

Chapter

Reserves and potential for generation

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CHAPTER 1

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Reserves and Potential

Energy reserves are part of the energy resources that, based on technical, economic and other relevant (e.g., environmental) considerations, can be recovered and for which extraction is justified. The exact definition of reserves depends on the kind of resources in focus.

Globally, the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources (UNFC 2009) provides a scheme for classifying and evaluating these resources according to three dimensions, namely, their economic and social viability, the field project status and feasibility, and the geological knowledge about these resources. System of Environmental Economic Accounting (SEEA)-Energy groups the detailed categories of UNFC into three aggregated classes characterizing the commercial recoverability of the resources as follows:

Categorization of mineral and energy resources relevant for energy

Class A: Commercially recoverable resources

Class B: Potentially commercially recoverable resources

Class C: Non - commercial and other known deposits

Thus, primary energy production relies on the capture or extraction of fuels or energy from natural energy flows, the biosphere and natural reserves of fossil fuels within the national territory in a form suitable for use mostly when extraction and sale have been confirmed to be economically viable.

A good measure of the overall resource and the geographical and technical potential of what can be produced is also often represented by the potential in case of renewable power.

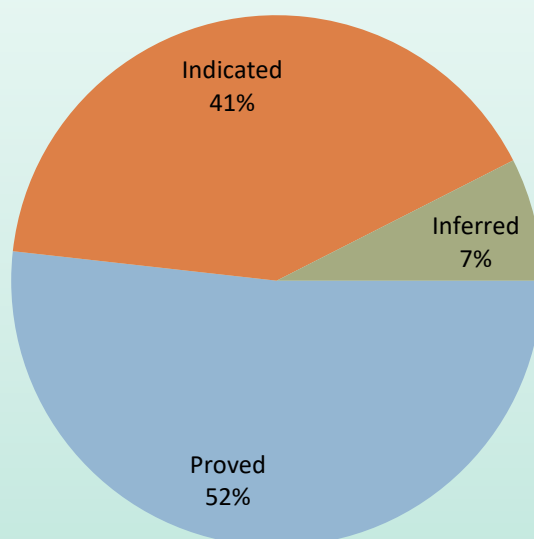
India has one of the largest proven coal reserves in the world. However, one of the objectives of India's energy mix has been to promote the production of energy through the use of renewable energy sources in accordance with climate, environment and macroeconomic considerations in order to reduce dependence on fossil fuels, ensure security of supply and reduce emissions of CO₂ and other greenhouse gases.

This chapter presents data on these reserves and potential in a concise form.

Highlights

- India has rich deposits of coal in the world. Total estimated reserves of coal as on 01-04-2022 were 361.41 billion tonnes, an addition of 9.29 billion tonnes over the corresponding period of previous year. In terms of percentage, there has been a growth of 2.64% in the total estimated coal reserves during the year 2022-23 over 2021-22 (Table 1.1.).
- The top three states with highest coal reserves in India are Odisha, Jharkhand, Chhattisgarh, which account for approximately 69% of the total coal reserves in the country.
- Out of the total reserves in the country, proven reserves i.e. those available for extraction in terms of i.e. economically viability, feasibility study and geologically exploration level, account for almost 52% of the total as depicted below in Fig 1.1.

