogen production capacity would be 15 Nm³/hr (about 1.35 kg/hr) when both electrolysers become operational. The new electrolyser had been delivered at the NISE Hydrogen facility and is being integrated with the existing facility.



Fig. 10.5: (Left) Solar PV based Green Hydrogen production-cum-dispensing facility at NISE (Right) Installation of new electrolyser at NISE Hydrogen generation facility

10.1.14 TESTING & STANDARDIZATION

(a) Testing - Solar Photovoltaic Testing Facility (Pvtf)

10.1.14.1 Advanced Solar Cell Characterization Facility

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.

The lab uses instruments for measuring textured and thin film solar cell optical constants. The facility has equipment for Automatic single and multi-point mapping of sheet resistance and resistivity of silicon wafers and solar cells, measuring film thickness, roughness and 2- dimensional stress, surface texture, laser ablation and LBSF microstructure analysis of front side metallisation. The facility is also capable of measuring the optical, morphological, and electrical properties of silicon wafers and solar cells. The laboratory has the capability of doing testing as per the following standards:

- **IEC 60904-1:2020 - Photovoltaic devices - Part 1:** Measurement of photovoltaic current-voltage characteristics.
- **IEC 60904-7: 2019 - Photovoltaic devices - Part 7:** Computation of the spectral mismatch correction for measurements of photovoltaic devices.
- **IEC 60904-8: 2014 - Photovoltaic devices - Part 8:** Measurement of spectral responsivity of a photovoltaic (PV) device.

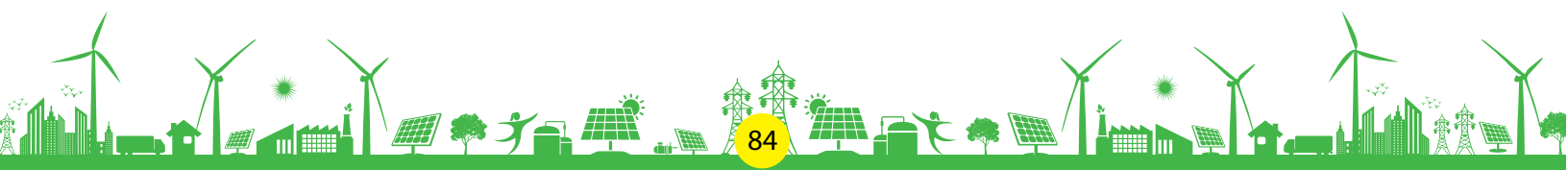




Fig. 10.6: Advanced Solar Cell characterization laboratory with ISO class 8 clean room facility at NISE

10.1.14.2 PV Module Testing Laboratory

NISE has a National Accreditation Board for Testing & Calibration Laboratories (NABL) accredited PV module testing laboratory as ISO/IEC 17025:2017. The facility is also recognised by Bureau of Indian Standard (BIS) for PV Module Testing as Type 2 category facility. At present the lab is NABL accredited for following test 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
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 and IEC 61701:2020	Salt mist corrosion testing of photovoltaic (PV) modules
IEC 61853-1	Photovoltaic (PV) module performance testing and energy rating - Part 1: Irradiance and temperature performance measurements and power rating
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

NISE also offer testing of PV module as per following standards and test specification (NABL accreditation under process) :

- IEC 61853-2: 2016 - Photovoltaic (PV) module performance testing and energy rating - Part 2: Spectral responsivity, incidence angle and module operating temperature measurements.
- IEC 61853-3:2018 - Photovoltaic (PV) module performance testing and energy rating - Part 3: Energy rating of PV modules.
- IEC 61853-4:2018 - Photovoltaic (PV) module performance testing and energy rating - Part 4: Standard reference climatic profiles.
- Performance and reliability of module cleaning device as per in-house developed testing procedure.
- Light induced degradation (LID) testing and Light and elevated temperature-induced degradation (LeTID) testing of PV module as per the standard and customer requirement.
- Climate specific model based accelerated testing of PV module to evaluate the module performance & reliability under harsh climatic conditions.
- Testing of new and innovative products as per the customized testing procedure.

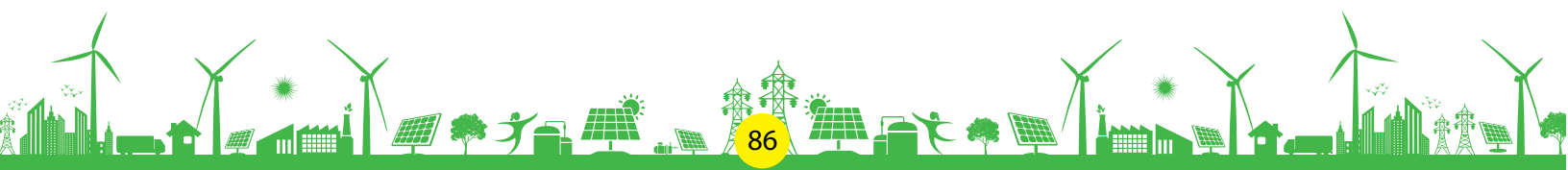
This laboratory has taken up various R&D activities to analyze the performance and reliability of PV modules in indoor and outdoor conditions. During this year, the laboratory has upgraded its facilities with addition of Impulse voltage tester, Ignitability test facility, Peel test facility as per IEC 61730-1,2. The lab is in the process of obtaining NABL accreditation for calibration of reference module as per IEC 60904-4 and characterization of solar simulator as per IEC 60904-9 standard.



Fig. 10.7: Solar Photovoltaic Testing Facility (PVTF) at NISE

10.1.14.3 Power Electronics Laboratory

Power Electronics Laboratory (PEL) at NISE is an NABL accredited laboratory as per ISO/IEC 17025: 2017. The lab is equipped for testing of all types of power conditioning units (PCUs) up to 100 kVA including hybrid, standalone, Grid-tied inverters (GI), and Pump Controllers. The facility is also recognized by BIS for IS 16169: test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters. The lab under takes the following NABL accredited tests as per IEC/IS standards:



Standard No.	Details
IEC 61683:1999	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
IS 16169/ IEC 62116:2008	Test procedure of islanding prevention measures for utility - interconnected photovoltaic inverters
CEI IEC 61727:2004	Photovoltaic (PV) systems - Characteristics of the utility interface
IS16797:2019/ IEC 62509:2010	Battery charge controllers for photovoltaic systems - Performance and functioning of the charge controller
EN50530:2010	Overall efficiency of grid connected photovoltaic inverters
IEC 60068-2 -1: 2007	Environmental test A: Cold
IEC 60068-2 -2: 2007	Environmental test B: Dry heat
IEC 60068-2 -14:2009	Environmental test N: Dry heat change of temperature
IEC 60068-2 -14:2005	Environmental test Db: Damp heat cycle

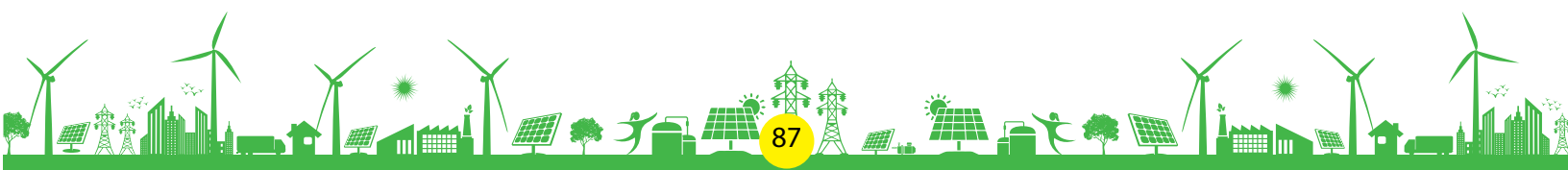


Fig. 10.8: Power Electronics Laboratory setup at NISE

10.1.14.4 Battery Test & Characterization

Battery Test & Characterization at NISE is an NABL accredited laboratory and is involved in testing the performance, reliability and life cycle of major secondary battery storage technologies, including Lead-acid, Nickel-Cadmium and Lithium-Ion Batteries. The laboratory is equipped with the latest technologies like deep cycle battery testers, a programmable power supply, advanced hardware and software, a data logger, and a temperature-controlled water bath. The laboratory is also recognised by BIS for IS 16270: 2014- secondary cells and batteries for solar photovoltaic application general – requirements and methods of test services. The lab under takes the following NABL accredited tests as per IEC/IS standards:

Standard No.	Details
IS 16270:2014	Secondary cells and batteries for solar PV application- general requirements and methods of test
IS 1651:1991	Stationary cells and batteries, lead acid type (with plante positive plates)
IS 13369:1992	Stationary lead acid batteries (with Tubular positive plates) in Monobloc Containers



Standard No.	Details
IS 15549:2005	Stationary Valve Regulated Lead Acid Batteries- Specification
IEC 61427	Secondary cells and batteries for PV energy systems- General requirements and methods of test
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)



Fig. 10.9: Battery Test & Characterization Laboratory setup at NISE

10.1.14.5 Advanced SPV System & Lighting Laboratory

Solar Photovoltaic (SPV) and Lighting laboratory at NISE is a well-established lab for performance and reliability testing of off-grid solar applications. The laboratory is equipped for testing as per below IEC/IS standards (NABL accreditation under process):

- IES LM-79-08/IS 16106: 2012 - Method of Electrical and Photometric Measurements of Solid-State Lighting products
- Testing of solar lighting systems as per MNRE specifications

The lab has upgraded its test facility for testing the remote monitoring system of solar lighting system and is also equipped to carried out test of solar lighting system as per customer specification.



Fig. 10.10: Advanced SPV system & lighting laboratory at NISE

10.1.14.6 Solar Water Pump Test Facility

NABL accredited Solar Water Pump (SWP) Laboratory at NISE is well-equipped, fully-automated, state-of-the-art testing facility for conducting performance testing of PV based water pumps against national and international standards/guidelines. In order to cater the futuristic demands for high powered solar water pumps in India, the test facility has been upgraded for testing of up to 50 hp solar water pumps. The facility is equipped with the latest test equipment and can cater to testing of all available major pump systems including submersible, surface, AC and DC systems. The laboratory has also tested various SWPs under innovative Distributed Renewable Energy (DRE) solutions for rural livelihood applications.

The lab undertakes the following NABL accredited tests as per IEC/IS standards:

Standard No.	Details
MNRE guidelines on testing procedure for solar photovoltaic water pumping systems	Annexure – I, II and III of circular no. F. No. 41/3/2018-SPV division dated 17.7.2019
	MNRE specification for Solar PV water pumping systems for micro pumping application (2016-2017)
	MNRE test methods for SPV water pumping systems (2014-15)
IEC 62253	Performance measurements of photovoltaic (PV) pumping systems in stand-alone operation
IS 17429:2020	Solar Photovoltaic Water Pumping Systems - Testing Procedure – Guidelines
IS 17018: Part 1 2018 [RD: IS 9283:2018, IS 3043:1987, and IS 9079:2018]	Solar photovoltaic water pumping systems - Centrifugal Pumps.

NISE also offer testing of solar PV water pumps as per following standards and test specification:

- MNRE specifications no. 32/645/2017-SPV of KUSUM Programme specifications and testing procedure for solar water pumping systems.
- MNRE test methods for SPV water pumping systems (2015-16) & (2017-18).



Fig. 10.11: Solar Water Pump Test facility for up to 50 hp at NISE

the reproducibility of LeTID testing is within $\pm 1\%$ of maximum power (P_{MP}). Overall, this work has helped inform the creation of a forthcoming standard technical specification for LeTID testing of PV modules, IEC TS 63342 ED1.

10.1.15 SKILL DEVELOPMENT AND CAPACITY BUILDING

NISE extends capacity-building opportunities for skilling up young minds through national and international training programmes. The organisation empowers aspirants by conducting skill development programmes, training, short-term courses, client specific courses related to solar energy technologies. NISE organised various technical training programs for both national and international participants. The main objective of these programs is to provide the basic know how about the solar energy technologies at the same time take this as a platform to impart awareness about the solar energy technologies.

As on December 2022, various skill development & capacity building activities conducted by the NISE are as follows:

- 95 *Suryamitra* batches allocated for conducting *Suryamitra* program funded by MNRE for the FY 2021-22.
- Organized 05 number of training programs for the various private and public sector companies and trained 213 participants. 12 more training programs are proposed from December to March 2023 for national level participants.
- Organized one ITEC program (Physical mode) and two E-ITEC programs (online mode) funded by Ministry of External Affairs (MEA). A total of 95 international participants have undergone the training.
- 3 months long special ITEC program is ongoing from 10th November, 2022 for Mongolian rural women, under which 28 women participants from rural Mongolia are undergoing training.
- 2 more ITEC programs (physical mode) are scheduled to be organized till 31st March, 2023
- Under ISA fellowship program 3rd and 4th batch are ongoing at IIT-Delhi with 5 and 19 ISA fellows in 3rd and 4th batch, respectively.

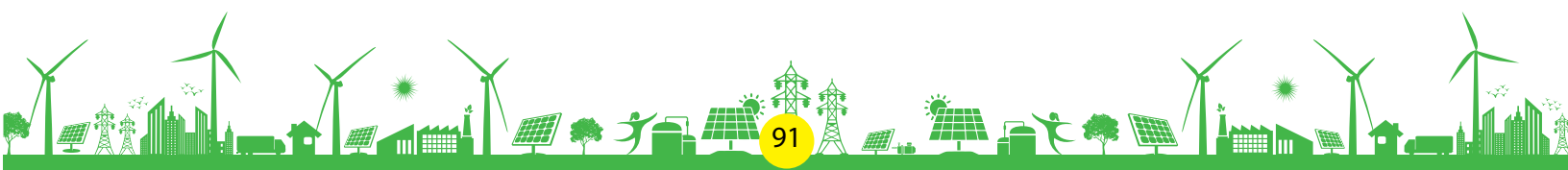
10.1.16 OUTREACH ACTIVITIES

10.1.16.1 Approved List for Models and Manufacturers (ALMM)

To ensure reliability of Solar PV products and to protect the consumer interests and ensure better energy security of the country, MNRE on 02.01.2019, has issued "Approved Models and Manufacturers of Solar Photovoltaic Modules (Requirements for Compulsory Registration) Order, 2019". The order provides for the enlistment of eligible models and manufacturers of solar PV cells and modules complying with the BIS Standards and publishes the same in a list called the "Approved List of Models and Manufacturers" (ALMM). Only the models and manufacturers included in this list will be eligible for use in Government/ Government assisted Projects/ Projects under Government Schemes & Program, installed in the country, including Projects set-up for the sale of electricity to the Government. NISE had been designated as an implementation support agency for processing applications and carrying out inspections, verifications, and quality checks on behalf of MNRE.

10.1.16.2 Technical Consultancy Services

NISE offers various consultancy services pertaining to all domains of solar energy technologies, such as Solar Photovoltaic, Solar thermal, Green Hydrogen, and balance of systems. The division provides specialised technical services to stakeholders, i.e., facility owners, investors, financial institutions, armed



forces, banks, etc., for various aspects of solar project implementation and performance mapping. During the year, NISE has offered consultancy services on field level inspection and field testing for various solar projects. Due diligence studies were carried out on a specific block of Solar PV power plant at the Pavagada Solar Park, Karnataka. NISE is also providing technical support to Solar Energy Corporation of India (SECI) for development, validation and implementation of qualitative requirement and acceptance test procedures for setting up of 3000 MW per annum cells and module manufacturing facility in India.



Fig. 10.13: Testing Services by NISE Technical Team at Roof Top Solar PV power plant, Manesar

10.1.17 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 41 sanctioned regular scientific, technical and administrative posts. The Governing Council approved the Rules in its 3rd meeting on 6th April, 2015.

The Institute is implementing the Right to Information (RTI) Act, 2005, as per the guidelines issued by the Department of Personnel and Training, Central Information Commission and Ministry of Home Affairs. The procedure/other details regarding seeking information under the RTI Act are available at the Institute's website www.nise.res.in.

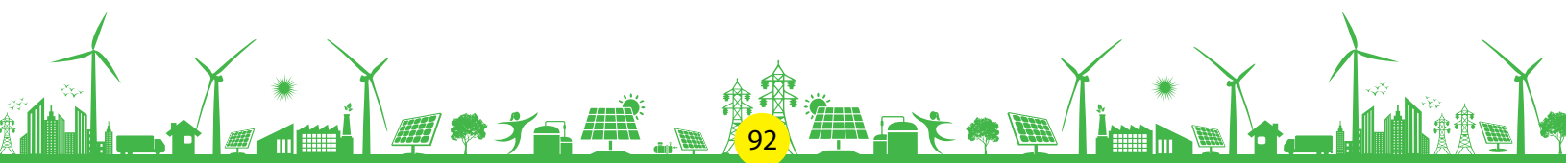
10.2 NATIONAL INSTITUTE OF WIND ENERGY (NIWE)

10.2.1 National Institute of Wind Energy (NIWE) is a technical arm of the Ministry for the smooth development of the wind energy sector in the country. 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:

10.2.2 OFFSHORE WIND DEVELOPMENT

Marine Spatial Planning for Offshore Wind Farms in Tamil Nadu

Marine Spatial Planning (MSP) for offshore wind projects off the coast of Gujarat and Tamil Nadu were carried out as joint initiatives between India and Denmark for planning and de-risking of the first offshore wind farms in India. Under MSP, the screening of offshore zones was carried out considering various key



factors such as wind speed, water depth, marine traffic, oil blocks, Environmentally sensitive zones, etc. with an objective to prepare Levelized Cost of Energy (LCOE) Heat maps. The aim was to arrive at the best possible use of the offshore zones for offshore wind farm development in an efficient, safe and sustainable way. Based on the MSP report, the best suitable offshore sites for initial offshore wind projects have been identified.

