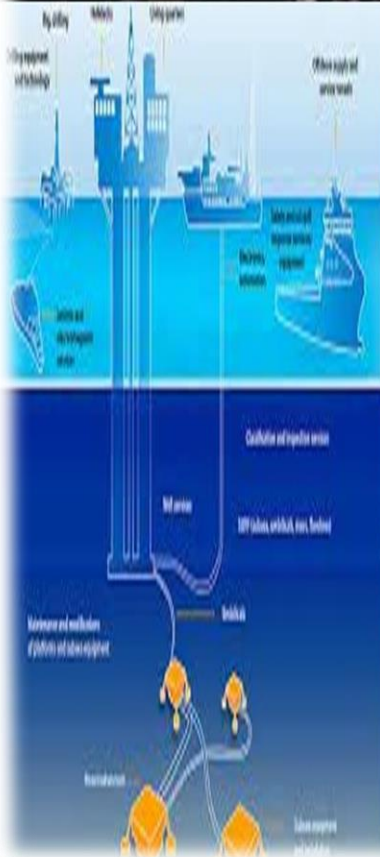


|| Chapter - 1 ||

Reserves and Potential for Generation



CHAPTER 1

Reserves and potential for generation

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.

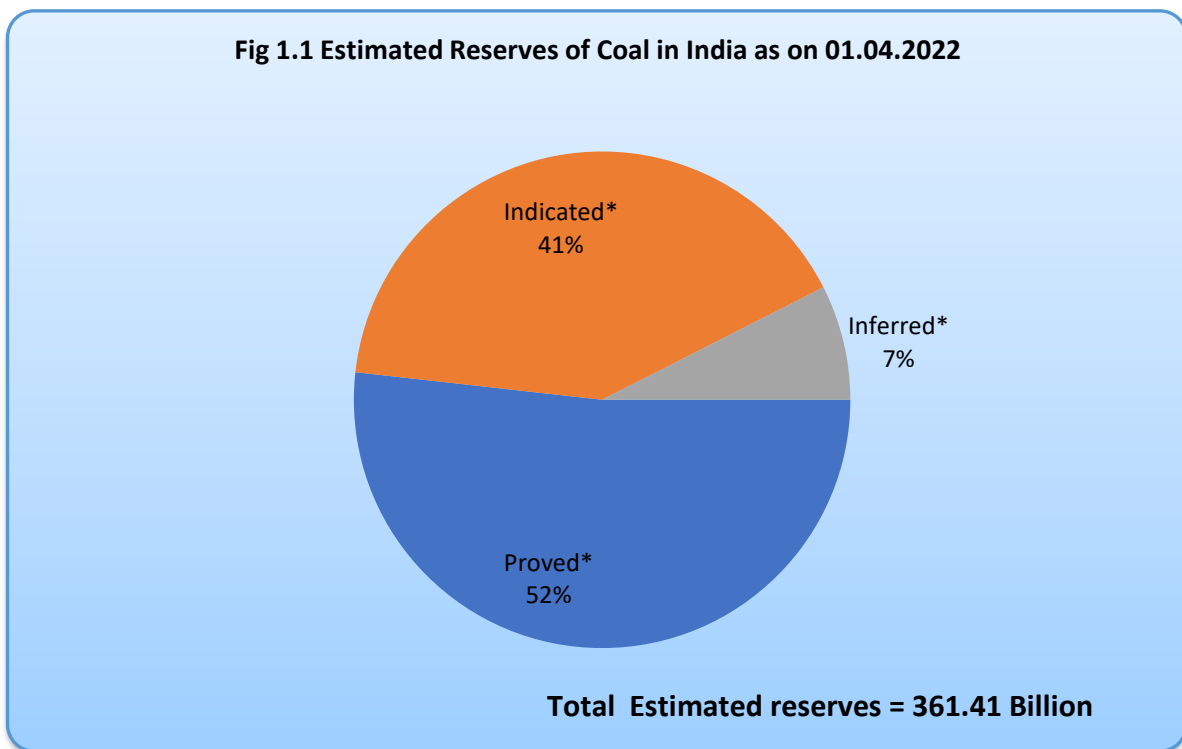
A good measure of the overall resource and the geographical and technical potential of what can be produced is also often represented by the potential in case of renewable power.