Fig 1.1 Estimated Reserves of Coal in India as on 01.04.2022

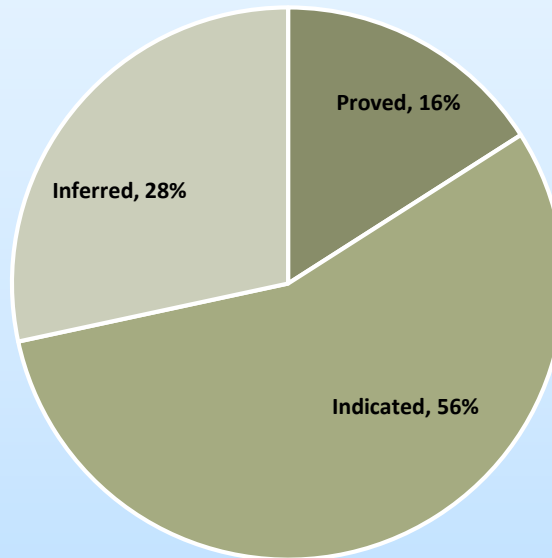


Total Estimated Reserves = 361.41 Billion

- Total estimated of lignite as on 01-04-2022 were 46.20 billion tonnes, an addition of 0.19 billion tonnes over the corresponding period of previous year. In terms of percentage, there has been a growth of 0.40% in the total estimated lignite reserves during the year 2022-23 over 2021-22 (Table 1.1A). The highest reserves of lignite are found in the state of Tamil Nadu. Out of the total Lignite reserves in the country, proven reserves account for almost only 16% of the total as depicted below in Fig 1.2.

* Brief about the Proved, Inferred and Indicated has been given under **Annexure – I**.

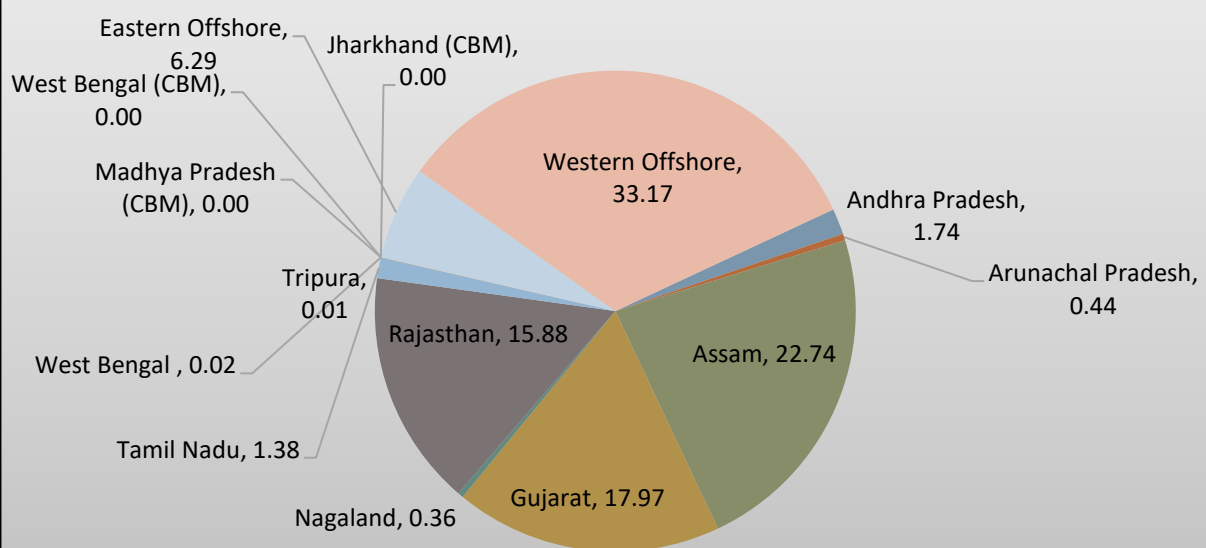
Fig 1.2 Estimated Reserves of Lignite in India as on 01.04.2022



Total Estimated Reserves = 46.20 Billion Tonnes

- The estimated reserves of crude oil in India as on 01-04-2022 stood at 653.02 million tonnes against 591.92 million tonnes in the previous year. An increase of over 10% over last year. Geographical distribution of Crude Oil indicates that the maximum reserves are in the Western Offshore (33%) followed by Assam (23%) (Table 1.2).