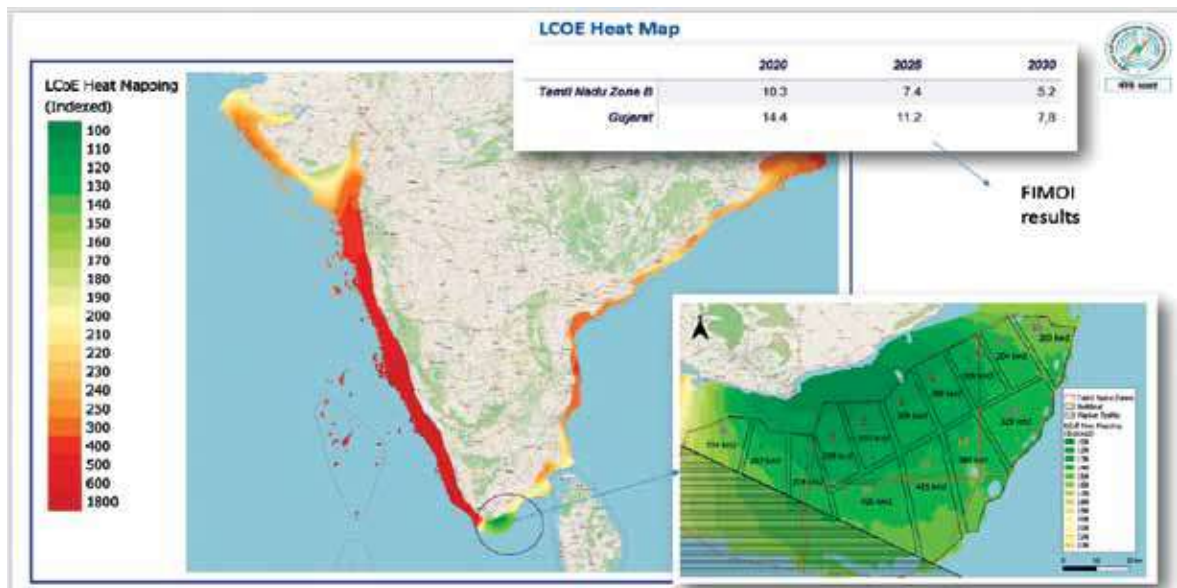


Fig. 10.14: LCOE Heat Map of offshore zones off Tamil Nadu Coast

Port Infrastructure Study

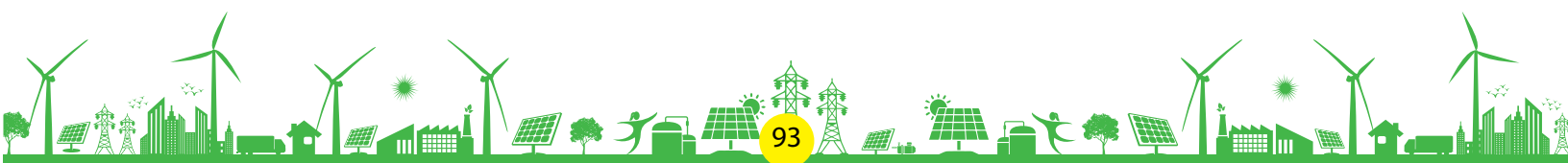
A study with collaboration of Denmark Energy Agency (DEA) was carried out to investigate existing port and terminal infrastructure, around the identified offshore wind sites in the coastal regions of Tamil Nadu and Gujarat with respect to the specific needs of offshore wind. Four ports in Gujarat and five ports along the Tamil Nadu coast were screened for suitability for offshore wind farm. Based on the report, Pipavav and Hazira Port for Gujarat offshore wind zones and Tuticorin and Vizhinjam for Tamil Nadu offshore zones are the best suitable ports for offshore wind development off respective States.



Fig. 10.15: Ports screened for offshore farm off T N coast



Fig. 10.16: Ports screened for offshore wind farm Gujarat coast



Launch Event of Marine Spatial Planning report and the Port Infrastructure Study Report

The Marine Spatial Planning report and the Port Infrastructure Study Report were launched on 23rd November, 2022 at Chennai in the presence of Shri T Mano Thangaraj Honourable Minister of Information Technology and Digital Services of Govt. of Tamil Nadu, H.E. Freddy Svane, Ambassador of Denmark to India and Shri Dinesh D. Jagdale, Joint Secretary (Wind), MNRE, for the benefit of the stakeholders.



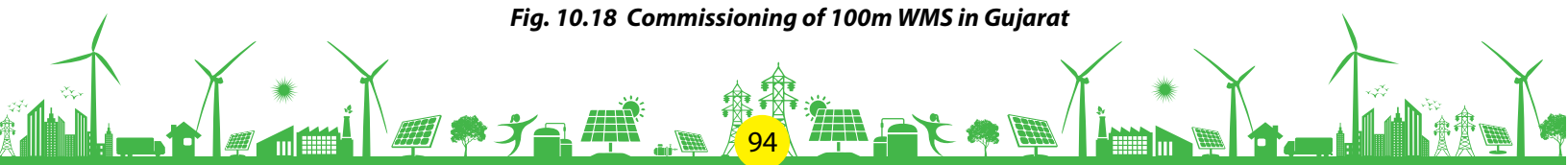
Fig. 10.17: Launch Event of Marine Spatial Planning & Port Infrastructure Reports

10.2.3 WIND & SOLAR RESOURCE MEASUREMENTS

Wind Resource Assessment (WRA) program data is being used widely to identify the potential site for establishment of wind farms in the country. Under this program of the Ministry, 913 dedicated wind monitoring stations & 127 dedicated Solar Radiation Resource Assessment stations have been established with the support of State Nodal Agencies & other institutions. As on 31.12.2022, 43 nos. of Wind monitoring stations and 17 nos. of Solar Radiation Resource Assessment stations are operational. Further, during the current year, 21 sites have been registered for wind measurement by private sector from various States in India.



Fig. 10.18 Commissioning of 100m WMS in Gujarat



'Carbon Neutral' Ladakh

To assess the wind power potential of Ladakh & Kargil region towards the development of wind power projects, NIWE had installed a 3 nos. of 100 m WMS and 2 nos. of SRRA station at Ladakh and data collection from these stations / sites are underway.

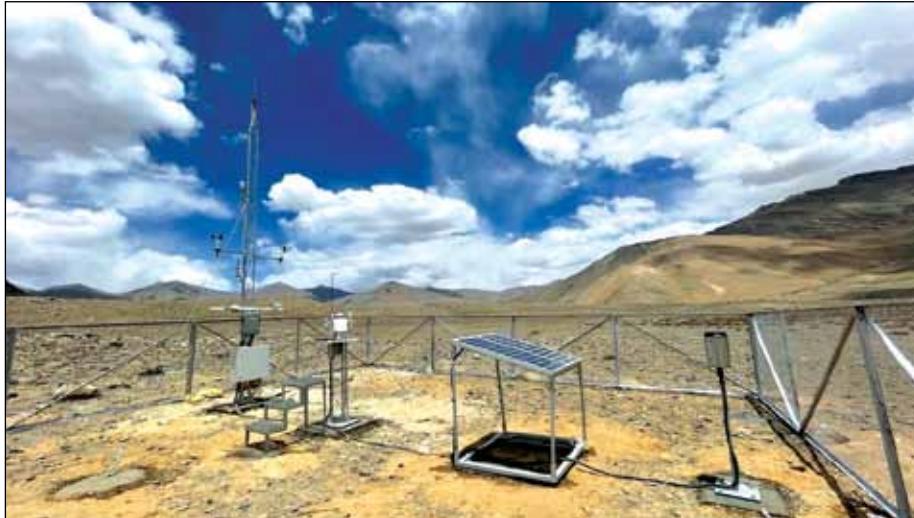


Fig. 10.19 : Solar Radiation Resource Assessment station installed at Debring, Ladakh

10.2.4 WIND TURBINE TESTING STATION (WTTS) AND 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 Turbines. The testing facilities are certified as per the requirements of ISO 9001:2015 and accredited as per the requirements of ISO / IEC 17025:2017. In the FY 22-23, testing of 4 models were in progress.

With the horizon opening for the Offshore Wind Turbine in India, efforts to establish India's first Test Centre for Offshore Wind Turbines at Dhanuskodi, Rameshwaram district, Tamil Nadu are underway for which NIWE along with DTU & DEA of Denmark under the INDEP program had had organized a External Stakeholders workshop on 13th October, 2022 at NIWE, Chennai to understand Industry needs.



Fig. 10.20: Stakeholder meeting for Setting Up of Offshore Wind Test Cum Research Centre at Dhanuskodi & Chennai



10.2.5 MEMORANDUM OF UNDERSTANDING (MoU)



Fig. 10.21: MoU inked between NIWE and ORE-Catapult

10.2.6 STANDARDS AND CERTIFICATION

NIWE is involved in the preparation of Indian Standards on wind turbines by supporting Bureau of Indian Standards (BIS). During the period (from 1st April, 2022 to 30th November, 2022), one Indian Standard has been finalized and accepted by BIS. 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 (QCI). During the year, NIWE has completed one project each in Certification of Wind Turbine, Verification of Wind Turbine components/accessories and Inspection of wind turbine components.

10.2.7 TRAINING COURSES

NIWE has conducted five numbers of customized training courses for National clients on “Basics of Wind Turbine Foundation” and “Wind Turbine Technology and Applications” for M/s Sembcorp Green Infra Ltd., M/s. NTPC Limited, M/s. NPTI, M/s. Renew Power Pvt. Ltd., and M/s. Nordex Engineering & Technology Pvt. Ltd and trained 104 participants.

NIWE has conducted 02nd International Online Course on “Wind Turbine Technology” with 23 participants from 12 ITEC countries and 03rd International Online Course on “Wind and Solar Resource Assessment” with 14 participants from 11 ITEC countries, sponsored by Ministry of External Affairs, Government of India. The following three International training courses under ITEC are scheduled to be held during February - March 2023. (1) “Wind Turbine Technology and applications”, (2) “Wind Resource Assessment and Wind Farm Planning” and (3). “Solar Resource Assessment and Development of Solar Power Plant.”



Fig. 10.22: M/s. Nordex Engineering & Technology Pvt. Ltd

10.2.8 AZADI KA AMRIT MAHOTSAV

NIWE with the support of MNRE has conducted 07 events of Azadi Ka Amrit Mahotsav to commemorate the 75 years of India's independence during the financial year 2022-23.

10.2.9 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 a total of 5,734 trainees out of which 3660 technicians plus 1350 site surveyors are to be trained in wind power plants with the support of 690 Training of Trainers and 34 Assessors through 22 identified institutions located close to the Wind Farms of windy States.

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

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 this year, the Institute has taken up key initiatives to further extend R&D activities in bio-energy and bioproducts. The research findings have been published in reputed journals of the frontier bioenergy area. The Institute has also successfully conducted training programmes on advancement in renewable energy and biogas technology. Furthermore, the Institute participated in all technical programs and meetings of MNRE, particularly related to bioenergy sector for activities such as recent research developments, strategy and policy, progress and dissemination of knowledge and technology in the area. The activities taken during the FY 2022-23 are given as under:

10.3.1 RECRUITMENT OF SCIENTISTS AND DG NIBE

Of the 17 vacant scientists post at SSS-NIBE, 11 posts were considered for recruitment in the first phase, of which 8 scientists including scientist D (04 nos.), Scientist C (03 nos.) and Scientist B (01 no) have joined the Institute. Further, a regular Director General appointed through MNRE has also joined the Institute. In continuation, the recruitment drive for hiring of 3 Scientist F is currently under process.

10.3.2 EXTERNALLY FUNDED PROJECTS

SSS-NIBE has awarded three research projects from CPRI, Bengaluru and one project from MNRE for 3 years duration worth Rs. 4.45 crores. The project wise details are as follows:

Project title	Funding Agency	Project Cost	Start w.e.f.	Project duration
Composition analysis of different types of pellets/briquettes received from unknown sources (PI Dr AK Sarma; Co-PI Dr Nikhil Gakkhar)	Central Power Research Institute, MoP	Rs. 37,00,000	Mar 2022	1 year
Complete heating and emission analysis of raw biomass and pellets during combustion(PI Dr Nikhil Gakkhar; Co-PI Dr AK Sarma)		Rs. 66,00,000	Mar 2022	2.5 years

Project title	Funding Agency	Project Cost	Start w.e.f.	Project duration
Complete Ash Analysis of biomass pellets and co-combusted fuels(PI Dr AK Sarma; Co-PI Dr Nikhil Gakkhar)		Rs. 2,70,00,000	Mar 2022	3 years
Densification of agro-waste and assessment for its application in the gasifier(PI Dr Nikhil Gakkhar; Co-PI Dr Sachin Kumar)	MNRE	Rs. 40,45,320	Mar 2022	2.5 years

For these projects, lignocellulosic biomass samples (variety of rice stalk, variety of wheat stalk, mustard stalk, groundnut stalk, bagasse, corn stalk, cotton stalk, saw dust, sweet sorghum, etc. from various parts of Punjab and Haryana have been collected (**Fig. 10.23**). Similarly, biomass samples native to Uttarakhand (wheat stalk, rice stalk, pine etc.) were also collected to determine its burning rate, thermal efficiency etc in end devices. Likewise, 26 different varieties of bamboo species native to the state of Tripura were collected in order to study their potential as fuel source and to study its ash properties. A few equipment sanctioned under these projects have been procured and functional (Automatic Proximate Analyser) and the remaining ones are in the process of procurement (**Fig. 10.24**). Presently, different biomass samples are being mixed and their physico-chemical properties are being studied.



Fig. 10.23: Samples stored in containers, collected from different region of Punjab and Haryana



Fig. 10.24: Automatic proximate analyser (left) and various bamboo species collected from Tripura

10.3.3 ACTIVITIES UNDER THERMOCHEMICAL CONVERSION DIVISION

During the year, the division worked on several funded and in-house R&D projects. The key research areas include biomass-based dryer, biomass characterization, testing of pellets and briquettes and testing on gasifier. The detailed research analysis and findings are discussed below.

10.3.3.1 Design and Development of Biomass Hybrid Dryer

During the year, SSS NIBE developed Biomass Hybrid dryer for drying of vegetables in collaboration with Bharat Heavy Electricals Ltd (**Fig. 10.25**). The dryer was connected with biomass cookstove which provides thermal energy for drying. During the initial testing, drying of Onions, Spinach and Curry Leaves were carried out and which showed positive results. It is planned to take up the work for further commercialization.



Fig. 10.25: Biomass Hybrid Dryer and drying of Onion flakes using bioenergy

10.3.3.2 Biomass Characterization for standardization of pellets and briquettes

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 from the states of Punjab, Uttarakhand, Haryana and Himachal Pradesh. The work was done under the projects and based on the findings, a comprehensive database would be prepared.

10.3.4 ACTIVITIES UNDER BIOCHEMICAL CONVERSION DIVISION

One DST funded and several in-house R&D projects are going on in the division. The key research areas include scale-up of lignocellulosic biorefinery, scale-up for biogas production using thermophilic anaerobic digestion, biogas upgradation to BioCNG etc. The detailed research analysis and findings are discussed below:

10.3.4.1 Exploration of lignocellulolytic enzymes producing thermophiles from hot springs of Western Himalayan region for biorefinery applications

A project funded by DST under the Women Scientist Scheme-B is going on. Several thermophilic bacteria have been isolated from the soil samples collected from hot springs of Western Himalayan Range, Himachal Pradesh. The potential and characterization of these bacteria are going on for its application in lignocellulosic biorefinery.

10.3.4.2 Scale-up of lignocellulosic biorefinery

A design has been finalized to process about 10-15 kg (TS) sugarcane bagasse/ paddy straw for ethanol production per day followed by biogas/ biohydrogen production out of the stillage. The set-up will be fabricated and installed in the campus.

10.3.4.3 Scale-up of biogas production using in-house developed thermophilic consortium THERMI-NIBE V.1

A design has been finalized to process about 100 kg (TS) kitchen/ green waste for biogas production per day using in-house developed thermophilic consortium THERMI-NIBE V.1. The set-up will be fabricated and installed in the Science City once the funds are available.

10.3.4.4 Thermophilic anaerobic consortium enrichment for enhanced biogas/biomethane production

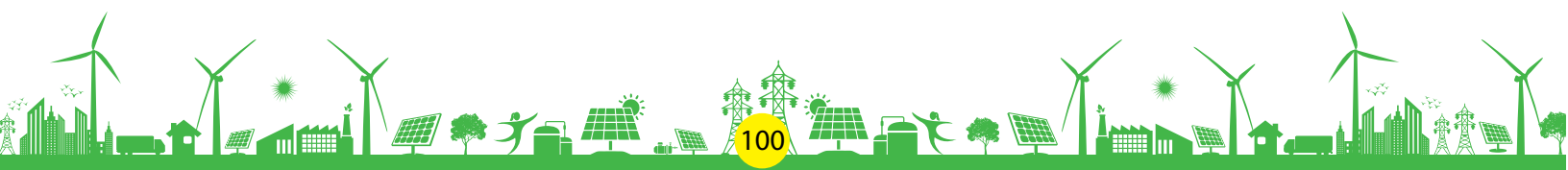
Further enrichment of in-house developed thermophilic consortium THERMI-NIBE V.1 is going on for enhanced biogas/ biomethane production from crop residues and other organic wastes including MSW.

10.3.4.5 Upgradation of Biogas to BioCNG

In this research work, biogas potential of feedstocks i.e., Corn Cob and Corn Stover was studied by using developed consortium. The experiment included Proximate and elemental analysis of the biomass samples. After analysis, lab scale biogas plants were set up for Corn Cob and Corn Stover by using developed consortium providing thermophilic conditions. The work is going on to upgrade the biogas using Microbial Electro-methanogenesis technique to BioCNG for its application in heating and transportation (**Fig. 10.26**).



Fig. 10.26: 50-L Anaerobic digester at SSS-NIBE



10.3.4.6 Process development for fermentative biohydrogen production from organic waste using sequential dark photo fermentation

The work is going on for biohydrogen production from paddy straw and other organic wastes i.e., MSW using sequential dark – photo fermentation. The organic waste which are produced as by-products of dark fermentation are potential substrate for the photo fermentation process, and the combination of both the processes (sequential dark photo fermentation) is a more effective and sustainable approach to attain high yield and high production rate of hydrogen.

10.3.4.7 CNA for Biogas Program

SSS-NIBE has been designated as the Central Nodal Agency (CNA) by MNRE for implementation of Biogas scheme in the country. SSS-NIBE actively participated in the formulation and finalization of standard 'Design, Construction, Installation and Operation of Biogas (Biomethane) Plant - Code of Practice' in collaboration with Bureau of Indian Standards (BIS), New Delhi. The standard is in the final stage of its publication.

10.3.5 ACTIVITIES UNDER CHEMICAL CONVERSION AND ELECTROCHEMICAL PROCESS DIVISION

During this the Chemical Conversion Division and Electrochemical Conversion Division carried following R & D activities:

10.3.5.1 Development of Biomass derived activated carbon for supercapacitor application

This work is focused on synthesizing electro-efficient and sustainable metal-free catalysts to replace noble material essential for the development of future renewable energy conversion and storage systems. In this work, an effective approach for “waste to clean energy” concept-based porous activated carbon from waste rice husk with hierarchical pore architecture for Oxygen evolution (OER) is devised. The physicochemical properties of the synthesized activated Carbon material were examined by XRD, FESEM, and BET analysis. Electro-catalytic performance of the prepared porous activated carbon has been studied which shows good stability towards OER performance (**Fig. 10.27**).