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

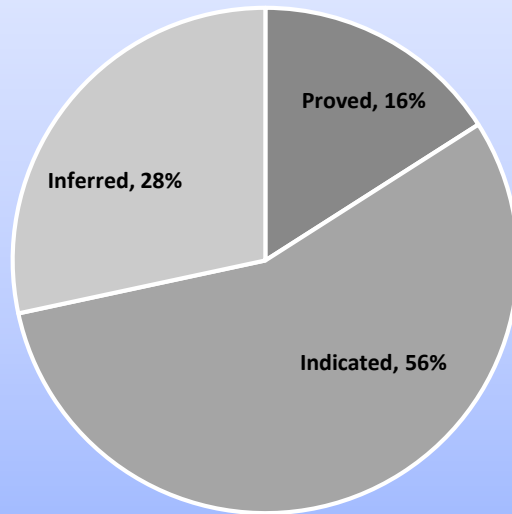
- India has rich deposits of coal in the world. Total estimated reserves of coal as on 01-04-2022 were 361.41 billion tonnes, an addition of 9.28 billion tonnes over the corresponding period of previous year. In terms of percentage, there has been a growth of 2.64% in the total estimated coal reserves during the year 2021-22 over 2020-21 (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.



- Total estimated of lignite as on 01-04-2022 were 46.20 billion tonnes, an addition of 0.18 billion tonnes over the corresponding period of previous year. In terms of percentage, there has been a growth of 0.39% in the total estimated lignite reserves during the year 2021-22 over 2020-21 (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**.

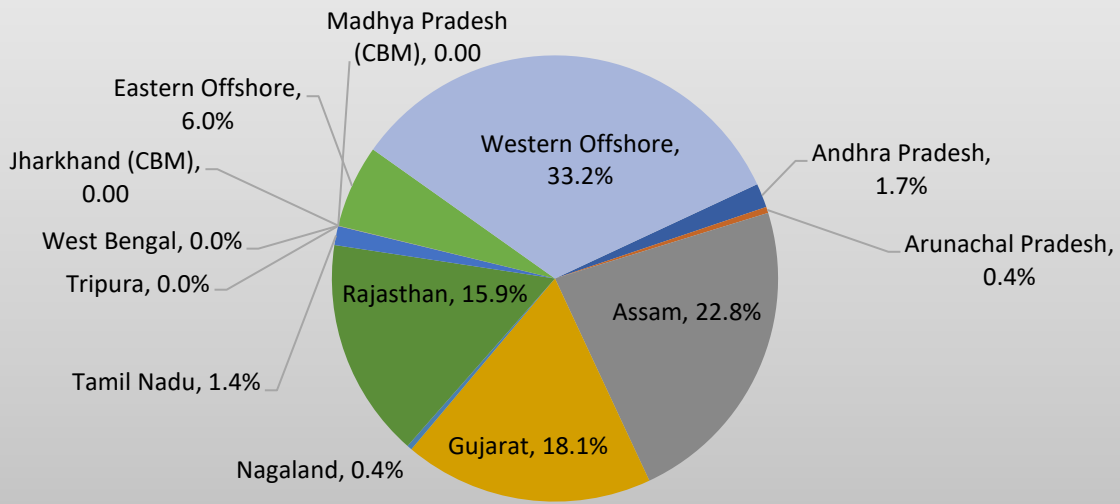
Fig 1.2 Estimated Reserves of Lignite in India as on 01.04.2022