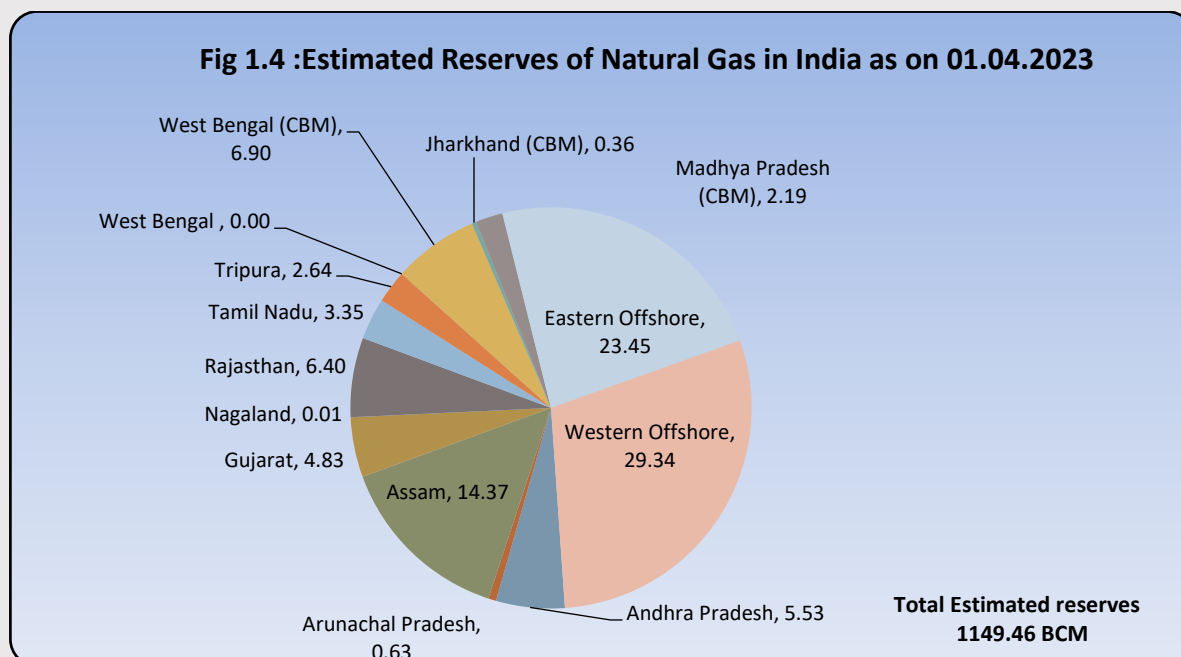
Fig 1.3: Estimated Reserves of Crude Oil in India as on 01.04.2023