Fig. 10.27: Electrochemical characterization carried out on Electrochemical Workstation in Electrochemical Division at Institute



10.3.5.2 Biomass lignin valorisation

In this work, research is initiated on suitable extraction and processing techniques of lignin to lignin-derived dimers, trimers and other phenolic compounds. The work includes (i) pretreatment of biomass followed by separation of lignin to reduce the crystallinity and complex chemistry of biomass and to produce high purity lignin (ii) advancements in the chemical analysis for precise in-situ lignin characterization during depolymerization. Valorization of lignin via cost-effective and carbon-neutral techniques is envisaged to gain striking opportunities and facilitate modern commercialization.

10.3.5.3 Impact of torrefaction on thermal behaviour of biomass agro residues

This work investigates the physicochemical behaviour of different agro residues and its impact on the thermal behaviour during torrefaction process (**Fig. 10.28**). During torrefaction, significant fraction of hemicellulose and volatile content reduces that improves the high heating value. This treatment improved the fuel properties with elevated torrefaction temperature, including the lower volatile content, higher carbon content, and higher heating value. In addition to that this pre-treatment reduced the activation energy significantly. The results provide important basic data support for the thermochemical conversion of agro residues to energy and chemicals.



Fig. 10.28: Torrefied agro-residue at different torrefaction temperature

10.3.5.4 Extraction of SiO₂ nanoparticles from the agro residue ash

The division also initiated the work on use of biomass residues for silica extraction for obtaining a product with higher added value. The initial testing were carried out to extract SiO₂ Nano particles from Rice straw (PB 126), Industrial coal fly ash, and Biomass fired fly ash (**Fig. 10.29**). The results obtained are positive in nature and it is planned to take it further for commercialization.



Fig. 10.29: Extracted SiO₂ Nano particles from Rice straw (PB 126), Industrial coal fly ash, and Biomass fired fly ash

10.3.6 ACTIVITIES UNDER BIOMASS AND ENERGY MANAGEMENT DIVISION

10.3.6.1 Biomass resource assessment using GIS technology

The division initiated the work on biomass resource assessment of the country. The initial primary and secondary data is collected and tested for its validation. A model is being prepared by considering all the key parameters to forecast the biomass availability throughout the country.

10.3.6.2 Technology outreach and demonstration

Kisan Mela at Punjab Agricultural University (PAU): SSS-NIBE exhibited a strategic stall at the Kisan Mela-2022 (23-24 September, 2022) organized by Punjab Agricultural University, Ludhiana. Kisan mela at PAU was mega event, with participation from farmers, agro-industry and other relevant stakeholders. A team consisting of scientist and RA's represented the institute at PAU Kisan Mela-2022 and showcased the technologies and on-going work. The stall drew a lot of attention among the mela visitors.

A live demonstration of improved biomass cookstoves was organized at SSS-NIBE on 26th -27th September, 2022. This initiative was a result of joint collaboration of SSS NIBE with Jain University, Bangalore. More than 15 different stakeholder organizations/individuals with heat as end-use application visited SSS-NIBE for the demonstration including people from Gurudwaras, sweet shop owners, Rail Coach Factory (RCF), faculty and students from different institutes, industry officials, etc. During the event, the work done on different biomass-to-bioenergy pathways at SSS-NIBE including biogas, ethanol, biodiesel, bio-crude, biochar, pellets etc. was also showcased.

10.3.6.3 Development of Standards for Densified Biomass Products in Indian Context

SSS-NIBE contributed as a knowledge partner in developing standards and guidelines for biomass briquette/pellets, which was anchored by Administrative Staff College of India, Hyderabad on behalf of MNRE and GIZ. This activity was taken under IGEN Access-II, a bilateral cooperation project between India and Germany, with an objective to improve energy supply in the rural areas. The draft standards and guidelines have been prepared based on multistakeholder discussion. SSS-NIBE is also working as Sub-Committee member under SAMARTH Mission of Ministry of Power.

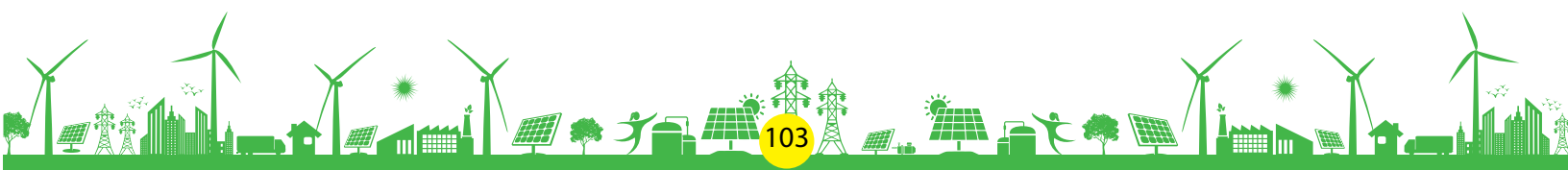
10.3.7 PUBLICATIONS

During 2022-23, 19 publications across various journals, conferences, books, etc. were brought out by scientists working in the Institute.

10.3.8 PATENTS

During the year, the Institute published two patents in the field of biochemical conversion. The details of published patents are:

- Sachin Kumar, Meenu Hans, Richa Singh, Nidhi Sahni and Pratibha Dheeran, Method of producing biogas from lignocellulosic biomass; (Application No.: TEMP/E1/27176/2022-DEL (Ref. No.: 202211024777); Dated: 27.04.2022; Country: India).
- Sachin Kumar, Richa Arora, Nilesh K Sharma and Shuvashish Behera, Simultaneous Saccharification and Co-Fermentation of Paddy Straw for Bioethanol Production; (Application No.: 202211001560; Dated: 11.01.2022; Country: India).



10.3.9 ACADEMIC PROGRAM IN RENEWABLE ENERGY

The institute started an academic course of Masters in Technology (M.Tech) in Renewable Energy, in joint collaboration with Dr B R Ambedkar National Institute of Technology (NIT), Jalandhar during 2020. The first batch of M. Tech program (2020-2022) has successfully completed their course work and all of them have been successfully placed in industry and academics. In the current year, the third batch of M Tech in Renewable Energy for Academic Session 2022-23 was started in August 2022. The students of Academic Session 2021-22 are undergoing M Tech thesis work at NIT-J and NIBE. The students under PhD program on Dr B R Ambedkar National Institute of Technology, Jalandhar also carried out research work for their doctoral work.

10.3.10 TRAINING PROGRAMMES

10.3.10.1 National hands-on training program on “Biogas Technology and its Implementation.”

A five-day “National hands-on training program on “Biogas Technology and its Implementation” was held on October 17-21, 2022 at SSS-NIBE. The aim of this programme was to impart training to Manufacturers of Biogas Plants, Purification Systems, Engines, Gas Flow Meters, Project Developers, Implementers, Consultants, Biogas Aspirants and Start-ups, to various aspects of biogas technology like biogas generation, enrichment, design, Operation & Maintenance, and Policy & Financing to familiarize them with the importance of biogas as a fuel and present status of biogas programme, inter-alia details about how biogas is upgraded to CBG & BioCNG. The programme was also intended for field supervisory functionaries involved in the implementation of biogas programmes. The training program was conducted with 40 participants including M Tech, PhD Scholars, stakeholders from industry, academia etc. The program is attended by participants from all over the country.

10.3.10.2 National Training Program on ‘Renewable Energy Technologies: Recent advancements and Techno-Economic aspects’

A National Training Program on ‘Renewable Energy Technologies: Recent advancements and Techno-Economic aspects’ was organized at the Institute from 28th November to 1st December, 2022. The program was designed to introduce the importance of different applications of renewable energy including solar, wind and bioenergy, off-grid and grid power generation, financing for industrial projects, and techno-economics and policies for renewable energy. Prof. Manoj Kumar, Vice Chancellor DAV University was invited as the chief guest and he delivered the inaugural address on 28th November, 2022. Participants were from diverse backgrounds including state nodal agencies, academia, KVIC, and industry etc.

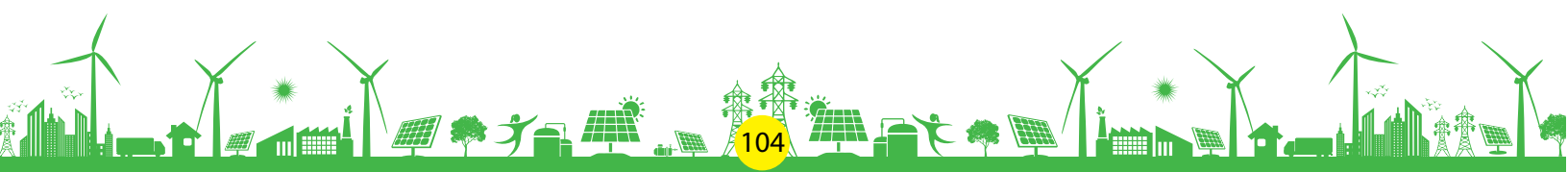
10.3.11 EVENTS ORGANIZED AT THE INSTITUTE

10.3.11.1 National Energy Conservation Day

A webinar was organized by Pushpa Gujral Science City on the event of National Energy Conservation Day-2022 on 14/12/2022. DG NIBE was invited on this occasion to address the student community of Punjab via zoom meeting.

10.3.11.2 Hindi Divas and Pakhwada

The Institute observed Hindi Pakhwada from 14-28 September, 2022. In accordance with the Official Language Act of the Government of India, many events are organized under Hindi Pakhwada for the promotion of the official language “Hindi”. In this 14-day long program, competitions of different genres, such as essay writing, and quiz competition, debate competitions and Kavi Sammelan were organized.



10.3.11.3 Celebration of 76th Independence Day

76th Independence Day was celebrated in the Institute on 15th August. The Director General hoisted the flag on the occasion. On this occasion, about 75+ tree saplings were planted by the employees in the campus.

10.3.11.4 Cyber Jagrookta Divas

The Institute celebrated the first anniversary of 'Cyber Jagrookta Diwas' initiative on 6th October, 2022, as directed by MHA. With the deeper penetration of the internet and the dependence on cyber activities in our daily lives, cyber security has become a major concern. Therefore, to generate more awareness in our institute on cyber hygiene and cyber safety issues an expert talk was organized at the institute. Mr Sanjeev Kumar Gaba, District Informatics Officer/Technical Director, NIC Kapurthala, was invited to deliver the talk.

10.3.11.5 Vigilance Awareness Week

Vigilance Awareness Week was observed/celebrated in the Institute during 31st October, 2022 to 6th November, 2022. In this week following different events were scheduled and performed:

- Quiz Competition
- Debate Competition
- Slogan Competition
- Guest Lecture on vigilance awareness

On this occasion, Sh. R K Verma (Chief Vigilance Officer), Rail Coach Factory, Kapurthala was invited to deliver a lecture on vigilance awareness and all the officials attended and interacted with him.

10.4 SOLAR ENERGY CORPORATION OF INDIA LIMITED (SECI)

10.4.1 INTRODUCTION

Solar Energy Corporation of India Ltd. (SECI) is a Section- 3 Company under the Companies Act, 2013, with 100 percent Government of India ownership, under the administrative control of the Ministry of New and Renewable Energy (MNRE). The company is an implementing and executing arm of Govt. of India for development of Renewable Energy (RE) sector in the country.

10.4.2 BUSINESS ACTIVITIES

10.4.2.1 Tenders for Large-scale Solar projects

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 (PPAs) with the developers and long-term Power Sale Agreements (PSAs) with various DISCOMs for off-take of power, as a power trading intermediary.

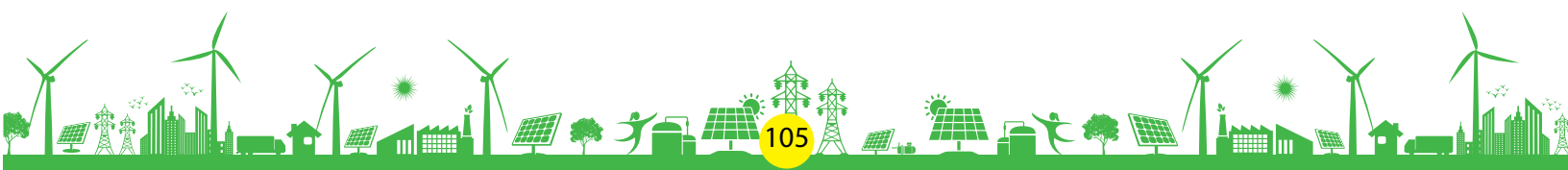




Fig.10.30: 2x300 MW Solar projects in Rajasthan under SECI (ISTS-I) tender

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



Fig. 10.31: 300 MW Solar Project in Jaisalmer, Rajasthan under SECI-IV tender

As on 31.12.2022, the cumulative awarded solar capacity is over 35.676 GW and 3 GW capacity of manufacturing facilities, of this, 12.465 GW capacity of projects have been commissioned (till 31.12.2022).

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.

Cumulative awarded wind capacity by SECI to 13.83 GW (till 31.12.2022), of which, 1.1 GW has been awarded during FY 2022-23 (till 31.12.2022). Of the awarded capacity, 4.75 GW has been commissioned (till 31.12.2022) and balance capacities are under various stages of implementation.

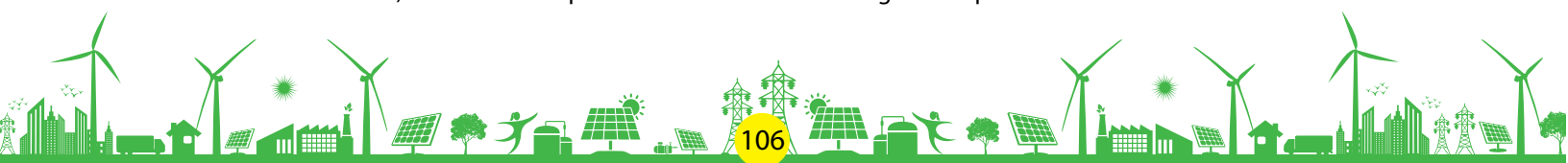




Fig. 10.32: 229.5 MW Wind project in Gujarat under SECI Wind (Tranche V) tender

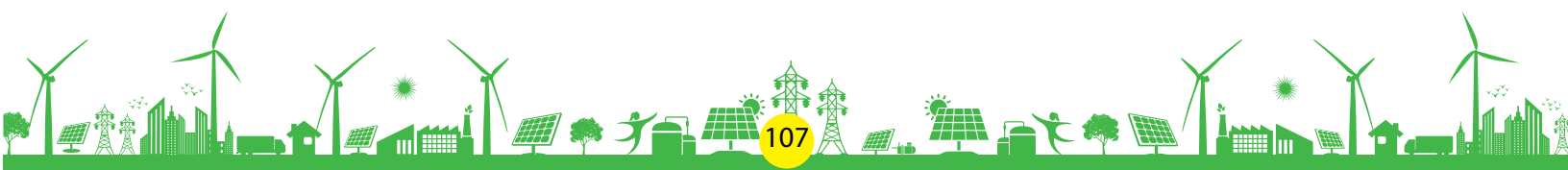
10.4.2.3 Tenders for Hybrid Projects

To cater to off-takers' demand for bringing firmness and flexibility in RE power, SECI has issued tenders with different configurations, viz. Solar-Wind Hybrid, RE with assured supply during peak hours and Round the Clock (RTC) RE, with provision for combination of different RE/energy technologies and/or energy storage, as applicable.

Cumulative awarded capacity in this segment is 6.77 GW (till 31.12.2022), of which 1.17 GW has been awarded during FY 2022-23. Of the awarded capacity, 1.44 GW projects have been commissioned till 31.12.2022.



Fig. 10.33: 600 MW Hybrid Project under SECI Hybrid (Tranche II) tender



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 48 MW has been installed (till 31.12.2022).

In May 2022, SECI signed MoU with Ministry of Home Affairs (MHA) for undertaking installation of Solar Rooftop PV Power Plants in the campuses of Central Armed Police Forces (CAPFs), National Security Guard (NSG) etc. In pursuance of the MoU, in September 2022, SECI has issued a tender for selection of developers for rooftop solar projects.

10.4.2.5 Other Schemes of MNRE for promotion of RE

SECI is also implementing MNRE schemes with the role of disbursement of Central Financial Assistance (CFA) to the implementing agencies based on pre-determined progress milestones. Ongoing schemes are: (a) Solar Parks Scheme; (b) Scheme for Defence Establishments.

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

10.4.2.6 Project Development

SECI develops RE projects through its own investment and offers Project Management Consultancy Services to other Govt. Agencies/PSUs for RE projects.

Operational CAPEX Projects:

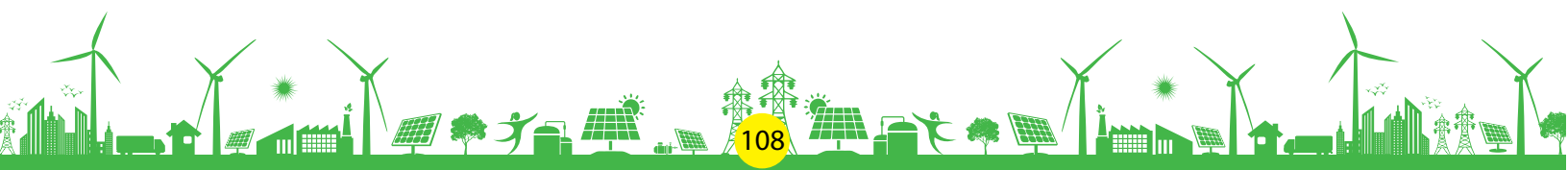
- 10 MW Solar Project in Badi Sid, Jodhpur district of Rajasthan.
- 1 MW Rooftop Solar Project in Andaman & Nicobar Islands.
- 10 MW Solar Project in DRDO Kolar in Karnataka.

Ongoing/Upcoming CAPEX Projects:

- 1.95 MW solar with Battery Storage project in Lakshadweep Islands. Project is under implementation.
- 20 MW Solar with Battery Storage project in Leh under J&K PMDP 2015 Scheme. Project is under implementation.
- 100 MW Solar with Battery Storage in Rajnandgaon, Chhattisgarh. Project is under implementation.
- 1200 MW capacity of solar projects has been allotted to SECI under MNRE's CPSU scheme Ph-II, Tranche- III.
- 100 MW Floating Solar project in Getalsud reservoir, Ranchi in Jharkhand. Project is approved by Govt. of India.

10.4.2.7 13 GW RE project in Ladakh

SECI had identified the site for setting up the Ultra Mega RE project in Ladakh. The project consists of setting up of 9 GW of solar and 4 GW of wind-based generation in the Pang, Debring and Kharnak villages of Leh District. This project will also have 3 GW, 12 GWh of BESS. Total land area of 48,250 acres has been identified.



SECI had awarded the work of detailed aerial topography as well as the work for Environmental and Social Impact Assessment (ESIA) studies for the project area. A transmission system of 5 GW capacity is being planned separately for the evacuation of the generated power.

