1 Chapter

Reserves and Potential for Generation

CHAPTER 1
Reserves and Potential for Generation

Introduction

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 resources in focus.

Global Classification of Energy Reserves

The classification of energy reserves is guided by the **United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources (UNFC 2009)**. This framework evaluates resources based on:

- **Economic and Social Viability**
- **Field Project Status and Feasibility**
- **Geological Knowledge**

The **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:

- **Class A**: Commercially recoverable resources.
- **Class B**: Potentially commercially recoverable resources.
- **Class C**: Non-commercial and other known deposits.

Energy Reserves in India

India has a diverse range of energy resources, with significant reserves of both fossil fuels and renewable energy potential. The country's energy mix is undergoing a transformation to reduce dependence on fossil fuels and promote the use of renewable energy sources, driven by environmental, economic, and macroeconomic consideration.

This chapter highlights the energy reserves and potential in India, focusing on both fossil fuels and renewable energy resources. It explores coal, lignite, crude oil, natural gas, and renewable energy potential, providing an overview of the country's energy landscape.

Chapter 1: Reserves and Potential for Generation

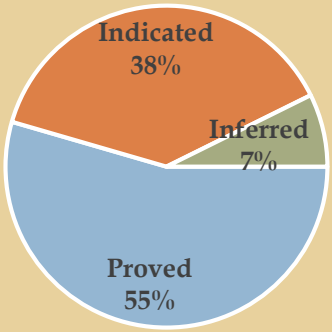
Highlights of reserves in India

1.1 Coal Reserves

India is home to one of the **largest proven coal reserves** in the world. As of **01-04-2024**, the total estimated coal reserves were **389.42 billion tonnes**, showing an addition of **11.21 billion tonnes** compared to the previous year. This marks a **growth of 2.97%** in total coal reserves during the year **2023-24(P)** over the previous year (2022-23) (Table 1.1). The distribution of coal reserves in India is concentrated in a few states like **Odisha**, **Jharkhand** and **Chhattisgarh.** These three states account for approximately **70% of the total coal reserves** in the country.

Out of the total reserves in the country, proven reserves i.e. economically viable and geologically confirmed account for approximately 55% of the total estimated coal reserves as depicted in the **figure 1.1**.

Fig 1.1: Estimated Reserves of Coal in India as on 01.04.2024



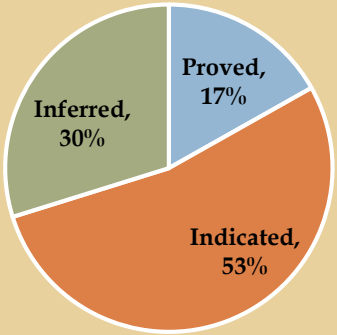
Total Estimated reserves = 389.42 Billion Tonnes

1.2 Lignite Reserves

The total estimated reserves of **lignite** as on **01-04-2024** stood at **47.30 billion tonnes**, showing a decrease of **0.07 billion tonnes** over the previous year. This marks a **decline of 0.15%** in lignite reserves during the year **2023-24(P)** compared to **2022-23 (Table 1.2)**. The highest reserves of lignite are located in the state of **Tamil Nadu (79%)**.

Out of the total lignite reserves in the country, proven reserves of lignite account for approximately **17%** of the total lignite reserves in India as shown in the **figure 1.2**.

Fig 1.2: Estimated Reserves of Lignite in India as on 01.04.2024



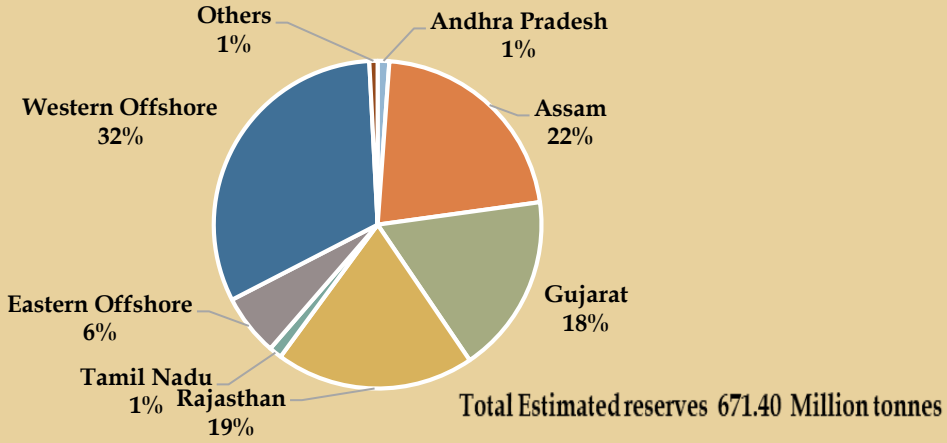
Total Estimated reserves = 47.30 Billion Tonnes