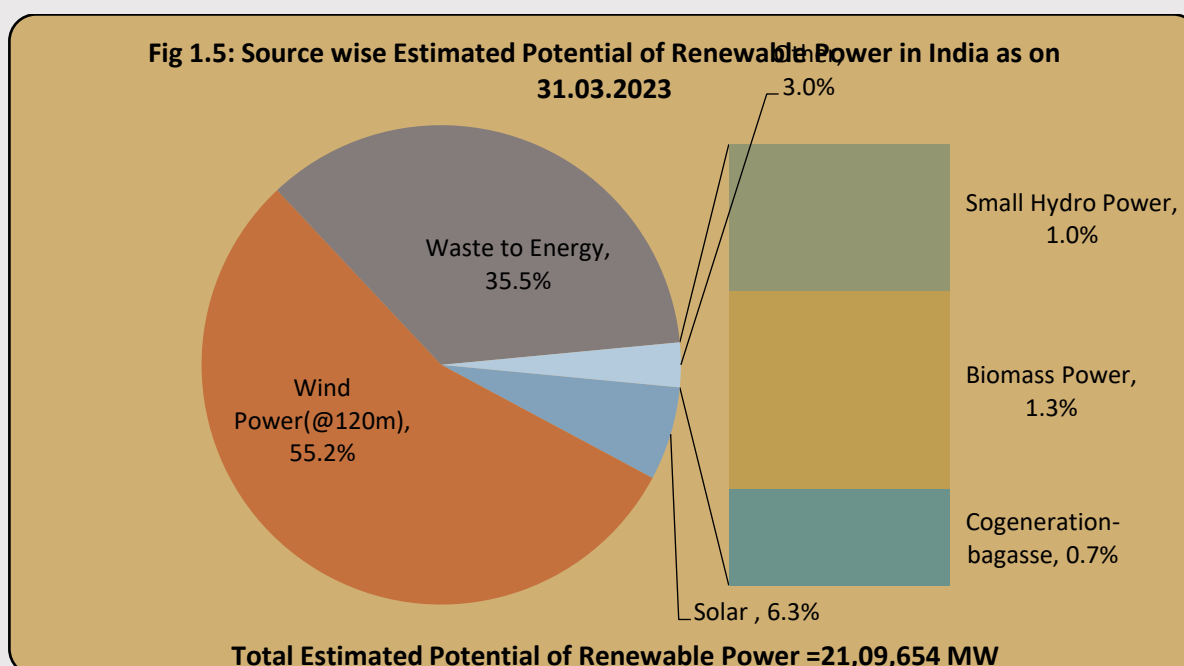
Total Estimated reserves 651.77 Million

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- The estimated reserves of Natural Gas as on 01-04-2022 was at 1149.46 Billion Cubic Meters. The maximum reserves of Natural Gas are in the Western Offshore (29.3%) followed by Eastern offshore (23.4%).



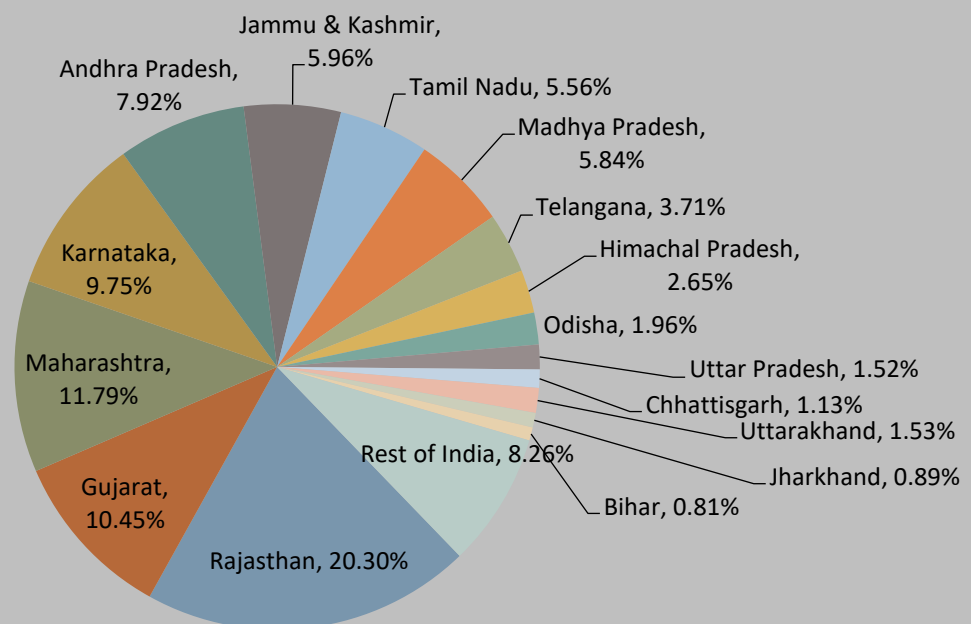
- There is a high potential for generation of renewable energy from various sources like wind, solar, biomass, small hydro and cogeneration bagasse in India. The total potential for renewable power generation in the country as on 31.03.2023 is estimated at 2,109,654 MW. This includes solar power potential of 7,48,990 MW (35.50%), wind power potential of 1,163,856 MW (55.17%) at 150m hub height, large hydro power of 133,410 MW (6.32%), SHP (small-hydro power) potential of 21,134 MW (1%), Biomass power of 28,447 MW (1.35%) and 13,818 MW (0.66%) from bagasse-based cogeneration in sugar mills (Table 1.3).



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- The geographic distribution of the estimated potential of renewable power as on 31.03.2023 shows that Rajasthan has the highest share of about 20.3% (428322 MW). This is followed by Maharashtra with 11.79% (share 248665MW). Gujarat and Karnataka come next with a 10.45% and 9.75% share (220505 MW and 205648 MW respectively). These four (4) states are having more than 52% of the total potential of Renewable Power in India.