10.4.2.8 Power Trading

SECI is the intermediary power procurer between developers and off-takers for Solar Wind, Hybrid projects set up through SECI tenders. SECI has a Category-I Trading License from Central Electricity Regulatory Commission (CERC) to carry out power trading on pan-India basis. SECI has signed Power Sale Agreements (PSAs) of 45.133 GW capacity (cumulative, till 31.12.2022) with 35 DISCOMs. In FY 2022-23, the company has traded 25.48 Billion units of RE power (provisional, till 31.12.2022).

10.4.3 NEW INITIATIVES

In line with rapidly evolving RE sector, SECI is foraying into new business areas such as Green Hydrogen & Green Ammonia, Greening Electric Vehicle charging infrastructure, Waste-to Energy, Energy Storage etc. and engaging with relevant stakeholders.

10.4.4 FINANCIAL PERFORMANCE

Highlights of Financial performance for fiscal year 2021-22, with comparative position of the previous year, are mentioned in **Table 10.2**.

Table 10.2: Financial Performance for FY 2021-22

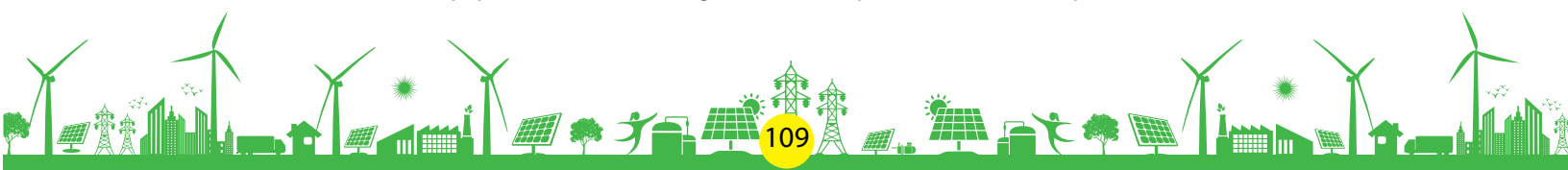
Particulars	Amount (Rs. in crore)		
	FY 2021-22	FY 2020-21 (for comparative reference)	% Increase in FY 2021-22 over FY 2020-21
Net Worth	1060.46	873.58	21.39%
Total Revenue	7310.38	5,464.68	33.78%
Profit Before Tax	319.92	237.59	34.65%
Profit After Tax	240.32	177.71	35.23%

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 2021-22, IREDA has achieved highest-ever loan sanction of Rs. 23,921.06 crore, with a growth of 117.44% over the previous year's sanction of Rs. 11,001.30 crore and highest ever loan disbursement of Rs. 16,070.82 crore registering a record increase of 82.04% over the previous year's disbursement of Rs. 8,828.35 crore. The above said sanctioned loan (includes co-financed projects / takeover loans) would support power generation capacity addition of 3,221.71 MW, RE Equipment Manufacturing of 5,199 MW per annum, Ethanol production of 650 KLPD, 3,000



units of Electrical Vehicles and 1,000 MVA Transmission / Evacuation infrastructure. The sector wise breakup of sanctions and disbursements for the Financial Year 2021-22 and the cumulative achievements as on 31.12. 2022 are given below in **Table: 10.3**.

- (ii) The sector-wise break-up of loan sanctions and disbursements during the Financial Year 2022-23 (up to 31.12.2022) and projected sanctions and disbursements for the period from 01.01.2023 to 31.03.2023 are given in **Table: 10.4**.

Table 10.3: IREDA – Sector-Wise Break-up of Loan Sanctions and Disbursements During FY 2021-22 & Cumulative Achievements

(Rs. in crore)

Sector-Wise Break-up of Loan Sanctions and Disbursements during FY 2021-22			Sector-Wise Break-up of Cumulative Loan Sanctions and Disbursements	
Sector	Sanctions	Disbursements (including previous year sanctions)	Cumulative Sanctions (As on 31.12.2022)	Cumulative Disbursements (As on 31.12.2022)
Wind Power	2,538.90	2,114.38	32,494.31	21,715.71
Hydro Power	2,1610.04	1,195.09	12,754.23	8,275.58
Biomass (including Biogas & Cogeneration)	42.79	16.57	5,596.58	3,603.82
Energy Efficiency & Conservation (including Energy Access)	95.70	77.85	1,381.71	434.51
Solar Energy	4,880.24	3,406.15	40,361.80	21,223.90
Waste to Energy	0.00	107.20	1,083.89	574.17
Biomethanation from Industrial Effluents, Biomass Briquetting & Biomass Gasification			104.37	72.71
National Clean Energy Fund (NCEF)			156.57	127.14
Bill Discounting			181.97	161.76
Bridge Loan			223.86	156.14
Short Term Loan	11,754.26	8,323.15	35,744.14	29,848.86
Guaranteed Emergency Credit Line for MSME	260.10	290.36	470.65	441.72
Electric Vehicles	267.79	35.71	311.48	214.24
Miscellaneous (Guarantee Scheme + Transmission & Evacuation + Ethanol + LoC + Manufacturing + Hybrid Wind & Solar)	1,912.24	504.37	10,446.34	2,686.29
Total	23,921.06	16,070.82	1,41,311.89	89,536.55

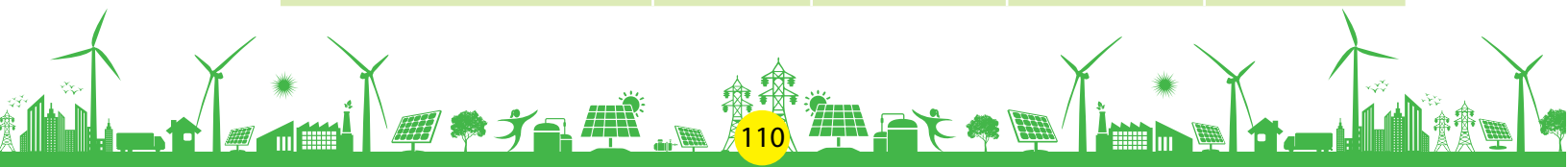


Table 10.4: IREDA Sector-Wise Break-up of Loan Sanctions and Disbursement during Financial year 2022-23 (upto 31.12.2022) and Projections

(Rs. in crore)

Sector-Wise Break-up of Loan Sanctions and Disbursement during Financial year 2022-23 (up to 31.12.2022)			Projected Sanctions and Disbursement from 01.01.2023 to 31.03.2023	
Sector	Sanctions	Disbursements	Sanctions	Disbursements
Wind Power	3,293.47	1,242.66	7,271.80	2,535.16
Hydro Power	1,332.88	1,435.68	4,545.61	4,392.50
Biomass (including Biogas & Cogeneration)	66.04	47.27	773.19	277.67
Energy Efficiency & Conservation (including Energy Access)				1.55
Solar Energy	7,698.46	2,193.80	3,411.33	6,333.05
Waste to Energy	122.60	33.59		62.77
Biomethanation from Industrial Effluents				
Biomass Briquetting				
Biomass Gasification				
National Clean Energy Fund (NCEF)				
Bill Discounting				
Bridge Loan				
Short Term Loan	3,908.00	3,560.65	350.00	950.00
Guaranteed Emergency Credit Line for MSME	4.00	6.19		
Electric Vehicles	43.69	178.53	220.00	229.00
Miscellaneous (Guarantee Scheme + Transmission & Evacuation + Ethanol + LoC + Manufacturing + Hybrid Wind & Solar)	4,320.52	1,649.75		899.00
Total	20,789.65	10,348.12	16,571.93	15,680.70

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 Financial Year 2022-23. The performance of Company has been rated as "Excellent" by DPE for the Financial Year 2021-22.

10.5.4 MOU FOR GREEN ENERGY COLLABORATIONS

During the Financial Year 2022-23, IREDA has entered into Memorandum of Understanding (MoU) with Bank of India for Co-Lending / Consortium Lending for Renewable Energy projects and with Mahatma Phule Renewable Energy and Infrastructure Technology (MAHAPREIT) to provide techno-commercial Consultancy in the field of Renewable Energy

10.5.5 RESOURCE MOBILIZATION

The total Borrowings of IREDA stood at Rs. 27,613.07 crore as on March 31, 2022 as against Rs. 24,000.01 crore in the previous year. During the Financial Year 2021- 22, IREDA has mobilized Rs. 5,810.53 crore from domestic as well as international sources.

Net Worth of the Company increased to Rs. 5,268.11 crore at the end of the Financial Year 2021-22, registering an increase of 75.89% over the previous year's Net Worth of Rs. 2,995.19 crore, which includes equity infusion of Rs. 1,500 crore by the Government of India (GoI). Paid up capital of IREDA is Rs. 2,284.60 crore at the end of Financial Year 2021-22.

10.5.6 INFORMATION TECHNOLOGY

IREDA continues to automate its business processes to ensure transparent systems and reduce human intervention. IREDA has successfully migrated the entire business processes to the cloud environment through Microsoft Office 365 with enhanced security features. The on-going Microsoft Dynamics-365 ERP implementation is expected to further strengthen the automation system and processes. Towards green initiative and paperless environment, centralized scanning solution has been implemented in the Company.

10.5.7 GOVERNMENT SCHEMES

- a. **MNRE Scheme on Production Linked Incentive (PLI-I):** MNRE has designated IREDA as the Implementing Agency for the PLI-I scheme for 'High Efficiency Solar PV Modules'. Letter of Award (LoA) under the scheme have been issued to three companies for an PLI outlay of Rs. 4500 crore. As per the LoA & scheme guidelines, fully integrated solar PV module manufacturing capacities of 8737 MW are scheduled to be commissioned by November / December 2024. The beneficiaries are under different stages of implementation with regard to land acquisition, technology tie up, financial closure etc.
- b. **MNRE Scheme on CPSU Scheme - Phase-II:** IREDA is the Implementing Agency for the VGF Based Bidding (Tranche-III) for Grid Connected Solar Power Projects under CPSU Scheme - Phase-II. IREDA has allocated a total capacity of 6200 MW under Tranche-III of Bidding under the CPSU Scheme (Phase-II) through VGF based Bidding. The successful applicants are required to commission the complete capacity allocated to them, within a 30-month period from the date of Letter of Award (LoA).

10.5.8 HUMAN RESEORCE 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. IREDA has taken several initiatives to promote wellbeing of its employees. The company organized a preventive health check-up for its employees, under the aegis of "Azadi Ka Amrit Mahotsav". The company observed meditation practice on regular basis under guidance of Spiritual Master for the overall holistic evolution of the workforce.

IREDA employees were nominated for several online and offline training programs, including nominations under DPE's Scheme of Research, Development & Consultancies (RDC). IREDA employees were nominated for various leadership programs such as 'Executive Development Program', 'Strategic leadership Program' from premium institutes. IREDA focused on mental and physical wellbeing of the employees by nominating employees for various lifestyle related training programs on 'Mindfulness for Workplace Productivity and Personal Effectiveness', "Managing Stress and Health Issues", 'Yoga through Naturopathy', etc. The women employees were nominated for trainings on, 'Gender equality and Women empowerment' and 'Gender sensitization and Women empowerment' programs conducted by external training agencies.



IREDA also celebrated 'Cyber Jagrukta Diwas' to create cyber awareness and sensitize the officials on safeguarding against cyber frauds and cybercrimes. During the year, the Company aims at achieving a total of 1500 man-days of training.

IREDA celebrated International Yoga Day, Azadi Ka Amrit Mahatosav, Vigilance Awareness Week, Hindi Pakhwada and Women's Day during the years. IREDA observes 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. IREDA provides equal growth opportunities for the women in line with Government of India philosophy on the subject. The Company has Women employees in important and critical functional areas across hierarchical levels. The women are well represented and constitute 26% of the total work force.

As on 31.12.2022, the Company has 158 fulltime employees comprising of 142 Executives and 16 Non-Executives.

10.5.9 CORPORATE SOCIAL RESPONSIBILITY / SUSTAINABLE DEVELOPMENT

As a Socially responsible corporate, IREDA is committed to assist meaningful community development projects in line with its business plans and GoI's vision for the nation's sustainable development and increasing its CSR impact and reach over the coming years.

For the Financial Year 2022-23, a CSR Budget of Rs. 977.83 lakhs was available including the carried forward unspent amount previous years prior to FY 2020-21 and also after adjustment /set off excess amount spent in Financial Year 2020-21. Till 31st December, 2022, total amount of Rs. 855.42 lakhs has been sanctioned and the amount of Rs. 150.95 lakhs has been spent on CSR projects.

Major CSR initiatives of IREDA in Financial Year 2022-23 are: -

- Providing of One Mobile Medical Van as "Therapy on Wheels" at Shimla to M/s. Samphia Foundation, which provides physiotherapy, occupational therapy, and speech therapy to children with disabilities.
- Two medical oxygen generation plants at Siddharathnagar and Deoria, Uttar Pradesh.
- Successful Cochlear implant surgery of 03 Children from EWS category.
- Sanction of total amount of Rs. 527.61 lakhs for aspiration districts at Balrampur, Chandauli and Sonbhadra, Uttar Pradesh

During the Financial Year 2022-23, following activities / projects were undertaken by the Company under its CSR initiatives as shown in **Table 10.5**.

**Table 10.5: CSR Initiatives undertaken by IREDA during the year 2022-23
(1st April, 2022 to 31st December, 2022)**

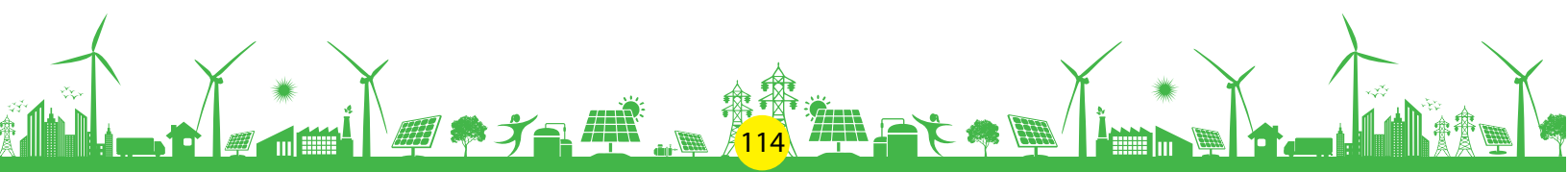
S. No.	Description	Rs. in Lakhs
1	Mobile Medical Van fabrication cost and operational expenses for two Mobile Medical Vans being operated at Shimla and Kullu, Himachal Pradesh.	42.45
2	Supply and installation of 500 LPM Medical Oxygen Generation Plant and 125 kVA Diesel Generator at CHC, Lar, Deoria, Pradesh.	96.97



S. No.	Description	Rs. in Lakhs
3	Providing drinking water and irrigation source by redeveloping / renovating 13 water wells in Undhithal Village, Gogunda Block, Udaipur, Rajasthan.	19.77
4	Supply & installation of 3 kW Solar PV System (off grid) and 50 LPH RO Water vending machine in 65 Government Schools in Chandauli Aspirational District, UP	293.08
5	Providing "Health services promotion of the Menstrual Hygiene in Ghorawal Block in Sonebhadra aspirational district, Uttar Pradesh	30.10
6	Supply and installation of R.O Water Treatment Plants in 23 villages of Vinukonda Assembly Constituency, Palnadu District, Narasaraopet, Andhra Pradesh.	93.25
7	Sanction of financial assistance for Cochlear implant surgery of 3 children from EWS category at Chiranjiv Medical Foundation, Delhi.	20.70
8	Supply & installation of 3 Kw Solar PV System (off grid) and 50 LPH RO Water vending machine (@ Rs. 450890/-) in 7 Government Schools in Jhanjharpur sub-division, Madhubani District, Bihar.	31.56
9	Supply & installation of total 170 kW Rooftop Solar PV System (offgrid) at 10 Government Health Centres at Balrampur aspirational district, Uttar Pradesh.	204.44
10	Supply & installation of 29.10 kW Rooftop Solar PV System (grid connected) at India International Centre, Lodhi Road, New Delhi.	23.10
Total sanctioned amount during the year 2022-23		855.42

Table 10.6: Projected Sanctions and disbursements under CSR from 01.01.2023 to 31.03.2023

Projected Sanctions	Rs. 1.23 crore
Projected Disbursements	Rs. 8.27 crore



CHAPTER 11

SUPPORT PROGRAMMES

11.1 INFORMATION AND PUBLIC AWARENESS PROGRAMME

11.1.1 India stands 4th globally in terms of renewable energy installed capacity including large hydro. 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 To strengthen 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 platforms including Facebook, Instagram, LinkedIn, YouTube, etc., a Social Media Cell 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) Central Bureau of Communication (CBC) (ii) National Film Development Corporation (NFDC); (iii) Doordarshan; (iv) All India Radio (AIR); (v) State Nodal Departments/Agencies for renewable energy; and (vi) 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. During the year, following I&PA activities were developed and implemented under the overall framework of the media strategy for renewables:

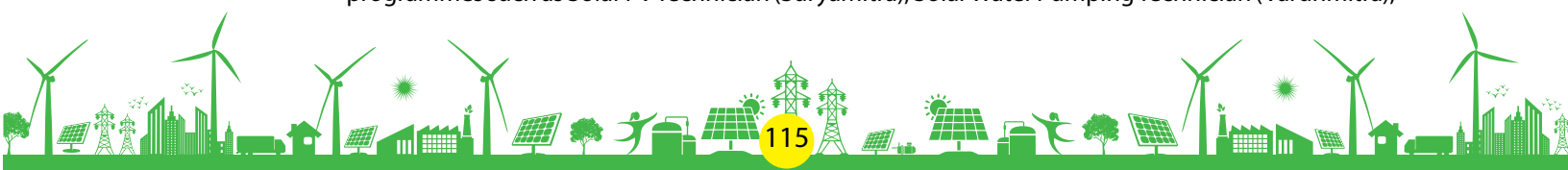
- i. Several events such as webinar, workshop on the Ministry's programmes, schemes, achievements and future plans etc. were organized under Azadi Ka Amrit Mahotsav and posted on social media platforms and also uploaded on the nodal Ministry's portal i.e. Ministry of Culture.
- ii. Logo Support of the Ministry was extended to different events/exhibitions on Renewable Energy.

11.2 HUMAN RESOURCE DEVELOPMENT

11.2.1 Human Resource Development (HRD) scheme of MNRE supports trainings for manpower at all levels including promoting higher studies and research courses by providing Fellowships to students and research scholars in R&D and academic institutions in Renewable Energy. Support is also provided to R&D and academic institutes for up-gradation of their 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 scheme, Skill Development Programmes namely **Suryamitra, Varunmitra, Vayumitra and Jalurjamitra were** launched to train workforce for installation, commissioning, operation and maintenance of renewable energy projects.