Total Estimated reserves = 46.20 Billion Tonnes

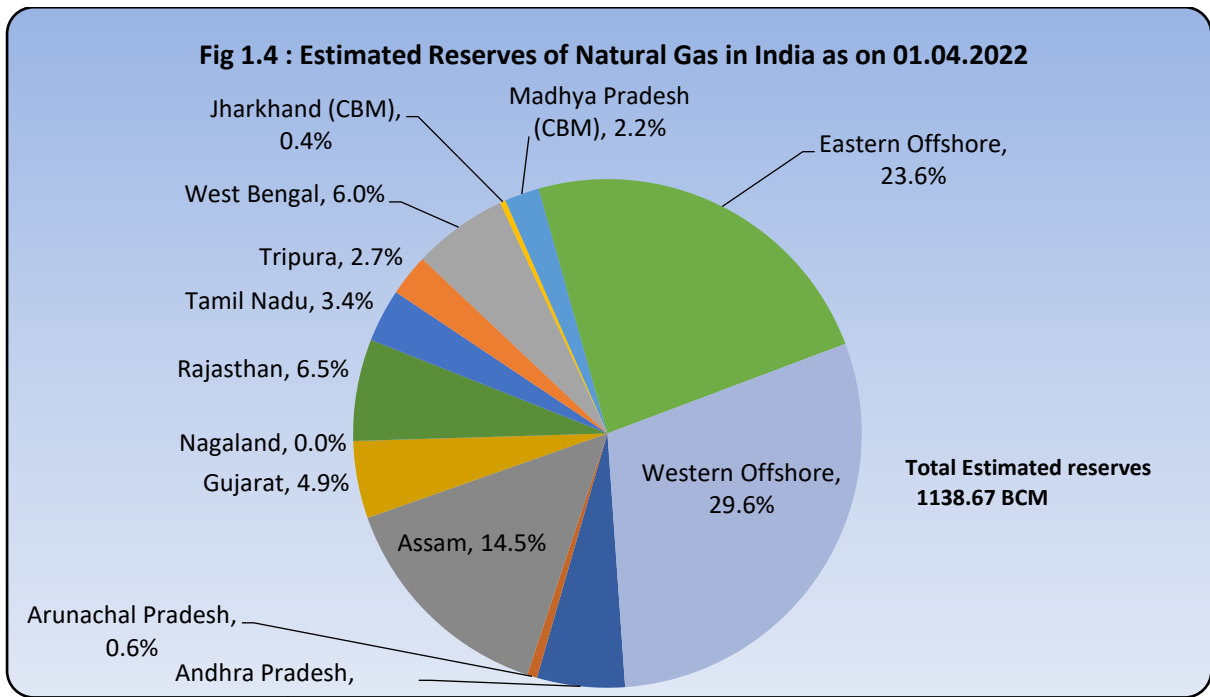
- The estimated reserves of crude oil in India as on 01-04-2022 stood at 651.77 million tonnes against 591.92 million tonnes in the previous year. An increase of over 10% over last year. Geographical distribution of Crude Oil indicates that the maximum reserves are in the Western Offshore (33%) followed by Assam (23%) (Table 1.2).