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

1.3 Crude Oil Reserves

As of **01-04-2024**, the estimated reserves of **crude oil** in India stood at **671.40 million tonnes**, compared to **669.47 million tonnes** in the previous year, reflecting a **0.29% increase** over the last year (Table 1.3). Geographically, the maximum crude oil reserves in India are concentrated in the **Western Offshore** region, which accounts for **32%** of the total crude oil reserves. This is followed by the **Assam** region, which holds **22%** of the country's crude oil reserves as shown in **figure 1.3**.

Fig 1.3: Estimated Reserves of Crude Oil in India as on 01.04.2024

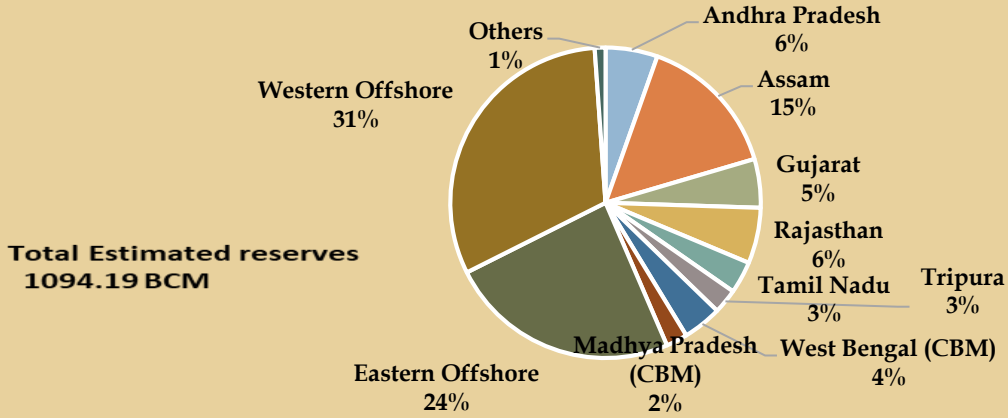


Others include Arunachal Pradesh (0.43%), Nagaland (0.35%), Tripura (0.01%), West Bengal (0.01%)

1.4 Natural Gas Reserves

The estimated reserves of **natural gas** as of **01-04-2024** were **1,094.19 billion cubic meters**. The largest reserves of natural gas in India are located in the **Western Offshore** region, which holds approximately **31%** of the total natural gas reserves. This is followed by the **Eastern Offshore**, which accounts for **24%** of the reserves as shown in **figure 1.4**.

Fig 1.4 : Estimated Reserves of Natural Gas in India as on 01.04.2024



#Others include Arunachal Pradesh (0.67%), Jharkhand (CBM) (0.44%), Nagaland (0.009%)

1.5 Renewable Energy Potential in India

India is increasingly focusing on renewable energy sources as part of its sustainable development and climate action efforts. As of **March 31, 2024**, the total estimated potential for renewable power generation in India stood at **2,109,655 MW**. This potential comes from a variety of renewable sources, including **wind**, **solar**, **biomass**, **small hydro**, and **cogeneration from bagasse (Table 1.4)**.

Fig 1.5: Source wise Estimated Potential of Renewable Power in India as on 31.03.2024

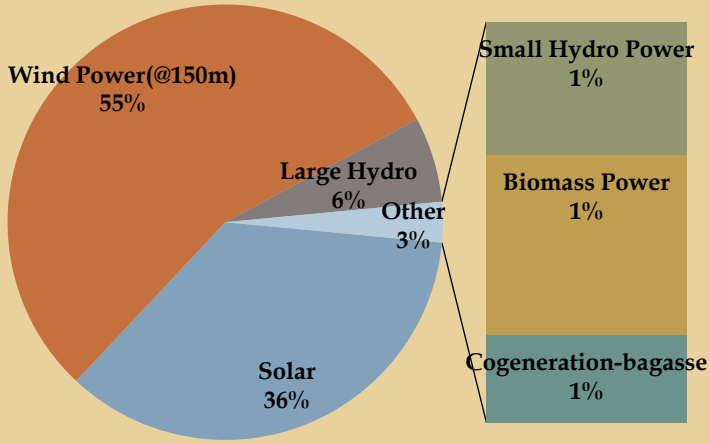


Figure 1.5 shows the potential is spread across several key renewable energy sources, as detailed below:

- **Solar Power**: India has immense potential for solar power generation, estimated at **748,990 MW**, which accounts for **36%** of the total renewable energy potential.
- **Wind Power**: With an estimated potential of **1,163,856 MW** (55% of total renewable energy potential), wind power stands as the most significant source of renewable energy in India.
- **Large Hydropower (Large Hydro)**: The potential for large hydropower generation is estimated at **133,410 MW**, contributing **6%** to the country's renewable energy potential.
- **Small Hydro Power (SHP)**: India also has a notable potential of **21,134 MW** (1%) from **small hydro power** projects.
- **Biomass Power**: Biomass, which includes agricultural waste, forest residues, and other organic matter, has a potential of **28,447 MW**, accounting for **1%** of the total renewable power potential.
- **Cogeneration from Bagasse**: India has a specific potential of **13,818 MW** (1%) from **bagasse-based cogeneration** in sugar mills. This is a highly efficient form of energy generation, especially in regions with a robust sugar industry.

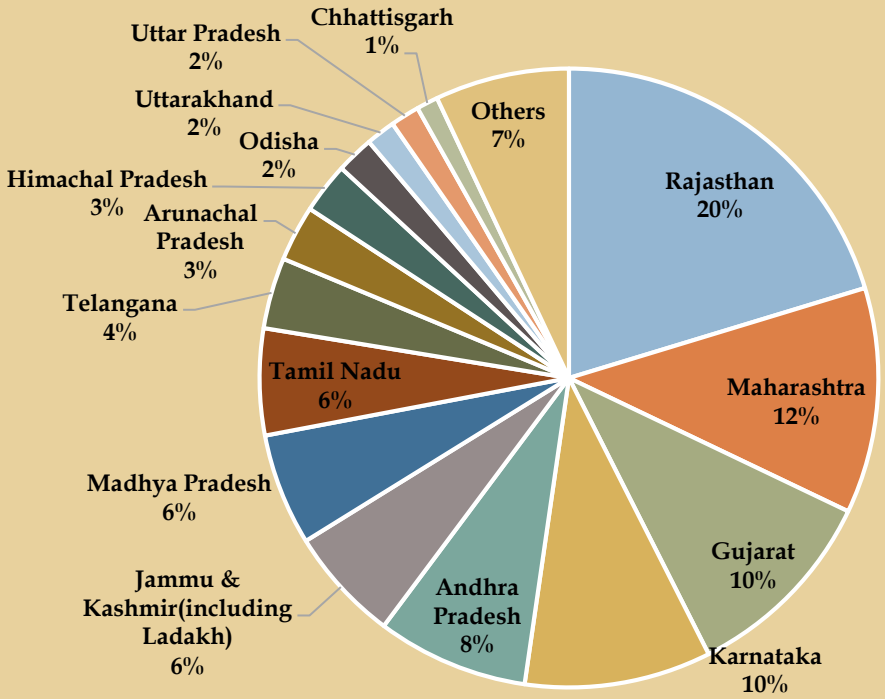
Geographical Distribution of Renewable Energy Potential

The geographical distribution of renewable energy potential in India (**Figure 1.6**) shows significant regional variations. The states with the highest renewable energy potential, as of **March 31, 2024**, are:

- **Rajasthan**: **20**% of total potential (428,322 MW)
- **Maharashtra**: **12**% of total potential (248,665 MW)
- **Gujarat**: **10**% of total potential (220,505 MW)
- **Karnataka**: **10**% of total potential (205,648 MW)

Together, these four states account for over **52**% of India's total renewable energy potential, highlighting their critical role in India's renewable energy future.

Fig 1.6: Statewise Estimated Potential of Renewable Power in India as on 31.03.2024



Total Estimated Potential of Renewable Power =21,09,655 MW

Table 1.1: Statewise Estimated Reserves of Coal (As on 1st April)

(in Million Tonnes)