Various components of the HRD scheme are as follows:

- a. 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. Skill development programmes such as Solar PV Technician (Suryamitra), Solar Water Pumping Technician (Varunmitra),



- Wind Power Plant Technician (Vayumitra) and Small Hydro Power Plant Technician (Jalurjamitra).
- b. National Renewable Energy Fellowship (NREF) Scheme for pursuing M.Sc./M.Tech/ PhD/ PDF degree courses.
- c. National Renewable Energy Science Fellowship Scheme for eminent scientists working in research institutes with an innovative idea in renewable energy.
- d. Support to higher educational institutions for laboratory upgradation.
- e. National Renewable Energy Internship scheme (NREI).
- f. Renewable Energy Chair

11.2.2 Call for proposals under HRD Scheme.

Human Resource Development Scheme of the Ministry is continued for the period of FY 2021-22 to 2025-26 with the components such as Short-term trainings and Skill Development programmes, fellowships, Internships, support to lab upgradation for RE and Renewable Energy Chair. Proposals have been invited through Advertisement in newspapers from educational, research institutions/training institutions, researchers, reputed NGOs etc. under the various components of the programme. Proposals received under various components are being processed.

11.2.3 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 through ongoing fellowships in 10 selected educational institutions by providing fellowships or stipend under NREF Scheme. The details of institutions supported by MNRE for ongoing fellowships under NREF scheme in 2022-23 are given below in **Table 11.1**.

Table 11.1: Institutions supported by MNRE for ongoing fellowships under NREF programme in 2022-23

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

In Financial Year 2022-23, MNRE continued its support by sanctioning 62 nos. new fellowships, which includes 5 nos. RA/PDF, 24 nos. Ph.D and 33 nos. M. Tech, to students and scholars for pursuing higher studies in 12 selected educational institutions every year till March 2026 under NREF Scheme. The fellowship payments are released through Direct Benefit Transfer (DBT). The list of institutes recommended for fellowship slots is given in **Table 11.2**.

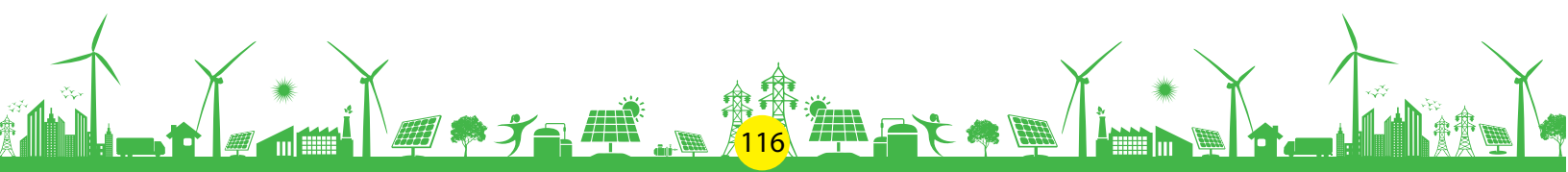


Table 11.2: Details of Institutes selected for providing fellowship slots for the period 2022-23 to 2025-26 (every year)

S. No.	Name of Department/Institute
1	Indian Institute of Technology, Kanpur
2	Department of Applied Sciences and Humanities, Jamia Milia Islamia
3	Centre for Energy Studies, Savitribai Phule University, Pune
4	Indian Institute of Technology, Roorkee
5	CSIR-National Physical Laboratory (NPL), New Delhi
6	Institute for Energy Studies, Anna University, Chennai
7	Cochin University of Science & Technology, Kochi
8	Department of Green Energy Technology, Pondicherry University
9	Department of Energy, Tezpur University
10	National Institute of Solar Energy, Gurugram
11	National Institute of Wind Energy, Chennai
12	National Institute of Bio Energy/NIT Jalandhar

11.2.4 Skill Development Programmes and Trainings

(a) Solar PV Technician (Suryamitra Skill Development) Programme

One of the skill development programmes viz. Solar PV Technician (Suryamitra) training was initiated by the Ministry in 2015 to develop work force to meet the demand of solar energy sector. In Financial Year 2022-23, 376 nos. of Suryamitras were trained and training of additional 7200 nos. of Suryamitras was allocated to National Institute of Solar Energy (NISE), Gurugram, out of which training of 474 nos. of Suryamitras is undergoing. These training programmes are being organized through Training Centres and partner organizations in different states across the country empanelled through Expression of Interest (EoI) floated by NISE. A cumulative number of 51529 nos. of Suryamitras have been trained by December, 2022. The state-wise progress of the Suryamitra programme from FY 2015-16 to 2022-23 is shown in **Table 11.3**.

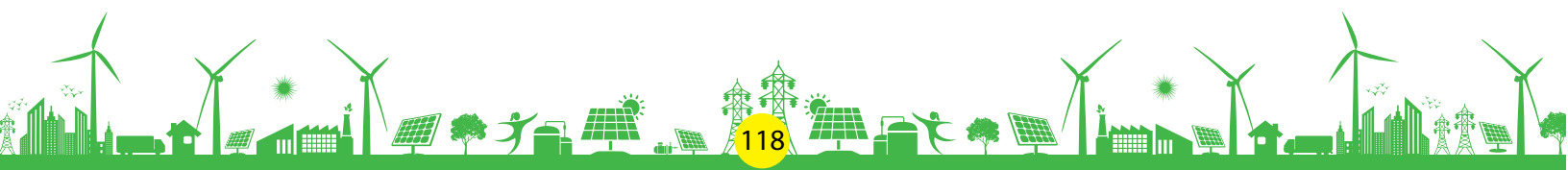
Table 11.3: Progress of Number of Suryamitras trained in different States 2015-16 to 2022-2023

S. No	States/UTs	No. of Suryamitras trained						Total
		2015-16	2016-17	2017-18	2018-19	2019-20	2020-21 and 2021-22 (upto 31.12.2022)	
1	Andhra Pradesh	235	398	211	464	488	219	2015
2	Arunachal Pradesh	30	0	0	0	0	0	30
3	Assam (NER)	30	151	252	400	561	148	1542
4	Bihar	30	402	287	420	568	179	1886
5	Chandigarh (UT)	0	0	58	90	90	0	238
6	Chhattisgarh	90	369	408	360	778	204	2209

S. No	States/UTs	No. of Suryamitras trained						Total
		2015-16	2016-17	2017-18	2018-19	2019-20	2020-21 and 2021-22 (upto 31.12.2022)	
7	Delhi (UT)	50	0	181	201	240	30	702
8	Goa	30	30	54	60	117	30	321
9	Gujarat	297	954	335	550	856	261	3253
10	Haryana	52	121	374	390	480	86	1503
11	Himachal Pradesh	0	36	138	150	120	30	474
12	Jammu and Kashmir (UT)	26	0	60	158	306	146	696
13	Jharkhand	0	152	185	180	269	60	846
14	Karnataka	90	420	513	348	363	79	1813
15	Kerala	57	176	120	142	240	90	825
16	Ladakh (UT)	0	0	0	0	0	30	30
17	Lakshadweep (UT)	0	0	30	0	0	0	30
18	Madhya Pradesh	269	492	597	1164	1616	535	4673
19	Maharashtra	660	829	561	883	1275	206	4414
20	Manipur (NER)	30	30	30	60	0	0	150
21	Meghalaya (NER)	0	0	0	0	0	30	30
23	Nagaland (NER)	30	0	30	0	0	0	60
24	Orissa	0	931	268	567	511	180	2457
25	Puducherry (UT)	0	62	0	0	0	0	62
26	Punjab	30	32	141	120	84	27	434
27	Rajasthan	53	581	597	775	1116	351	3473
28	Tamil Nadu	122	436	672	912	1132	249	3523
29	Telangana	90	274	600	950	1401	406	3721
30	Tripura (NER)	60	0	28	60	30	0	178
31	Uttar Pradesh	185	664	795	964	1604	548	4760
32	Uttarakhand	60	311	78	231	263	89	1032
33	West Bengal	0	556	564	1313	1566	150	4149
	Total	2606	8407	8167	11912	16074	4363	51529

(b) Vayumitra Programme :

Ministry of New & Renewable Energy, Government of India has launched “Vayumitra Skill Development Program (VSDP)” to create skilled workforce for the operation & maintenance of wind farms in the country. National Institute of Wind Energy (NIWE), Chennai has been assigned as the nodal agency to implement this programme. A total of 5734 trainees out of which 3660 electrical and mechanical technicians plus 1350 site surveyors are to be trained with the support of 690 Training of Trainers and 34 Assessors. NIWE



has provisionally selected 13 Institutions through Expression of Interest to roll out Training of Participants (ToP) programme to train participants. The content Development for Facilitator Guide for Trainers and Participants Hand Book is under preparation through National Instructional Media Institute (NIMI). The first two batches of 12 days Training of Trainers (ToT) programme will commence on 2nd January, 2023. A special Web Portal for VSDP is developed to manage the programme in an effective and transparent manner.

(c) Jalurjamitra Programme:

Ministry launched Jalurjamitra Skill Development Programme with the objective to develop more than 1600 skilled and employable workforce (Jalurjamitras) for Small Hydro Projects by the year 2025-26 for the country. The programme is coordinated and managed by Department of Hydro and Renewable Energy (HRED, IIT Roorkee. Five (5) nos Training Centres were selected through an expression of Interest (EoI) to impart training under Jalurjamitra skill development program. The first Training of Trainer (ToT) programme is scheduled to be held at HRED IIT Roorkee during January 18 - 28, 2023. A second round of EoI has been issued for other potential States Bihar, UT J&K, Kerala, UT of Ladakh, Maharashtra and Nagaland, Punjab, and Uttarakhand.

11.2.5 National Renewable Energy Internship Scheme (NREI)

Under the National Renewable Energy Internship (NREI) programme, the Ministry provides internship opportunity to students pursuing under-graduate, graduate, post graduate degrees or research scholars enrolled in recognized institutions or universities within India or abroad, as Interns to understand the various activities/policies/schemes in RE sector.

11.2.6 Support to Higher Educational Institutions for Laboratory Upgradation

In order to encourage the institutions to include education/training renewable energy courses, the financial support for laboratory up-gradation is provided to enhance their capacity for conducting M. Sc., M.Tech., Ph.D courses in NRE. The following 4 Institutes/Universities have been selected for providing one time grant of Rs. 50 lacs each:

- i. Indian Institute of Technology, Kanpur
- ii. Indian Institute of Technology, Roorkee
- iii. Cochin University of Science and Technology, Kochi
- iv. Jamia Millia Islamia University, New Delhi

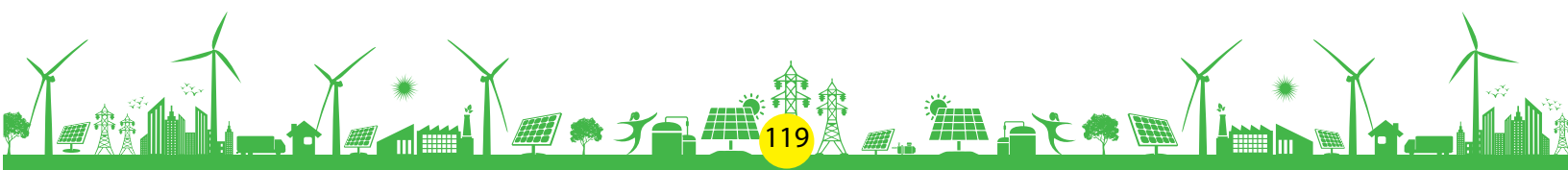
11.2.7 Other Important HRD Activities and Initiatives

RE courses in ITI: To initiate RE courses in ITIs, Ministry prepared 2 no. course curriculums in Wind energy and Small Hydro Power (SHP) areas in coordination with Directorate General of Training (DGT), under the Ministry of Skill Development and Entrepreneurship, NIWE, IIT, Roorkee and respective Industry associations. These course curriculums were forwarded to DGT for NSQF approval, for which stakeholder committee meeting was held in December, 2022.

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

11.3.1 E-GOVERNANCE/INFORMATION TECHNOLOGY (IT) INITIATIVES

MNRE has developed different web portals and Mobile apps for transparency in operations and better service delivery to stakeholders under Digital India Initiative of the Government of India. Further, taking



forward a step towards digitization, MNRE has signed an MoU with NIC to maintain/enhance existing software applications developed in-house and by third party developers and to develop newly identified applications on 2nd February, 2022. Along with Operation & Maintenance, enhancement and upgradation of existing applications, development of new applications, NIC provides support for various applications such as e-Office, e-HRMS, SPARROW, and Video Conferencing.

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

(a) Ministry Official Website (<https://mnre.gov.in>):

Ministry new website has been redesigned and redeveloped in SWAAS (Secure, Scalable, Sugama (Accessible) cloud service platform. It is a bilingual website (Hindi and English).

(b) National Portal for Rooftop Solar (<https://solarrooftop.gov.in/>):

An online portal with simplified procedure for residential consumers to have flexibility to get the rooftop solar plant installed by themselves or through vendor of their choice. The portal has been integrated with DBT SANDES, PRAYAS, NGO DARPAN. Portal is under integration with DISCOMs and PFMS. The portal is managing from submission of application till disbursement of CFA.

Till present, 86352 consumers have been registered and 35496 have submitted their application for installation of rooftop solar.

(c) Human Resource Development (HRD) Portal (<https://hrd.mnre.gov.in/>):

A portal developed to institutionalize renewable energy education and training to meet the requirement of qualified and trained manpower in the country. Beneficiaries can submit online applications/proposals for following programmes:

- i. Short term trainings and skill development in renewable energy
- ii. Fellowships for higher studies and research in renewable energy
- iii. Enhancement of Renewable Energy education and training infrastructure
- iv. Renewable Energy Chair
- v. National Renewable Energy Internship Programme

(d) CCDC (Concessional Custom Duty Certificate) Solar (<https://scms.gov.in/>)

It is a user interactive online portal that can enhance and help solar power manufacturers to apply CCDC application and generate reconciliation report for CCDC via portal.

(e) CCDC (Concessional Custom Duty Certificate) Wind (<https://ccdcwind.gov.in/>)

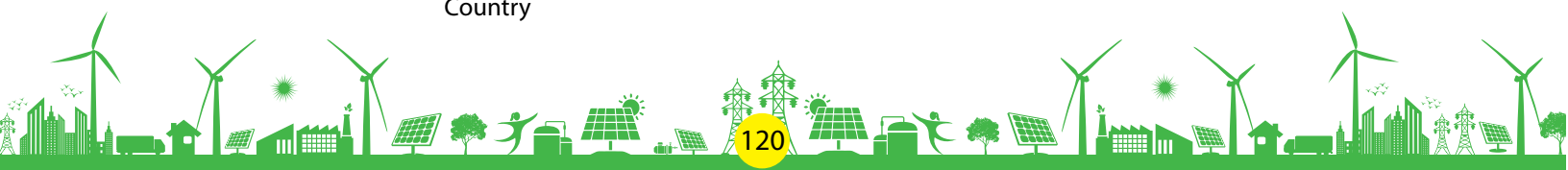
Similarly, it is a user interactive online portal that can enhance and help wind turbine manufacturers to apply CCDC application and generate CCDC via portal.

(f) Biourja Portal (<https://biourja.mnre.gov.in/>)

A portal developed for setting up Waste to Energy and Biomass projects for generation of Biogas/ BioCNG/Power/Producer gas from urban, industrial, and agricultural wastes/residues providing Central Financial Assistance (CFA).

There is provision for online submission of applications 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/>):

The portal promotes beneficiaries to apply for installation of small and medium biogas plants by implementing Central Sector Schemes under Off-Grid/distributed and decentralized Renewable Power.

(h) **Research and Development (R&D) Portal** (<https://serviceonline.gov.in/dbt/>):

The portal has been developed for online submission of RE related R&D proposals.

(i) **PM KUSUM Portal** (<https://pmkusum.mnre.gov.in/landing.html>):

The portal has been developed for monitoring of implementation of PM KUSUM scheme, which is meant for farmers.

(j) **Solar Street Light Portal** (<https://ssl.mnre.gov.in/>):

The portal has been developed for monitoring the implementation of solar street lights under the solar off-grid programme Phase III.

(k) **AkshayUrja Portal** (<https://akshayurja.gov.in>):

The portal will provide single platform for obtaining information regarding state-wise power potential, monthly installed capacity and power generation in respect of solar, wind, small hydro, bio energy & waste-to-energy plants, and off-grid components such as like Street Lighting System, Home Lighting System, etc.

(l) **Indian Renewable Energy Idea Exchange portal (IRIX)** (<https://irix.gov.in>):

IRIX is a real-time idea exchange platform for the Global RE community to ideate, innovate and incubate in the renewable energy sector

(m) **ALMM Portal**

The portal is being developed to manage procedural framework for the implementation of MNRE's Approved Models and Manufacturers of Solar Photovoltaic Modules.

(n) **Solar Power Portal**

The portal is being developed to facilitate the solar power project developers to set up projects in a plug and play model.

(o) **Intra MNRE**

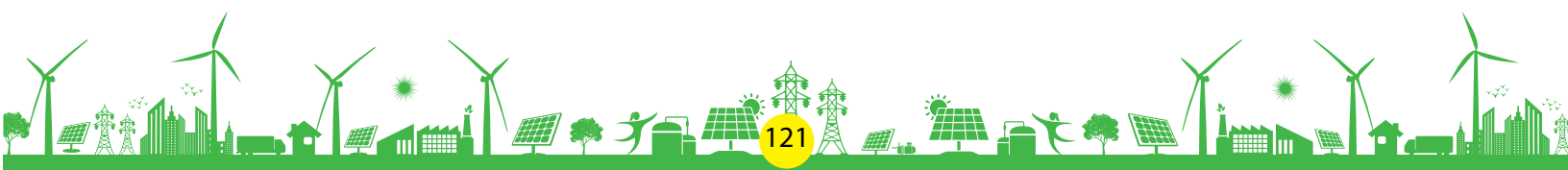
The portal is being developed for managing services being used in MNRE premises such as management of inventory, IT assets, canteen, conference room booking, vehicle management etc.

(p) **eHRMS:**

e-HRMS is a common application tool for personnel management activities like leave, posting, promotion, transfer, maintenance of service book, etc.

(q) **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, the Ministry's work continued without disruption.



Vigilance Awareness Week was observed in the Ministry from 31st October, 2022 to 6th November, 2022 along with 3 Months campaign (16.08.2022 to 15.11.2022) on housekeeping activities as a precursor to Vigilance Awareness Week wherein the following activities were undertaken:

- a. Integrity Pledge was Administered by Secretary, MNRE to all the staff and officers.
- b. A Lectures on Preventive Vigilance was organized.
- c. An Essay competition for the officials of the Ministry was organized.
- d. A Poster making competition on Vigilance issues was organized.
- e. A Debate competition for the officials of the Ministry was organized.
- f. An Extempore Speech competition for the officials of the Ministry was also organized.
- g. Slogans on curbing corruption and preventive vigilance with banners were placed in the premises of the Ministry.