Fig 1.3: Estimated Reserves of Crude Oil in India as on 01.04.2022

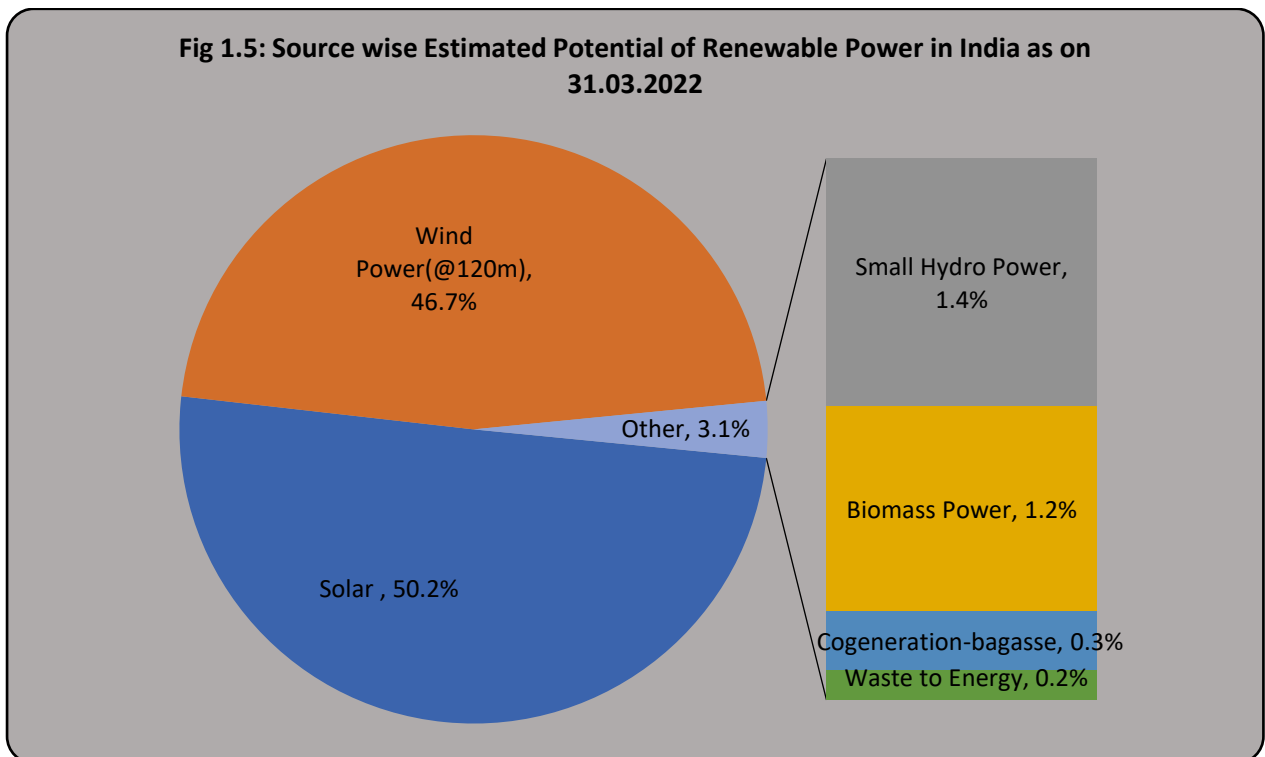


Total Estimated reserves 651.77 Million tonnes

- The estimated reserves of Natural Gas as on 01-04-2022 was at 1138.67 Billion Cubic Meters. The maximum reserves of Natural Gas are in the Western Offshore (29.6%) followed by Eastern offshore (23.6%).