Fig 1.6: Statewise Estimated Potential of Renewable Power in India as on 31.03.2023



Total Estimated Potential of Renewable Power =21,09,654 MW

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Table 1.1: State wise Estimated Reserves of Coal (as on 01st April)

(in Million Tonnes)

States/ UTs	Proved		Indicated		Inferred		Total		Distribution (%)	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
Andhra Pradesh	921	921	901	2,443	425	778	2,247	4,142	0.64	1.15
Arunachal Pradesh	31	31	40	40	19	19	90	90	0.03	0.02
Assam	465	465	57	57	3	3	525	525	0.15	0.15
Bihar	310	310	3,143	4,080	11	48	3,464	4,437	0.98	1.23
Chhattisgarh	31,562	32,053	40,425	40,701	1,437	1,437	73,424	74,192	20.85	20.53
Jharkhand	52,046	53,245	28,882	28,260	5,288	5,15x5	86,217	86,660	24.48	23.98
Madhya Pradesh	13,479	14,052	13,060	12,723	3,678	4,142	30,217	30,917	8.58	8.55
Maharashtra	7,770	7,984	3,320	3,390	1,847	1,847	12,936	13,221	3.67	3.66
Meghalaya	89	89	17	17	471	471	576	576	0.16	0.16
Nagaland	9	9	22	22	416	448	446	478	0.13	0.13
Odisha	43,326	48,573	35,222	34,080	6,330	5,452	84,878	88,105	24.10	24.38
Sikkim	0	0	58	58	43	43	101	101	0.03	0.03
Uttar Pradesh	884	884	178	178	0	0	1,062	1,062	0.30	0.29
West Bengal	15,199	17,234	13,296	12,859	4,597	3,779	33,092	33,871	9.40	9.37
Telangana	11,089	11,257	8,328	8,344	3,433	3,433	22,851	23,034	6.49	6.37
All India Total	1,77,179	1,87,105	1,46,949	1,47,252	27,998	27,054	3,52,126	3,61,411	100	100
Distribution (%)	50.32	51.77	41.73	40.74	7.95	7.49	100	100		

Total may not tally due to rounding off

Source: Ministry of Coal

Table 1.1(A): State wise Estimated Reserves of Lignite (as on 01st April)

(in Million Tonnes)

States/ UTs	Proved		Indicated		Inferred		Total		Distribution (%)	
	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23	2021-22	2022-23
Gujarat	1279	1279	284	284	1160	1160	2722	2722	5.92	5.89
Jammu & Kashmir	0	0	20	20	7	7	28	28	0.06	0.06
Kerala	0	0	0	0	10	10	10	10	0.02	0.02
Odisha	NA	0	NA	0	NA	6	NA	6	NA	0.01
Puducherry	0	0	406	406	11	11	417	417	0.91	0.90
Rajasthan	1169	1169	3030	3030	2151	2259	6349	6458	13.80	13.98
Tamil Nadu	4927	4927	21910	21981	9653	9653	36490	36561	79.29	79.13
West Bengal	0	0	1	1	3	3	4	4	0.01	0.01
All India	7374	7374	25651	25722	12994	13108	46018	46204	100	100
Distribution (%)	16.02	15.96	55.74	55.67	28.24	28.37	100	100		

Total may not tally due to rounding off

Source: Ministry of Coal

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Table 1.2: State wise Estimated Reserves of Crude Oil and Natural Gas (as on 01st April)

States/ UTs/ Region	Crude Oil (Million Tonnes)				Natural Gas (Billion Cubic Metres)			
	2021-22		2022-23		2021-22		2022-23	
	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)
Andhra Pradesh	7.33	1.24	11.39	1.74	64.80	4.72	63.58	5.53
Arunachal Pradesh	3.64	0.61	2.89	0.44	3.14	0.23	7.30	0.63
Assam	153.05	25.86	148.47	22.74	166.55	12.14	165.13	14.37
Gujarat	115.41	19.50	117.37	17.97	57.22	4.17	55.55	4.83
Nagaland	2.38	0.40	2.38	0.36	0.09	0.01	0.09	0.01
Rajasthan	35.26	5.96	103.67	15.88	59.07	4.30	73.57	6.40
Tamil Nadu	9.01	1.52	8.98	1.38	37.90	2.76	38.46	3.35
Tripura	0.07	0.01	0.07	0.01	29.27	2.13	30.35	2.64
West Bengal	0.02	0.00	0.11	0.02	32.17	2.34	-	-
West Bengal (CBM)	-	-	-	0.00	-	-	79.33	6.90
Jharkhand (CBM)	-	-	-	-	8.56	0.62	4.12	0.36
Madhya Pradesh (CBM)	-	-	-	-	30.88	2.25	25.18	2.19
Eastern Offshore	42.96	7.26	41.07	6.29	557.07	40.59	269.50	23.45
Western Offshore	222.79	37.64	216.63	33.17	325.65	23.73	337.29	29.34
Total	591.92	100	653.02	100	1372.37	100	1149.46	100

CBM : Cold Bed Methane (Jharkhand, West Bengal and M.P.)