As part of preventive vigilance, a list of sensitive and non-sensitive posts of the Ministry has been prepared and surprise checks were made by CVO.

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 and Rule 48 of CCS (Pension) Rules. Quarterly Reports and returns have also been submitted to CVC & DoPT 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 12,720 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. Library has also procured the Hydrogen Standards of various International Institutions in digital format.

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 37 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) and Central Information Commission (CIC). The Procedure / other details regarding seeking information under RTI Act, 2005 are available at the Ministry's website (www.mnre.gov.in).

The Progress Report in terms of RTI Applications and First Appeals received, disposed off as well as pendency during the period (01.01.2022 to 31.12.2022) is given in the **Table 11.4**.

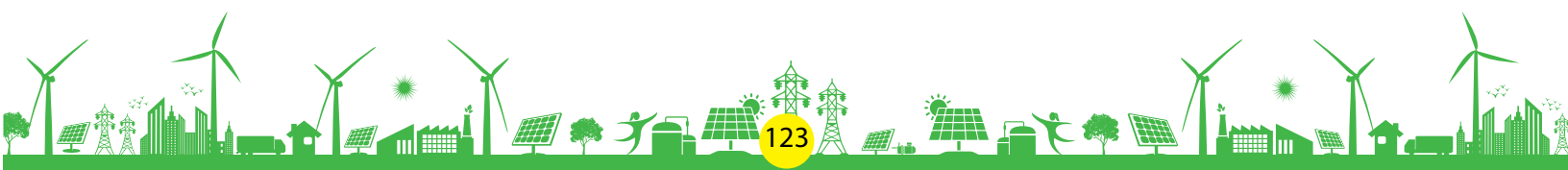


Table 11.4: Number of RTI Applications and First Appeals received, disposed off as well as pendency during the period from 01.01.2022 to 31.12.2022

Item	Received	Disposed off	Pending as on 31.12.2022
RTI Applications	671	656	15
First Appeals	50	50	00

The 3rd Party Audit proactive disclosure 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 required under section 4(1) (b) of the RTI Act.

The Ministry has designated Central Public Information Officers (CPIOs) and First Appellate Authorities (FAAs) to respond the RTI applications and First Appeals in accordance with subjects assigned to them. The list of CPIOs and FAAs is given in the **Table 11.5**. Nodal officer of RTI coordinates all the physical and online applications and persuades the CPIOs and FAAs to reply them within the stipulated time lines.

Table 11.5: List of Designated Central Public Information Officers (CPIOs) and First Appellate Authorities (FAAs)

S. No.	Subject	Name of CPIOs & Designation (Shri/Ms./Mrs.)	Name of FAAs & Designation (Shri/Ms./Mrs.)
1.	i. Comments on EFC/SFC/ Cabinet Notes/Concept Paper received from other Ministries/Departments; ii. 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.	Tarun Valecha, Scientist 'B'	Pankaj Gupta, DS
2	All Matters related to National Infrastructure Pipeline	Pankaj Gupta, DS	J. Rajesh Kumar, EA
3	Administration	Devendra Singh, US	K. Salil Kumar, Director
4	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.	Anubhav Uppal Scientist 'C'	Dr. Pankaj Saxena, Scientist 'G'

S. No.	Subject	Name of CPIOs & Designation (Shri/Ms./Mrs.)	Name of FAAs & Designation (Shri/Ms./Mrs.)
5	National Green Hydrogen Mission	Prashant Dwivedi, Scientist 'B'	Dipesh Pherwani Scientist 'C'
6	Policy and Regulatory Matters	Arun Kumar, Director	Ajay Yadav, JS
7	Energy Storage (Mission on Transformative Mobility & Battery Storage); E-Mobility [Charging Infrastructure, Electric Vehicle for Surface transport, National Board for Electric Mobility (NBEM)]	Dipesh Pherwani Scientist 'C'	PNBV Chalapathi Rao, Scientist 'D'
8	All matters of SECI	Divyanshu Jha, DS	Lalit Bohra, JS
9	International Solar Alliance (ISA); Multilateral initiatives; G-20 Coordination	Anant Kumar, Director	Dinesh Dayanand Jagdale, JS
10	PM Gati Shakti	Tarun Singh, Scientist 'D'	Dilip Nigam, Scientist 'G'
11	Solar Park Scheme	P.V. Tarun Saketh, Scientist 'B'	A. S. Parira, Scientist 'D'
12	Transmission, Green Energy Corridor	Rohit Thakwani, Scientist 'C'	Tarun Singh, Scientist 'D'
13	Clean Drinking water in Coastal Areas and Solar Powered Cold Storage	Rohit Thakwani, Scientist 'C'	G. Upadhyay, Scientist 'G'
14	Information Technology (IT)	Priya, Scientist 'C'	Prasad Arvind Chapekar, DS
15	Solar Parks Scheme & UMREPP Schemes, (Solar Parks in NE States, Jharkhand & Odisha UMREPP by other CPSUs),	Aravindh MA, Scientist 'C'	A. S. Parira, Scientist 'D'
16	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 related to Department of Commerce; Solar projects in Ladakh under PMDP.	Aravindh MA, Scientist 'C'	Dilip Nigam, Scientist 'G'
17	Lab Policy & Standards Quality Control	Vikram Dhaka, Scientist 'C'	Hiren C Borah, Scientist 'D'
18	All work related to Biomass Power Schemes and policies, Bio energy mission, Biomass cook-stove, Biomass Gasifier	Vikram Dhaka, Scientist 'C'	Aseem Kumar, Director
19	Waste to Energy, RPO (beyond 2022-2023, Compliance Monitoring), REC Policy, Directorate for Regulatory Compliance, All Administrative and Financial matters of NIBE	Vijay Kumar Bharti, Scientist 'C'	Aseem Kumar, Director
20	Biogas Power (Off Grid Programme), National Biogas Programme, Biogas Training Centres	P M Barik, Scientist 'C'	S.R. Meena, Scientist 'D'
21	All Administrative matters of IREDA	Sunita Sajwan, US	Tarun Singh Scientist 'D'
22	Off-Grid Solar PV Schemes and thermal applications including Decentralized Renewable Energy (DRE) livelihood application	V.S.S. Chaitanya, Scientist 'C'	J K Jethani, Scientist 'F'

S. No.	Subject	Name of CPIOs & Designation (Shri/Ms./Mrs.)	Name of FAAs & Designation (Shri/Ms./Mrs.)
23	PM KUSUM Scheme	Aditya Gangwar, Scientist 'B'	Shobhit Srivastava, Scientist 'D'
24	HRD & Training including ITEC Innovation Centre	Virendra Tyagi, US	Vasanta V.Thakur, Scientist 'E'
25	Rooftop Solar; Solar City	Manish Singh Bisht, Scientist 'C'	Divyanshu Jha, DS
26	Wind Energy (Offshore), Small Wind, Wind Energy (On-shore); Repowering and Hybrid Policies; All Administrative and Financial Matters of NIWE	Rahul Rawat, Scientist 'C'	P K Dash Scientist 'D'
27	R&D (including Wind, Solar, Biomass, Hydrogen & Battery), New Proposals of R&D under consideration; Solar Water Heater; New Technologies, Geothermal, Ocean/Tidal Energy	Arun Kumar Choudhary, Scientist 'B'	Anil Kumar, Scientist 'D'
28	Old Schemes (Greening of Islands, Solar Thermal, Gir Forest Solarisation)	Anil Kumar, Scientist 'D'	Dr. A.K Tripathi, Scientist 'G'
29	CPSU Govt. Producer Scheme; Canal Top Solar Scheme; Solar Manufacturing scheme; Renewable Energy Industry Promotion and Facilitation Board (REIPFB); PLI Scheme for manufacturing of High Efficiency Solar Modules; Coordination for resolving Solar Manufacturers and Developers issues.	Mohd. Azmal Mansoori, Scientist 'C'	Sanjay Karndhar, Scientist 'D'
30	Guidelines & Standard Bidding Documents (SBDs),	Mohd. Azmal Mansoori, Scientist 'C'	Divyanshu Jha, DS
31	FDI Cell and GST Cell,	Pankaj Gupta, DS	J. Rajesh Kumar, EA
32	Small Hydro Projects; PM's Package of Ladakh Renewable Energy Initiatives; PM Development & Reconstruction Package 2015 for Hydro Power for Jammu & Kashmir	S K Shahi, Scientist 'D'	G. Upadhyay Sci. 'G'
33	Direct Benefit Transfer (DBT) Cell	Mala Ram Sonwal, Dy. Dir.	Pankaj Gupta, DS
34	Climate Change and Coordination with MoEF & CC	Suman Chandra, DS	Ajay Yadav, JS
35	I & PA; Media / Social Media	A.K Manish, US	Suman Chandra, DS
36	Akshay Urja Magazine	A.K Manish, US	Dr. A K Tripathi, Scientist 'G'
37	Vigilance; Lokpal & Lokayukt	Sunita Dhewal, US	Anurag Sharma, DS
38	National Solar Mission (NSM)	Seema Srivastava, US	A. S. Parira, Scientist 'D'
39	International Relations (IR) and International Cooperation	Sunita Dhewal, US	Aseem Kumar, Director

S. No.	Subject	Name of CPIOs & Designation (Shri/Ms./Mrs.)	Name of FAAs & Designation (Shri/Ms./Mrs.)
40	Legal Cell	A.K.Singh, US	Anurag Sharma, DS
41	Parliament Work/All Matters related to Parliament	A.K.Singh, US	Dr. Pankaj Saxena, Sci. 'G'
42	Public Grievances (CPGRAMS)	A.K. Singh, US	Anurag Sharma, DS
43	IFD	K G Suresh Kumar, US	Kailash Chand, DS
44	Budget Monitoring; Audit	Sunita Sajwan, US	Anurag Sharma, DS
45	RTI Matters	Mala Ram Sonwal, Dy. Dir.	Anurag Sharma, DS
46	Cash Section	Anjana, SO/ DDO	M R Sonwal, Dy. Dir.
47	Library	Sunita Sajwan, US	Anurag Sharma, DS
48	Hindi	Parmanand, AD	N.S Dugtal, Dy. Dir.
49	PAO; Budget	Dharmendra Kumar Singh, Sr. Accounts Officer	Stuti Ghildiyal, DCA
50	All administrative and financial matters of NISE	Seema Srivastava, US	Anurag Sharma, DS
51	Office of Hon'ble Minister, NRE	D K Pandey, US	K. Salil Kumar, Director
52	RE in UTs	Priya, Scientist 'C'	Dr. A.K Tripathi, Scientist 'G'
53	Study of IT tools like Artificial Intelligence, Data Mining, Block chain and Deep Learning for development of Renewable Energy	Sanjay Prakash Bhagat, Scientist 'C'	Dr. A.K Tripathi, Scientist 'G'

CHAPTER 12

INTERNATIONAL COOPERATION IN RENEWABLE ENERGY

12.1 The International Relations (IR) Division of the Ministry has been continuously engaging with several Ministries/Departments of the Government of India, Indian Missions, Foreign Diplomatic Missions located in India, Multilateral International Organizations and Agencies, Regional Groupings and development banks among others for promoting international cooperation in the field of Renewable Energy.

12.2 In the current financial year also, the Ministry has taken several initiatives for the promotion of Renewable Energy. The Ministry has signed Memorandum of Understandings (MoUs), Joint Declaration of Intents (JDIs) with various countries and institutes in the field of New & Renewable Energy.

12.3 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. Details of Joint Working Groups Meetings held during the current year are as under:

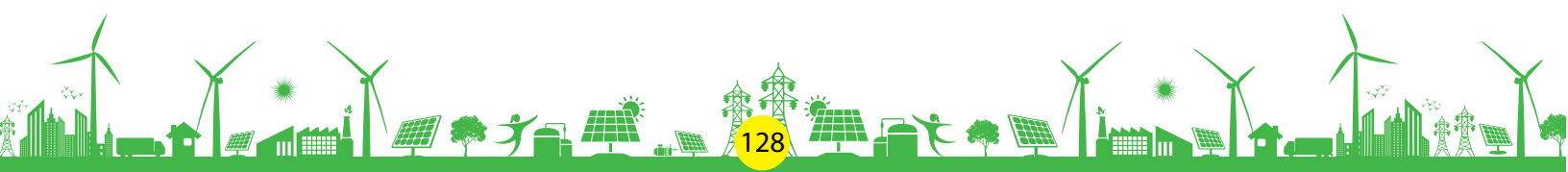
(i)	JWG meeting India-Tajikistan Virtually	28 th July, 2022
(ii)	4 th JWG meeting India-Denmark	07 th September, 2022
(iii)	JWG meeting India-Saudi-Arabia Virtually	12 th September, 2022

12.4 The following Memorandum of Understandings (MoUs)/Joint Declaration of Intent (JDI)/Letter of Intent (LoI) have been signed in the current year:

- a. A Memorandum of Understanding (MoU) between Ministry of Economic Affairs and Employment of the Republic of Finland and Ministry of New and Renewable Energy on cooperation in the field of Renewable Energy was signed on 29th April, 2022 in New Delhi.
- b. Joint Declaration of Intent (JDI) between the Ministry of New and Renewable Energy (MNRE) of the Republic of India and the Ministry for Economic Affairs and Climate Action (BMWK) of the Federal Republic of Germany on Indo- German Green Hydrogen Task force was signed on 02nd May, 2022 at New Delhi/Berlin.
- c. Joint Declaration of Intent (JDI) between the Ministry of New and Renewable Energy of the Republic of India and the Federal Ministry for Economic Cooperation and Development of the Federal Republic of Germany on Indo- German Development Cooperation regarding Renewable Energy Partnership was signed on 02nd May, 2022 at New Delhi/Berlin.

12.5 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 regularly participates in the Council and General Assembly meetings of IRENA. India will assume the Presidency of IRENA General Assembly in 2023.

The 22nd IRENA Council meeting was held in a hybrid format on 27-28 October, 2022 at Abu Dhabi, UAE. The delegation was led by the Ambassador of India to the UAE. Joint Secretary (IR), MNRE participated in the meeting virtual mode.

12.6 ENGAGEMENT WITH INTERNATIONAL SOLAR ALLIANCE (ISA)

International Solar Alliance (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). As on 13th December, 2022, 110 countries have signed the ISA Framework Agreement and out of which, 90 countries have also ratified the Framework Agreement of the ISA.

The International Solar Alliance is an observer to the United Nations Framework Convention on Climate Change (UNFCCC) and actively participated at COP27. ISA has also been granted observer status at the UN General Assembly.

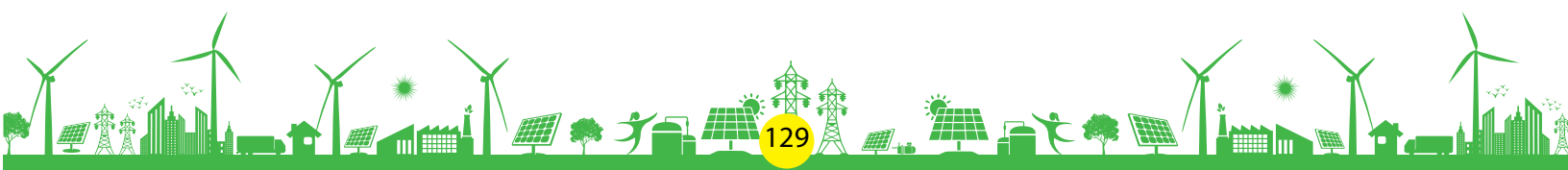
The Fifth Session of the ISA Assembly was held in New Delhi 18th October, 2022. The ISA Secretariat has also conducted a series of technical sessions on various strategic initiatives of the ISA and other emergent issues in the solar and clean energy sectors, between 19th to 20th October, 2022. The technical sessions featured in-depth expert deliberations on various thematic issues to help the ISA Secretariat refine its programmatic focus moving forward. The Fifth Assembly of the International Solar Alliance dedicated demonstration projects executed by ISA to the Cooperative Republic of Guyana, Jamaica, and the Togolese Republic. The Fifth Assembly also announced the SolarX Grand Challenge for the Africa region among other businesses of the day.

12.7 G20

India assumed the G20 Presidency on the 1st of December, 2022 from Indonesia. Under the Energy Transition Working Group (ETWG), India will focus on the following priority areas:

- I. Energy Transition through addressing technology gaps
- II. Low-cost Financing for Energy Transition
- III. Energy Security and Diversified Supply Chains
- IV. Energy Efficiency, Industrial Low Carbon Transitions and Responsible Consumption
- V. Fuels for Future (3F)
- VI. Universal Access to Clean Energy and Just Transition Pathway

The Ministry of New and Renewable Energy is working with the Ministry of Power on a range of deliverables covering essential issues/sectors like low-cost finance, green hydrogen, offshore wind, decentralized renewable energy, supply chain diversification and so on.



12.8 COOPERATION UNDER QUAD FRAMEWORK

At the first Quad Leaders' Summit held on 12th March, 2021, Quad Leaders announced the setting up of a Quad Climate Working Group (QCWG) to strengthen climate actions globally on mitigation, adaptation, resilience, technology, capacity- building and climate finance.

The Quad Climate Working Group has organized its work according to three core themes, (i) Climate Ambition, (ii) Clean Energy Innovation and Deployment, (iii) Adaptation, Resilience and Preparedness.

The Clean Energy Innovation and Deployment pillar is co-chaired by MNRE from the Indian side. The Indian side also comprises of representatives from MoP, MoEFCC, MoPNG, DBT and MEA. Under this pillar, member countries are working on key priority areas like Clean Hydrogen/Ammonia, Methane abatement in natural gas sector, Clean Energy supply chains and CCUS/Carbon Recycling. Under the CEID pillar, India has taken the lead on establishing the Quad Clean Hydrogen Strategic Initiative in line with the Hon'ble Prime Minister's proposal for a Global Green Hydrogen Partnership announced at the Quad Leaders' Summit in September, 2021.

12.9 INDIA-US STRATEGIC CLEAN ENERGY PARTNERSHIP (SCEP)

US-India SCEP was launched in accordance with US-India Climate and Clean Energy Agenda 2030. Partnership announced by Hon'ble Prime Minister Shri Narendra Modi and H.E. President Joe Biden at the Leaders' Summit on Climate held in April, 2021.