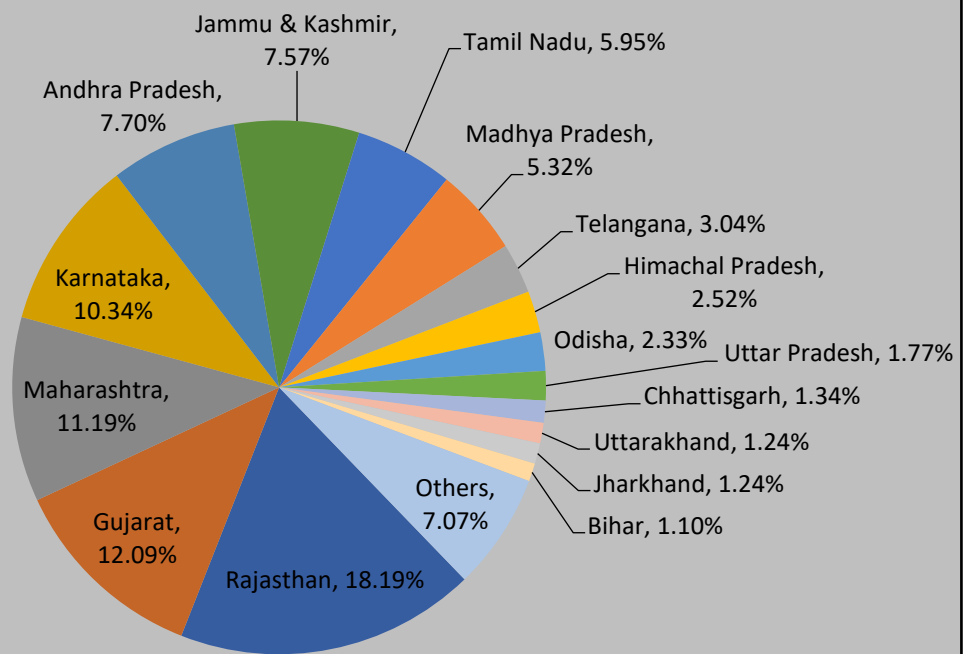


- There is a high potential for generation of renewable energy from various sources like wind, solar, biomass, small hydro and cogeneration bagasse in India. The total potential for renewable power generation in the country as on 31.03.2022 is estimated at 14,90,727 MW. This includes solar power potential of 7,48,990 MW (50.24%), wind power potential of 6,95,509 MW (46.66%) at 120m hub height, SHP (small-hydro power) potential of 21,134 MW (1.42%), Biomass power of 17,538 MW (1.18%), 5,000 MW (0.34%) from bagasse-based cogeneration in sugar mills and 2,556 MW (0.17%) from waste to energy (Table 1.3).



- The geographic distribution of the estimated potential of renewable power as on 31.03.2022 shows that Rajasthan has the highest share of about 18.2% (271219 MW). This is followed by Gujarat with 12.1% (share 180215 MW). Maharashtra and Karnataka come next with a 11.2% and 10.3% share (166743MW and 154162 MW respectively). These four (4) states are having more than 50% of the total potential of Renewable Power in India.

Fig 1.6: Statewise Estimated Potential of Renewable Power in India as on 31.03.2022



Total Estimated Potential of Renewable Power =14,90,727 MW

Table 1.1: Statewise 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	55	3	3	525	522	0.15	0.14
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	5,155	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	1,47,250	27,998	27,054	3,52,126	3,61,409		
Distribution (%)	50.32	51.77	41.73	40.74	7.95	7.49	100.00	100.00		

*Total may not tally due to rounding off**Source: Office of Coal Controller, Ministry of Coal***Table 1.1(A): Statewise 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	6	6
Jammu & Kashmir	0	0	20	20	7	7	28	28	0	0
Kerala	0	0	0	0	10	10	10	10	0	0
Puducherry	0	0	406	406	11	11	417	417	1	1
Rajasthan	1169	1169	3030	3030	2151	2259	6349	6458	14	14
Tamil Nadu	4927	4927	21910	21981	9653	9653	36490	36561	79	79
West Bengal	0	0	1	1	3	3	4	4	0	0
All India	7374	7374	25651	25722	12994	13102	46018	46198	100	100
Distribution (%)	16	16	56	56	28	28	100	100		

*Total may not tally due to rounding off**Source: Office of Coal Controller, Ministry of Coal*

Table 1.2: Statewise 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	1.2%	11.39	1.7%	64.80	4.7%	63.58	5.6%
Arunachal Pradesh	3.64	0.6%	2.89	0.4%	3.14	0.2%	7.30	0.6%
Assam	153.05	25.9%	148.60	22.8%	166.55	12.1%	165.09	14.5%
Gujarat	115.41	19.5%	117.86	18.1%	57.22	4.2%	55.87	4.9%
Nagaland	2.38	0.4%	2.38	0.4%	0.09	0.0%	0.09	0.0%
Rajasthan	35.26	6.0%	103.67	15.9%	59.07	4.3%	73.65	6.5%
Tamil Nadu	9.01	1.5%	8.98	1.4%	37.90	2.8%	38.46	3.4%
Tripura	0.07	0.0%	0.07	0.0%	29.27	2.1%	30.35	2.7%
West Bengal	0.02	0.0%	0.11	0.0%	32.17	2.3%	68.63	6.0%
Jharkhand (CBM)	-	-	-	-	8.56	0.6%	4.12	0.4%
Madhya Pradesh (CBM)	-	-	-	-	30.88	2.3%	25.18	2.2%
Eastern Offshore	42.96	7.3%	39.19	6.0%	557.07	40.6%	269.04	23.6%
Western Offshore	222.79	37.6%	216.63	33.2%	325.65	23.7%	337.29	29.6%
Total	591.92	100%	651.77	100%	1372.37	100%	1138.67	100%