1. Western offshore includes Gujarat offshore

2. Total may not tally due to rounding off

Source: M/o Petroleum & Natural Gas

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**Table 1.3: Source wise and State wise Estimated Potential of Renewable Power in India
(as on 31.03.2023)**

(in MW)									
Sl. No.	States/ UTs	Wind Power @ 150m	Small Hydro Power	Biomass Power	Cogeneration-bagasse	Solar Energy	Large Hydro	Total	Distribution (%)
1	Andhra Pradesh	123336	409	1999	280	38440	2596	167060	7.92%
2	Arunachal Pradesh	246	2065	18	0	8650	50394	61373	2.91%
3	Assam	459	202	322	0	13760	643	15386	0.73%
4	Bihar	4023	527	964	347	11200	130	17191	0.81%
5	Chhattisgarh	2749	1098	354	0	18270	1311	23782	1.13%
6	Goa	14	5	33	0	880	0	932	0.04%
7	Gujarat	180790	202	2638	555	35770	550	220505	10.45%
8	Haryana	593	107	1353	362	4560	0	6976	0.33%
9	Himachal Pradesh	239	3460	70	0	33840	18305	55914	2.65%
10	Jammu & Kashmir	1 (Ladakh)	1707	83	0	111050	12972	125812	5.96%
11	Jharkhand	16	228	146	0	18180	300	18870	0.89%
12	Karnataka	169251	3726	1794	1762	24700	4414	205648	9.75%
13	Kerala	2621	647	778	0	6110	2473	12629	0.60%
14	Madhya Pradesh	55423	820	2516	0	61660	2819	123239	5.84%
15	Maharashtra	173868	786	2630	3917	64320	3144	248665	11.79%
16	Manipur	0	100	62	0	10630	615	11407	0.54%
17	Meghalaya	55	230	69	0	5860	2026	8240	0.39%
18	Mizoram	0	169	3	0	9090	1927	11189	0.53%
19	Nagaland	0	182	54	0	7290	325	7851	0.37%
20	Odisha	12129	286	299	0	25780	2825	41318	1.96%
21	Punjab	428	578	3022	414	2810	1301	8554	0.41%
22	Rajasthan	284250	52	1300	0	142310	411	428322	20.30%
23	Sikkim	0	267	5	0	4940	6051	11262	0.53%
24	Tamil Nadu	95107	604	1560	639	17670	1785	117366	5.56%
25	Telangana	54717	102	1678	117	20410	1302	78327	3.71%
26	Tripura	0	47	34	0	2080	0	2161	0.10%
27	Uttar Pradesh	510	461	2800	4926	22830	502	32028	1.52%
28	Uttarakhand	49	1664	93	215	16800	13481	32303	1.53%
29	West Bengal	1281	392	1742	0	6260	809	10484	0.50%
30	Andaman & Nicobar	1245	7	18	0	0	0	1270	0.06%
31	Chandigarh	0	0	0	0	0	0	0	0.00%
32	Dadar & Nagar Haveli, Daman & Diu	17	0	2	0	0	0	19	0.00%
33	Delhi	0	0	0	0	2050	0	2050	0.10%
34	Lakshadweep	31	0	1	0	0	0	32	0.00%
35	Puducherry	408	0	5	0	0	0	413	0.02%
36	Others§	0	0	0	284	790	0	1074	0.05%
All India Total		11,63,856	21,134	28,447	13,818	7,48,990	1,33,410	21,09,654	100
Distribution (%)		55.17	1.00	1.35	0.66	35.50	6.32	100.00	

§: Others includes installations through NGOs/IREDA in different states

Source: Ministry of New and Renewable Energy