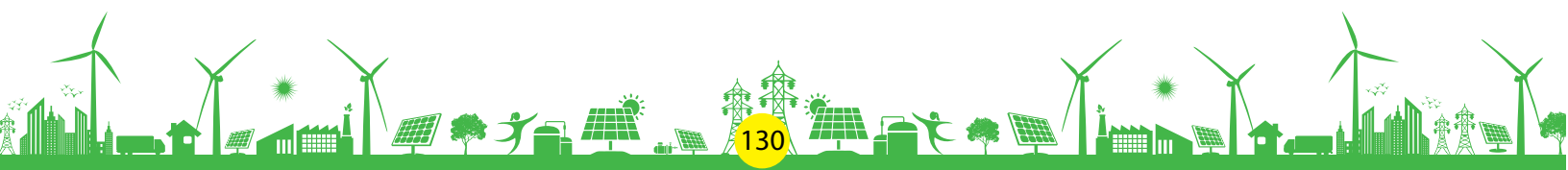
The partnership continues to advance energy security and innovation; scaling up emerging clean energy technologies; and deploying technical solutions through 5 pillars:

- I. Responsible Oil and Gas Pillar
- II. Power and Energy Efficiency Pillar
- III. Renewable Energy Pillar
- IV. Sustainable Growth Pillar
- V. Emerging Fuels and technologies.

MNRE co-leads the Renewable Energy Pillar from the Indian side. A meeting of the Renewable Energy Pillar under the SCEP was held on 15th September, 2022, eventually feeding into the Ministerial meeting held on 7th October, 2022 in the US.

12.10 INDIA NORWAY TASK FORCE

India and Norway Task Force on Energy sector was constituted for an India-Norway Energy Policy Dialogue for adopting best practices, share learning, clean energy technology transfer, availing low-cost finance, business tie-up etc. The Task Force on Energy sector is co-chaired by Ministry of New and Renewable Energy from India side. The other Indian participants of the task force are from Ministry of Power, Ministry of External Affairs, NITI Aayog, SECI, IREDA, NIWE, NIBE etc. The first meeting of task force was held on 31.10.2022.



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:

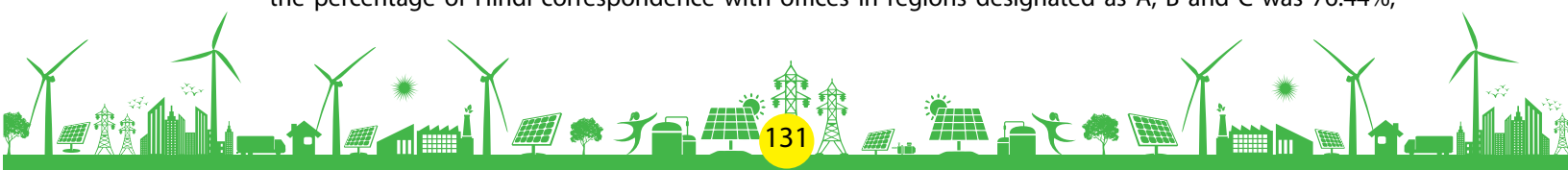
- i. Translation work: Various documents of the Ministry including those to be laid in Parliament such as Parliament Questions, Parliamentary Assurances, papers related to Standing Committees and other Parliamentary Committees, Private Member Bills, Calling Attention Notices, Budget related documents, 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 2022-23, 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 2022-23, 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, 2022, the percentage of Hindi correspondence with offices in regions designated as A, B and C was 76.44%,



70.99% and 73.07% 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 29th September, 2022. 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 34 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, 2022. 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.

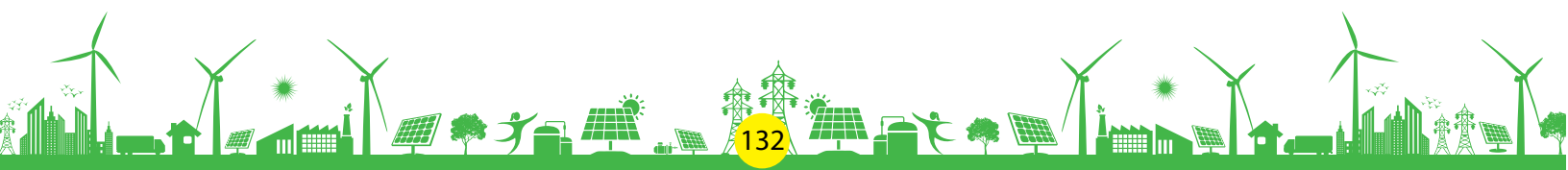
13.7 Hindi Noting and Drafting Incentive Scheme of the Department of Official Language, Ministry of Home Affairs was continued to be implemented during the year. On the occasion of prize distribution ceremony, the winners of this scheme were also awarded by Secretary, MNRE who had participated in Incentive Scheme for doing Official work (Noting/ Drafting) Originally in Hindi.

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. Two meetings of Hindi Salahkar Samiti under the chairmanship of Union Minister for New and Renewable Energy were held on 13.04.2022 and 04.01.2023 respectively.

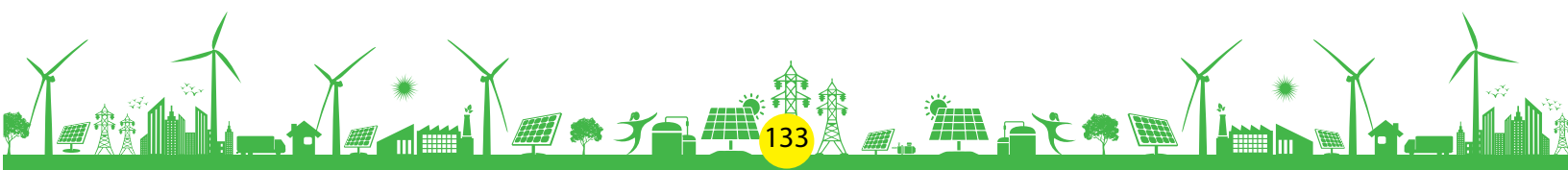
13.9 INSPECTION OF SUBORDINATE OFFICES

With a view to assess the status regarding progressive use of Official Language, inspections of 3 offices (IREDA, SECI & NISE) under the administrative control of the Ministry were carried out on 15-16 December, 2022 and remedial measures were suggested for compliance of Official Language Policy of the Union in their offices.





Meeting of Hindi Salahkar Samiti held under the Chairmanship of Hon'ble Minister (NRE) on 13.04.2022.



ANNEXURE-I

STAFF STRENGTH

MINISTRY OF NEW AND RENEWABLE ENERGY (ADMINISTRATION)

Table 1: As on 31.12.2022, the sanctioned and in-position strength in **MNRE** are as follows:

Group	A	B	C	Total
Sanctioned	141	85	79	305
In Position	87	45	57	189
SC	14	10	17	41
ST	3	2	3	8
OBC	13	9	13	35
PH	0	2	1	3

NATIONAL INSTITUTE OF WIND ENERGY (NIWE)

Table 2: Group-wise Sanctioned and In-Position Posts in **NIWE** as on 31.12.2022 are as follows:

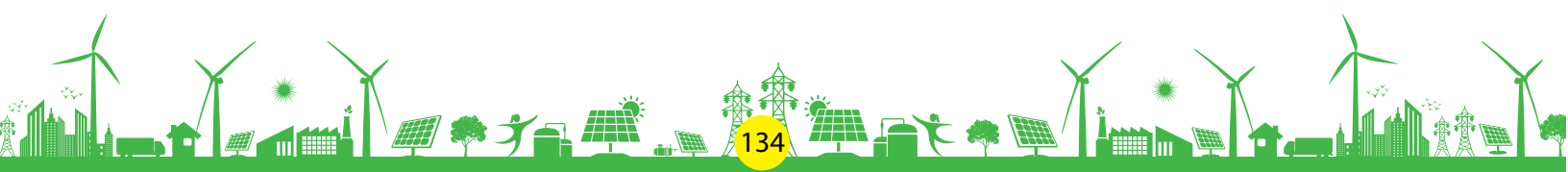
No. of Posts	Group **			Total
	A	B	C	
Sanctioned	18	13	17	48
In Position	16	09	16	41
SC	04	02	05	11
ST	01	--	--	01
OBC	07	04	11	22
PH	--	--	--	--

** 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

INDIAN RENEWABLE ENERGY DEVELOPMENT AGENCY (IREDA)

Table 3: Group-wise Sanctioned and In-position Posts in **IREDA** as on 31.12.2022 are as follows:

Classification	Board Level	Group A	Group B	Group C	Group D	Total
Sanctioned	03	213				216
In Position	02	134	08	16	-	160
SC	-	16	03	03	-	22
ST	-	07	-	01	-	08
OBC	-	23	-	03	-	26
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 31.12.2022 are as follows:

Group	Board Level	A	B	C	D	Total
Sanctioned	1(DG)	19	1	5	0	26
In Position	1(DG)	10	1	5	0	17
SC	-	-	-	-	-	-
ST	-	-	-	-	-	-
OBC	0	2	0	0	0	2
PH	-	-	-	-	-	-

NATIONAL INSTITUTE OF SOLAR ENERGY (NISE)

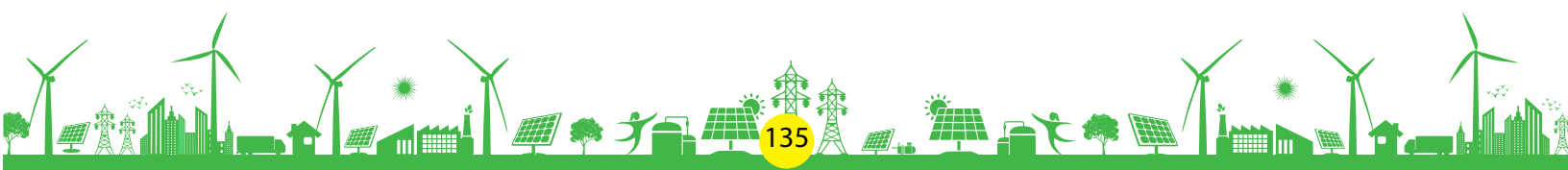
Table 5: Group-wise Sanctioned and In-positioned Posts in **NISE**, as on 31.12.2022 are as follows:

Group	A	B	C	D	Total
Sanctioned	24	16	-	-	40
In Position	22	05	-	-	27
SC	01 filled	01 filled	-	-	02
ST	-	-	-	-	-
OBC	02 filled	02 filled 01 vacant	-	-	05
PH	01 filled	01 vacant	-	-	02

SOLAR ENERGY CORPORATION OF INDIA (SECI)

Table 6: Group-wise Sanctioned and In-position Posts in **SECI** Staff as on 31.12.2022 are as follows:

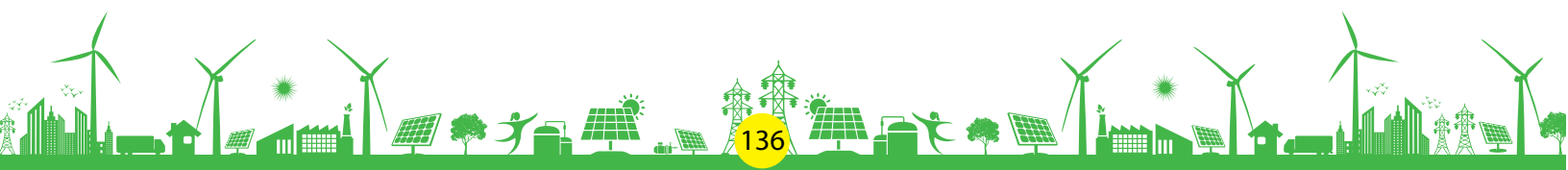
Group	A	B	C	D	Total
Sanctioned	126	36	Non-operational		162
In Position	98	11			109
SC	08	02			10
ST	04	0			04
OBC	17	04			21
PH	02	01			03



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 31.12.2022 is as follows:

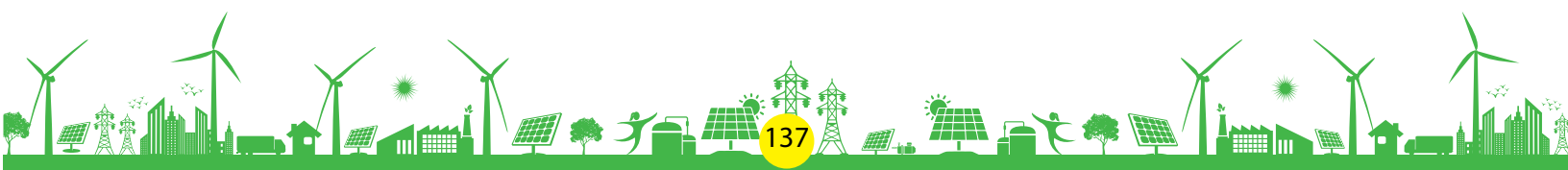
Group	A	B	C	D	Total
Sanctioned	3	5	14	0	22
In-Position	2	3	9	0	14
SC	1	0	1	0	2
ST	0	0	1	0	1
OBC	0	0	2	0	2
PH	0	0	0	0	0



ANNEXURE-II

AUDIT PARA

Year	Report No.	Chapter No.	Para No.	Action	Subject	Stage
No Audit Para is pending in the Ministry.						



ANNEXURE-III

GRANTS IN AID TO STATES AND VOLUNTARY ORGANISATIONS

Table 1: Funds released to implementing Agencies under HRD Programme in FY 2022-23 (as on 31.12.2022)

Sl. No.	Sanction No.	Agency Name	Sanction Date	Amount (Rs.)
1	10/1(26)/2015-P&C	National Institute of Solar Energy, Gurugram	04.08.2022	6,40,00,000

Table 2: Grant given to State PIAs of more than Rs. 50 lakh in Green Energy Corridor from 01.01.2022 to 31.12.2022

S. No.	Sanction No.	Project/ Organization Name	State	Funds released	
				Sanction Date	Amount (Rs. In lakh)
1	1/7/2015-EFM	Tamil Nadu Transmission Corporation Limited	Tamil Nadu	21.02.2022	5925.94
2	367-11/1/2022-GEC	Madhya Pradesh Power Transmission Company Limited	Madhya Pradesh	26.03.2022	7315.84
3	367-11/25/2017-GEC	Rajasthan Rajya Vidyut Prasaran Nigam Limited	Rajasthan	31.03.2022	225.33
4	367-11/1/2022-GEC	Madhya Pradesh Power Transmission Company Limited	Madhya Pradesh	09.12.2022	9676.58
5	367-11/25/2017-GEC	Rajasthan Rajya Vidyut Prasaran Nigam Limited	Rajasthan	26.12.2022	1084.75
6	367-11/1/2019-GEC	Maharashtra State Electricity Transmission Corporation Limited	Maharashtra	28.12.2022	508.05
7	367-11/26/2017-GEC	Himachal Pradesh Transmission Corporation Limited	Himachal Pradesh	28.12.2022	402.70
8	1/7/2015-EFM	Gujarat Energy Transmission Company Limited	Gujarat	30.12.2022	2077.6
Total					27216.79

Table 3: CFA released to SPPD/STU/CTU by SECI for development of Solar Parks as on 31.12.2022 (Rs. In Lakh)

S.No.	State	Solar Park	Effective CFA released to SPPD/STU/CTU
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
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 (Pragat)	217.08
23		Patoda Solar Park (Paramount)	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

S.No.	State	Solar Park	Effective CFA released to SPPD/ STU/CTU
29	Rajasthan	Bhadla-II Solar Park (District: Jodhpur)	4489.74
30		Bhadla-III Solar Park (District: Jodhpur)	11069.76
31		Bhadla-IV Solar Park (District: Jodhpur)	6025.00
32		Phalodi-Pokaran Solar Park (District: Jodhpur and Jaisalmer)	1825.00
33		Fatehgarh Phase-1B Solar Park (District: Jaisalmer)	25.00
34		Nokh Solar Park (Jaisalmer)	6685.00
35		External Transmission System by RVPN for Bhadla II, III & IV (District: Jodhpur)	11440.00
36		External Transmission System by PGCIL- for Bhadla III, IV and Phalodi Pokaran (District: Jodhpur)	12000.00
37	Tamil Nadu	Kadaladi Solar Park	25.00
38	Uttar Pradesh	Solar Park in UP	2081.80
39		Jalaun Solar Park (BSUL)	25.00
40		Lalitpur Solar Park (TUSCO)	25.00
41		Jhansi Solar Park (TUSCO)	25.00
42		Mirzapur Solar Park (BSUL)	10.00
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			183820.73

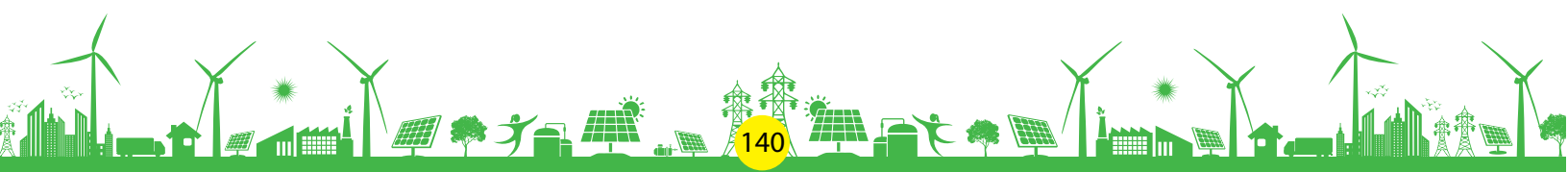


Table 4: PM KUSUM (Off-grid Solar) - Funds released above Rs. 50 Lakh from 1.1.2022 to 31.12.2022

S. No.	Sanction No.	Project/ Organisation	State	Funds released	
				Date	Amount (Rs.)
1	32/12/2020-SPV Division	Department of Agriculture, Government of Uttar Pradesh	Uttar Pradesh	24-01-22	8,73,05,883.00
2	32/17/2020-SPV Division	Tripura Renewable Energy Development Agency	Tripura	30-03-2022	7,35,69,197.00
3	32/22/2020-SPV Division	Punjab Energy Development Agency	Punjab	28-01-2022	12,00,00,000.00
4	32/264/2020-SPV Division	Rajasthan Horticulture Development Society Solar Project	Rajasthan	31-03-2022	20,58,79,320.00
5	32/264/2020-SPV Division	Rajasthan Horticulture Development Society Solar Project	Rajasthan	31-03-2022	7,62,51,600.00
6	32/61/2021-SPV Division	Indian Renewable Energy Development Agency	Maharashtra and Puducherry	24-01-2022	2,15,00,000.00
7	32/61/2021-SPV Division	Solar Energy Corporation of India Limited	Odisha and Tamil Nadu	24-01-2022	1,27,74,236.00
8	32/61/2021-SPV Division	NTPC LTD	Madhya Pradesh, Karnataka and Uttar Pradesh	24-01-2022	4,86,44,337.00
9	32/61/2021-SPV Division	Power Grid Corporation of India Limited	Andhra Pradesh, Kerala and Rajasthan	24-01-2022	2,98,97,159.00
10	32/61/2021-SPV Division	POWER FINANCE CORPORATION LIMITED	Chhattisgarh and Jharkhand	24-01-2022	62,77,724.00
11	32/61/2021-SPV Division	North Eastern Electric Power Corporation Ltd.	Assam, Manipur, Meghalaya, Nagaland and Tripura	24-01-2022	76,52,456.00
12	32/61/2021-SPV Division	RURAL ELECTRIFICATION CORPORATION LTD	Delhi, Gujarat and Haryana	24-01-2022	1,60,92,977.00
13	32/61/2021-SPV Division	CONVERGENCE ENERGY SERVICES LIMITED	Goa and Telangana	31-01-2022	1,38,21,398.00
14	32/517/2022-SPV Division	Solar Energy Corporation of India Limited	Punjab	16-08-2022	27,99,00,000.00
15	32/694/2022-SPV Division	Solar Energy Corporation of India Limited	Haryana	12-12-2022	62,95,00,000.00
16	32/264/2022-SPV Division	Solar Energy Corporation of India Limited	Rajasthan	22-08-2022	1,90,98,00,000.00