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

Notes:

1. Western offshore includes Gujarat offshore
2. Total may not tally due to rounding off

Source: M/o Petroleum & Natural Gas

Table 1.3: Sourcewise and Statewise Estimated Potential of Renewable Power in India during 2021-22

(in MW)

Sl. No.	States/ UTs	Wind Power @ 120m	Small Hydro Power	Biomass Power	Cogeneration-bagasse	Waste to Energy*	Solar Energy	Total	Distribution (%)
1	Andhra Pradesh	74906	409	578	300	123	38440	114756	7.7%
2	Arunachal Pradesh	274	2065	8			8650	10997	0.7%
3	Assam	246	202	212		8	13760	14428	1.0%
4	Bihar	3650	527	619	300	73	11200	16369	1.1%
5	Chhattisgarh	348	1098	236		24	18270	19976	1.3%
6	Goa	8	5	26			880	919	0.1%
7	Gujarat	1,42,560	202	1221	350	112	35770	180215	12.1%
8	Haryana	419	107	1333	350	24	4560	6793	0.5%
9	Himachal Pradesh	151	3460	142		2	33840	37595	2.5%
10	Jammu & Kashmir	3	1707	43			111050	112803	7.6%
11	Jharkhand	0	228	90		10	18180	18508	1.2%
12	Karnataka	1,24,155	3726	1131	450		24700	154162	10.3%
13	Kerala	2311	647	1044		36	6110	10148	0.7%
14	Madhya Pradesh	15404	820	1364		78	61660	79326	5.3%
15	Maharashtra	98213	786	1887	1250	287	64320	166743	11.2%
16	Manipur	0	100	13		2	10630	10745	0.7%
17	Meghalaya	1	230	11		2	5860	6104	0.4%
18	Mizoram	0	169	1		2	9090	9262	0.6%
19	Nagaland	0	182	10			7290	7482	0.5%
20	Odisha	8346	286	246		22	25780	34680	2.3%
21	Punjab	278	578	3172	300	45	2810	7183	0.5%
22	Rajasthan	127756	52	1039		62	142310	271219	18.2%
23	Sikkim	0	267	2			4940	5209	0.3%
24	Tamil Nadu	68750	604	1070	450	151	17670	88695	5.9%
25	Telangana	24835	102				20410	45347	3.0%
26	Tripura	0	47	3		2	2080	2132	0.1%
27	Uttar Pradesh	101	461	1617	1250	176	22830	26435	1.8%
28	Uttarakhand	54	1664	24		5	16800	18547	1.2%
29	West Bengal	1050	392	396		148	6260	8246	0.6%
30	Andaman & Nicobar	1277	7				0	1284	0.1%
31	Chandigarh	0				6	0	6	0.0%
32	Dadar & Nagar Haveli	0					0	0	0.0%
33	Daman & Diu	0					0	0	0.0%
34	Delhi	0				131	2050	2181	0.1%
35	Lakshadweep	31					0	31	0.0%
36	Puducherry	382				3	0	385	0.0%
37	Others\$					1022	790	1812	0.1%
All India Total		6,95,509	21,134	17,538	5,000	2,556	7,48,990	14,90,727	100%
Distribution (%)		46.66	1.42	1.18	0.34	0.17	50.24	100.00	

\$ Others includes installations through NGOs/IREDA in different states

* Industrial waste

Source: Ministry of New and Renewable Energy