States/ UTs	Proved		Indicated		Inferred		Total		Distribution (%)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
Andhra Pradesh	1,025	1,025	2,369	2,369	778	778	4,172	4,172	1.10	1.07
Arunachal Pradesh	31	31	40	40	19	19	90	90	0.02	0.02
Assam	465	465	57	57	3	3	525	525	0.14	0.13
Bihar	310	2,346	5,040	3,015	48	37	5,398	5,398	1.43	1.39
Chhattisgarh	37,236	40,078	42,294	41,093	1,244	1,495	80,774	82,666	21.36	21.23
Jharkhand	55,749	59,877	26,994	27,135	5,095	4,799	87,838	91,812	23.22	23.58
Madhya Pradesh	15,279	15,425	12,457	12,379	4,482	5,011	32,219	32,815	8.52	8.43
Maharashtra	8,065	8,163	3,425	3,372	1,847	1,817	13,336	13,352	3.53	3.43
Meghalaya	89	96	17	17	471	471	576	583	0.15	0.15
Nagaland	9	9	22	22	448	448	478	478	0.13	0.12
Odisha	52,046	53,799	37,536	39,053	4,936	6,351	94,519	99,204	24.99	25.47
Sikkim	0	0	58	58	43	43	101	101	0.03	0.03
Telangana	11,257	11,257	8,497	8,497	3,433	3,452	23,186	23,206	6.13	5.96
Uttar Pradesh	884	884	178	178	0	0	1,062	1,062	0.28	0.27
West Bengal	17,459	18,752	12,699	11,433	3,775	3,773	33,933	33,958	8.97	8.72
All India Total	**199,904**	**212,207**	**151,682**	**148,717**	**26,621**	**28,498**	**378,207**	**389,421**	**100**	**100**
Distribution (%)	**52.86**	**54.49**	**40.11**	**38.19**	**7.04**	**7.32**	**100**	**100**		

Total may not tally due to rounding off

Source: Ministry of Coal

Table 1.2: Statewise Estimated Reserves of Lignite(As on 1st April)

(in Million Tonnes)

States/ UTs	Proved		Indicated		Inferred		Total		Distribution (%)	
	2023	2024	2023	2024	2023	2024	2023	2024	2023	2024
Gujarat	1279	1279	284	284	1160	1160	2722	2722	5.75	5.76
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	6	6	0	0	0	0	6	6	0.01	0.01
Puducherry	0	0	406	406	11	11	417	417	0.88	0.88
Rajasthan	1204	1204	3109	3109	2274	2274	6586	6586	13.90	13.93
Tamil Nadu	5023	5476	21885	21412	10688	10635	37597	37524	79.37	79.34
West Bengal	0	0	1	1	3	3	4	4	0.01	0.01
All India	**7512**	**7964**	**25704**	**25231**	**14153**	**14100**	**47369**	**47296**	**100**	**100**
Distribution (%)	**15.86**	**16.84**	**54.26**	**53.35**	**29.88**	**29.81**	**100**	**100**		

Total may not tally due to rounding off

Source: Ministry of Coal

Table 1.3: Statewise Estimated Reserves of Crude Oil and Natural Gas (As on 1st April)

States/ UTs/ Region	Crude Oil (Million Tonnes)				Natural Gas (Billion Cubic Metres)			
	2023		2024		2023		2024	
	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)	Estimated Reserves	Distribution (%)
Andhra Pradesh	11.11	1.66	7.69	1.15	63.16	5.53	59.27	5.42
Arunachal Pradesh	2.97	0.44	2.88	0.43	7.24	0.63	7.33	0.67
Assam	148.13	22.13	145.41	21.66	165.68	14.51	164.51	15.03
Guiarat	120.33	17.97	118.86	17.70	56.60	4.96	55.46	5.07
Nagaland	2.38	0.36	2.38	0.35	0.09	0.01	0.09	0.01
Rajasthan	116.68	17.43	131.50	19.59	63.96	5.60	63.55	5.81
Tamil Nadu	8.72	1.30	8.54	1.27	37.54	3.29	36.57	3.34
Tripura	0.07	0.01	0.07	0.01	28.93	2.53	28.18	2.58
West Bengal	0.11	0.02	0.15	0.02	0.00	0.00	0.00	0.00
West Bengal (CBM)	0.00	0.00	0.00	0.00	79.33	6.95	44.37	4.06
Jharkhand (CBM)	0.00	0.00	0.00	0.00	4.87	0.43	4.86	0.44
Madhya Pradesh (CBM)	0.00	0.00	0.00	0.00	25.18	2.21	24.38	2.23
Eastern Offshore	40.54	6.06	40.67	6.06	262.36	22.98	263.34	24.07
Western Offshore	218.42	32.63	213.26	31.76	346.80	30.37	342.29	31.28
Total	**669.47**	**100.00**	**671.40**	**100.00**	**1141.73**	**100.00**	**1094.19**	**100.00**

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

Chapter 1: Reserves and Potential for Generation

Table 1.4: Sourcewise and Statewise Estimated Potential of Renewable Power in India (as on 31.03.2024)

(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	J& K(including Ladakh)	1 (Ladakh)	1707	83	0	111050	12972	**125813**	**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		**1,163,856**	**21,134**	**28,447**	**13,818**	**748,990**	**133,410**	**2,109,655**	**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

*capacity upto 25 MW, # capacity > 25 MW

Source: Ministry of New and Renewable Energy