S. No.	Sanction No.	Project/ Organisation	State	Funds released	
				Date	Amount (Rs.)
17	32/12/2021-SPV	Solar Energy Corporation of India Limited	Maharashtra	01-09-2022	7,22,00,000.00
18	32/12/2021-SPV	Solar Energy Corporation of India Limited	Maharashtra	01-09-2022	10,74,00,000.00
19	32/12/2021-SPV	Solar Energy Corporation of India Limited	Maharashtra	01-09-2022	1,33,80,00,000.00
20	32/12/2021-SPV	Solar Energy Corporation of India Limited	Maharashtra	30-12-2022	4,00,00,000.00
21	32/12/2021-SPV	Solar Energy Corporation of India Limited	Maharashtra	30-12-2022	5,90,00,000.00
22	32/12/2021-SPV	Solar Energy Corporation of India Limited	Maharashtra	30-12-2022	4,88,000,000.00
23	32/294/2022-SPV Division	Solar Energy Corporation of India Limited	Uttar Pradesh	29-12-2022	58,74,000.00
24	32/294/2022-SPV Division	Solar Energy Corporation of India Limited	Rajasthan	29-12-2022	2,63,34,000.00
25	32/294/2022-SPV Division	Solar Energy Corporation of India Limited	Haryana	29-12-2022	84,48,000.00
26	32/542/2022-SPV Division	Solar Energy Corporation of India Limited	Himachal Pradesh	05-08-2022	5,77,00,000.00
27	32/630/2022-SPV	Solar Energy Corporation of India Limited	Uttarakhand	30-09-2022	3,31,00,000.00
28	32/633/2022-SPV	Solar Energy Corporation of India Limited	Jammu & Kashmir	02-09-2022	15,45,00,000.00
29	32/634/2022-SPV	Solar Energy Corporation of India Limited	Uttar Pradesh	27-10-2022	35,79,00,000.00
30	32/692/2022-SPV Division	Solar Energy Corporation of India Limited	Gujarat	19-12-2022	5,08,00,000.00
31	32/692/2022-SPV Division	Solar Energy Corporation of India Limited	Gujarat	19-12-2022	51,00,000.00
32	32/698/2022-SPV Division	Solar Energy Corporation of India Limited	Jharkhand	29-12-2022	3,39,99,750.00
33	32/698/2022-SPV Division	Solar Energy Corporation of India Limited	Jharkhand	29-12-2022	1,24,96,140.00
34	32/698/2022-SPV Division	Solar Energy Corporation of India Limited	Jharkhand	29-12-2022	15,38,56,110.00
35	32/97/2021-SPV Division	Solar Energy Corporation of India Limited	Haryana	29-07-2022	38,46,00,000.00

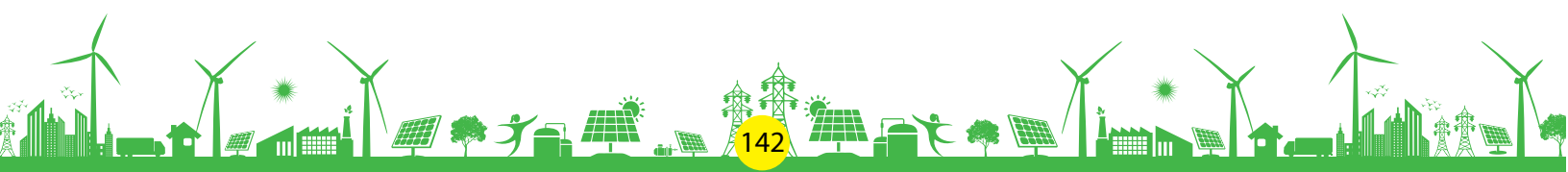


Table 5: Solar Photovoltaic (Off-grid Solar) - Funds released above Rs.50 lakh from 01.01.2022 to 31.12.2022

S. No.	Sanction No.	Project/ Organisation	State	Funds released	
				Date	Amount (Rs.)
1	32/1/2020-SPV Division	Telangana New & Renewable Energy Development Corporation Limited	Telangana	31-03-2022	2,27,60,000
2	32/6/2021-SPV Division	Arunachal Pradesh Energy Development Agency	Arunachal Pradesh	31-03-2022	1,56,91,211
3	32/60/2018-SPV Division-Part (1)	Tripura Renewable Energy Development Agency	Tripura	31-03-2022	1,62,36,000
4	32/60/2018-SPV Division-Part (4)	Uttarakhand Renewable Energy Development Agency	Uttarakhand	31-03-2022	6,23,44,327
5	32/60/2018-SPV Division-Part (2)	Nagaland Renewable Energy Development Agency	Nagaland	31-03-2022	5,86,02,735
6	32/29/2020-SPV Division	Manipur Renewable Energy Development Agency	Manipur	31-03-2022	56,208,244
7	32/299/2022-SPV Division	Indian Renewable Energy Development Agency	Jammu & Kashmir	12-08-2022	11,04,23 250
8	32/60/2018-SPV Division	Indian Renewable Energy Development Agency	Assam	08-09-2022	10,86,18,286
9	32/60/2018-SPV Division-Part (2)	Indian Renewable Energy Development Agency	Arunachal Pradesh	01-12-2022	8,48,70,000
10	32/60/2018-SPV Division-Part (3)	Indian Renewable Energy Development Agency	Mizoram	13-12-2022	1,51,30,000
11	32/60/2018-SPV Division-Part (3)	Indian Renewable Energy Development Agency	Mizoram	13-12-2022	4,85,22,500

Table 6: State-wise expenditure on Rooftop Solar Programme in FY 2022-23 (as on 31.12.2022)

SI. No.	State/UTs	Amount (Rs. in crore)
1	Andaman & Nicobar	0
2	Andhra Pradesh	5.64
3	Arunachal Pradesh	0
4	Assam	3.16
5	Bihar	0
6	Chandigarh	0.73
7	Chhattisgarh	0
8	Dadra and Nagar Haveli and Daman and Diu	0

Sl. No.	State/UTs	Amount (Rs. in crore)
9	Goa	0
10	Gujarat	985.31
11	Haryana	14.67
12	Himachal Pradesh	9.88
13	Jammu & Kashmir	1.25
14	Jharkhand	2.52
15	Karnataka	3.07
16	Kerala	89.71
17	Ladakh	0.00
18	Lakshadweep	0.00
19	Madhya Pradesh	23.69
20	Maharashtra	18.55
21	Manipur	0.00
22	Meghalaya	0.00
23	Mizoram	0.00
24	Nagaland	0.00
25	Delhi	10.07
26	Odisha	0.11
27	Puducherry	0.00
28	Punjab	25.73
29	Rajasthan	50.37
30	Sikkim	0.00
31	Tamil Nadu	8.60
32	Telangana	42.81
33	Tripura	0.00
34	Uttarakhand	1.72
35	Uttar Pradesh	4.74
36	West Bengal	4.71
37	Solar Energy Corporation of India	16.21
	Sub-total	1323.26
38	Central Electronics Limited	0.31
	Total	1323.57

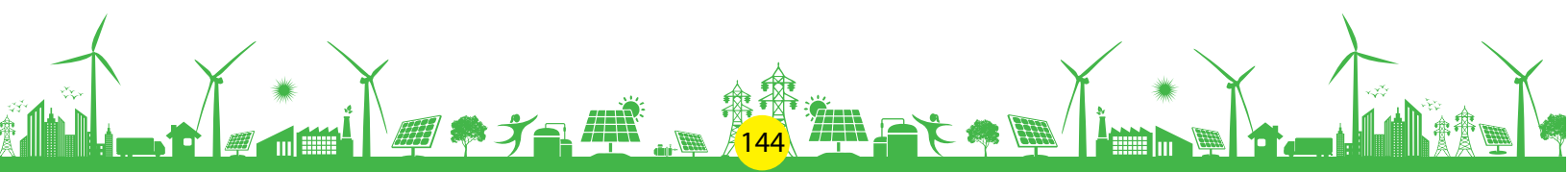


Table 7: Funds released under 750 MW VGF Scheme (Phase-II Batch-III) to Solar Energy Corporation of India Ltd (SECI) from 01.01.2022 to 31.12.2022

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F. No. 32/7/2017-Solar Energy Group	SECI	28-03-2022	11,62,35,218.00
2	F. No. 32/7/2017-Solar Energy Group	SECI	08-07-2022	18,89,62,655.00
3	F. No. 32/7/2017-Solar Energy Group	SECI	20-09-2022	4,61,60,000.00
4	F. No. 32/7/2017-Solar Energy Group	SECI	31-10-2022	18,41,70,114.00
			Total	53,55,27,987.00

Table 8: Funds released under 2000 MW VGF Scheme (Phase-II Batch-III) to Solar Energy Corporation of India Ltd (SECI) from 01.01.2022 to 31.12.2022

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F. No. 283/70/2017-GRID SOLAR	SECI	28-01-2022	4,03,79,800.00
2	F. No. 283/70/2017-GRID SOLAR	SECI	30-03-2022	2,30,58,853.00
3	F. No. 283/70/2017-GRID SOLAR-Part (1)	SECI	30-03-2022	9,51,95,794.00
4	F.No.283/70/2017-GRID SOLAR-Part(1)	SECI	12-09-2022	29,54,21,650.00
5	F. No. 283/70/2017-GRID SOLAR	SECI	21-09-2022	61,72,16,269.00
6	F. No. 283/70/2017-GRID SOLAR	SECI	29-12-2022	1,01,46,19,700.00
			Total	2,08,58,92,066.00

Table 9: Funds released under 5000 MW VGF Scheme (Phase-II Batch-IV) to Solar Energy Corporation of India Ltd (SECI) from 01.01.2022 to 31.12.2022

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F.No.283/69/2017-GRID SOLAR – Part (1)	SECI	25-01-2022	8,07,59,155.00
2	F.No.283/69/2017-GRID SOLAR	SECI	05-12-2022	12,11,38,733.00
			Total	20,18,97,888.00

Table 10: Funds released under DEMO GBI Scheme to Solar Energy Corporation of India Ltd (SECI) from 01.01.2022 to 31.12.2022

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F. No. 32/39/2017-Solar Energy Group	SECI	28-12-2022	2,87,98,167.00

Table 11: Funds released under RPSSGP Scheme to Solar Energy Corporation of India Ltd (SECI) from 01.01.2022 to 31.12.2022

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1	F. No. 32/06/2017-Solar Energy Group	SECI	13-09-2022	65,14,73,433.00

Table 12: Funds released to Indian Renewable Energy Development Agency Ltd. (IREDA) for payment of interest on Government of India Fully Serviced Bonds in FY 2022-23 till 31.12.2022.

Sl. No.	Sanction Number	Agency Name	Sanction Date	Amount (Rs.)
1.	340-12/2/2018-IREDA	IREDA	04-08-2022	21,85,66,255
2.	340-12/2/2018-IREDA	IREDA	11-08-2022	8,29,12,877
3.	340-12/2/2018-IREDA	IREDA	22-08-2022	32,05,38,082

Table 13: The Private, voluntary organizations and State PIAs received grant of more than Rs. 50.00 lakh during the year 2022-23 (up to 31.12.2022)

S. No.	Sanction No.	Project	State	Organization / Agency	Funds released		Remarks
					Date	Amount (Rs. in Lakh)	
1	286/55/2017-SHP	Setting up of SHP-I & SHP-II on Saurashtra Branch Canal in Gujarat	Gujarat	Sardar Sarovar Narmada Nigam Ltd.	14.07.2022	135.00	Release of balance part of 4th and final installment of CFA
2	286/107/2017-SHP	Setting up of Sumbachu SHP (2x1.5MW) project at Zemithang in Tawang district of Arunachal Pradesh	Arunachal Pradesh	Hydro Power Development Corporation of Arunachal Pradesh Ltd.	10.11.2022	126.66	Release of 3rd & final installment of CFA
3	6/4/2015-SHP	Setting up of SHP-I, SHP-II & SHP-III on Mityagam Branch Canal in Gujarat	Gujarat	Sardar Sarovar Narmada Nigam Ltd.	14.12.2022	183.75	Release of 4th & final installment of subsidy
4	286/6/2017-SHP	Setting up of New Karnah SHP(3x4MW) project in Kupwara district of Jammu & Kashmir	UT of Jammu & Kashmir	Jammu & Kashmir State Power Development Corporation Ltd.	16.08.2022	150.00	Release of balance part of 2nd of CFA

Table 14: Funds released to Implementing Agencies under CPSU Scheme Phase II in FY 2022-23 (till December, 2022)

Sl. No.	Sanctioned Order	Agency Name	Sanction Date	Amount (Rs.)
1	302/4/2017-GRID SOLAR	SECI	30.12.2022	1,76,63,777

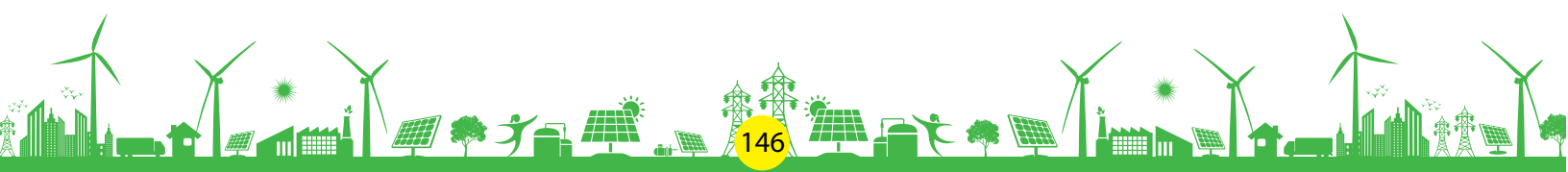


Table 15: Funds Released to Implementing Agencies under CPSU Scheme Phase I in FY 2022-23 (till December, 2022)

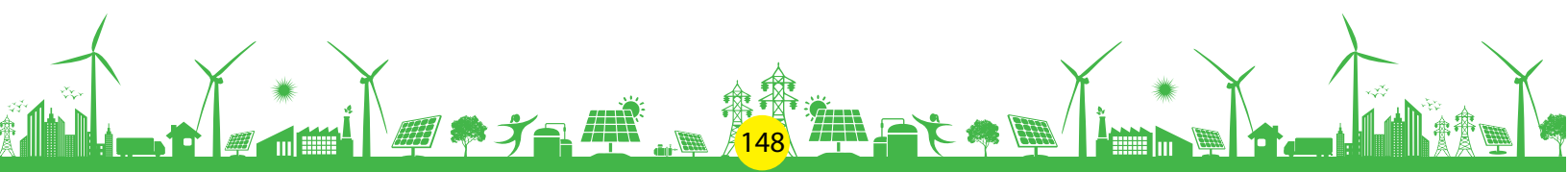
Sl. No.	Sanctioned Order	Agency Name	Sanction Date	Amount (Rs.)
1	302/6/2017-GRID SOLAR	SECI	31.10.2022	32,57,25,000
2	302/1/2022-GRID SOLAR	SECI	31.10.2022	1,51,50,000

Table 16: Funds released to Implementing Agencies under New National Biogas Organic Manure Programme (NNBOMP) & Biogas Power (Off-Grid) Generation and Thermal Programme (BPGTP) from 01.01.2022 to 31.12.2022

S. No.	Executing Agency	Sanction Number	Date	Amount (Rs.)
1	Chhattisgarh State Renewable Energy Development Agency	343/4/2019-BIOGAS	01.02.2022	4050000
2	Chhattisgarh State Renewable Energy Development Agency, Raipur (C.G.)	253/41/2019-BIOGAS	11.03.2022	6335300
3	Chhattisgarh State Renewable Energy Development Agency, Raipur (C.G.)	253/40/2018-BIOGAS	22.08.2022	9676574
4	Chhattisgarh State Renewable Energy Development Agency, Raipur (C.G.)	253/5/2022-BIOGAS	29.09.2022	1192500
5	Chhattisgarh State Renewable Energy Development Agency, Raipur (C.G.)	253/3/2022-BIOGAS	26.12.2022	15725100
6	Gujarat Agro Industries Corporation Ltd., Gandhinagar, Gujarat	252/61/2017-BIOGAS	10.02.2022	8121500
7	Gujarat Agro Industries Corporation Ltd., Gandhinagar, Gujarat	253/73/2017-BIOGAS	23.03.2022	4821100
8	Madhya Pradesh State Agro Industries Development Corporation, M.P.	253/6/2020-BIOGAS	30.03.2022	1178000
9	Madhya Pradesh State Agro Industries Development Corporation, M.P.	253/8/2020-BIOGAS	30.03.2022	93000
10	Punjab Energy Development Agency, Chandigarh	253/15/2020-BIOGAS	31.03.2022	3191690
11	Punjab Energy Development Agency, Chandigarh	253/15/2020-BIOGAS	29.09.2022	21126336
Total				7,55,11,100




Table 17: Funds released to Implementing Agencies under RE-RTD Programme in FY 2022-23 (as on 31.12.2022)

S. No.	Sanction No.	Project	Institution Name	Funds Released	
				Date	Amount (in Rs.)
1.	353/5/2020-New Technology	Green Hydrogen Mobility Projects at Leh	NTPC Ltd., Noida, U.P.	1.11.2022	10,00,00,000
2.	31/13/2013-14/PVSE-R&D	Process development for fabrication of CZTS based of solar cells on flexible polyimide substrate	KIIT University, Bhubaneswar	26.11.2022	6,35,887





2 M3 Per Day Flexible Biogas Plant

Manufactured By:  Funded By:  Implemented By:  **Karnataka Sahaj**

Manufactured: 2013-14
No. No.: CARRATION / 11 / URBARD / 057



सत्यमेव जयते

Government of India

Ministry of New and Renewable Energy