सत्यमेव जयते

Report on Resource Adequacy Plan (Generation) for Odisha (2025-26 to 2035-36) (Version 2.0)

November, 2025

Government of India
Ministry of Power
Central Electricity Authority

Contents

Disclaimer 3

Executive Summary 4

1.0 Introduction 6

2.0 Highlights of the Previous RA Study (Up to FY 2033–34) 7

3.0 Odisha RA Study (from 2025-26 to 2035-36) 9

3.1 Present Power Scenario in Odisha 9

3.2 Demand Analysis of the FY 2024-25 10

4.0 Principles of Generation Planning 12

4.1 Generation Expansion Planning Tool -ORDENA 13

5.0 Reliability Analysis 13

5.1 Demand variation 14

5.2 RE variation 15

5.3 Forced Outage of Thermal Generators 15

6.0 Inputs/Assumptions for the Study 15

7.0 Outcome of the model 18

7.1 Unserved Energy Projections 18

7.2 Investment options to meet the unserved energy 18

7.3 Day-wise Surplus Coal Capacity (in MW) 23

8.0 Conclusions 23

Disclaimer

This Resource Adequacy Study for the state of Odisha has been conducted based on data and inputs provided by GRIDCO (Odisha). The findings, analysis and conclusions presented in this report are contingent upon the accuracy, completeness and timeliness of the information furnished by the State. Any discrepancies or limitations in the data may affect the outcomes of the study accordingly.

In accordance with the Resource Adequacy Guidelines dated 28th June 2023, each Distribution Licensee is mandated to prepare a Resource Adequacy Plan (RAP) for a 10-year horizon, referred to as the Long-Term Distribution Licensee Resource Adequacy Plan (LT-DRAP), which shall be vetted and validated by the Central Electricity Authority (CEA). CEA has facilitated this study and prepared the report solely to assist the state of Odisha in fulfilling this requirement.

It is expressly stated that the responsibility for the implementation of the study's recommendations, ensuring the adequacy of electricity resources, and undertaking any related actions rests entirely with the State.

Executive Summary

Ministry of Power had notified the Electricity (Amendment) Rules in December, 2022. As per Rule 16 of the Electricity (Amendment) Rules, Ministry of Power has notified Resource Adequacy (RA) Guidelines. According to these Guidelines, Central Electricity Authority (CEA) is entrusted with the responsibility of preparing the Long-Term National Resource Adequacy Plan (LT-NRAP). Further, each Distribution Utility is required to carry out a Long-Term Distribution Licensee Resource Adequacy Plan (LT-DRAP) to reliably meet its peak electricity demand and electrical energy requirements.

As per the Resource Adequacy Guidelines dated 28th June 2023, each Distribution Licensee shall prepare a Resource Adequacy Plan (RAP) with a 10-year planning horizon, LT-DRAP to meet its own peak electricity demand and electrical energy requirement. This plan shall be vetted/validated by CEA to leverage the benefits of national-level optimization for the Distribution Licensees. The LT-DRAP shall be prepared by the Distribution Licensees on an annual rolling basis, factoring in the already contracted capacity and optimizing the requirement for additional capacity.

Government of India has notified the Renewable Purchase Obligation (RPO) trajectory up to 2029-30 vide gazette notification dated 20th October 2023, which mandates that a specified portion of energy consumption must be met from renewable energy sources.

To support the state in fulfilling this requirement, CEA, initially carried a Resource Adequacy (RA) study with a planning horizon up to FY 2033-34, based on the data provided by GRIDCO and in compliance with the RPO trajectory specified in the Ministry of Power's Office Memorandum dated 20th October, 2023. This study has now been updated and extended to cover the period up to FY 2035-36, incorporating the latest data furnished by the State and planning assumptions. The RPO requirement for the state has also been assessed in accordance with the gazette notified trajectory specified in the Ministry of Power's Office Memorandum dated 20th October, 2023.

The electrical energy requirement and peak electricity demand for Odisha, as furnished by GRIDCO, are projected to increase with a CAGR of 4.01% and 4.79% respectively from 2025-26 to 2035-36. However, as per mid-term review of 20th EPS projections, the electricity energy requirement and peak electricity demand for Odisha is projected to increase with a CAGR of 16.79% and 15.72% respectively from 2025-26 to 2035-36. The study has been done considering the demand projections furnished by GRIDCO, as these projections are in alignment with the projections of 20th EPS and the earlier projections furnished by GRIDCO. For satisfying resource adequacy i.e., meeting the electricity demand reliably and at affordable cost, the state needs to methodically plan its capacity expansion either by investing in new generation or by procuring power. In view of the reduction in cost of solar panels and newer technology options like battery energy storage systems, planning for long term optimal generation capacity mix gains tremendous importance so as the future generation capacity mix is cost effective as well as environment friendly.

The study for Odisha, based on existing contracted capacity and planned capacity additions, indicates that the available capacity may be sufficient to meet the projected future demand. However, the state, with its existing and planned Renewable Energy (RE)- based capacity, may be unable to fulfill its Renewable Purchase Obligation targets.

To find out the least cost option for generation capacity expansion for the period 2025-26 to 2035-36, generation expansion study has been carried out with an objective to minimize the total system cost of generation including the cost of anticipated future investments while fulfilling all the technical constraints associated with various power generation technologies. Additionally, reliability study has been carried out to determine the probability of unmet demand and hours by implementing the variation in demand, RE generation and forced outage of thermal generators (Coal/ Lignite) etc.

Generation capacity expansion pathways have been considered for the long-term study based on the yearly capacity addition plan of Odisha along with RPO constraints for Solar, Wind and DRE technologies. The Renewable capacities have been assessed in view of adherence to RPO notified by Ministry of Power, considering the fungibility among different sources.

The Resource adequacy studies have projected likely optimal capacity mix for future years till 2035-36 which shall be able to meet anticipated demand reliably at every instance. Based on the study, the likely total projected contracted capacity for the year 2035-36 is around 25,305 MW which consists of 7,856 MW from coal; 3,061 MW from hydro; 7,205 MW from solar; 2,245 MW from wind; 2,113 MW from Distributed Renewable Energy (DRE) source and 2,825 MW from Storage (BESS & PSP). This capacity shall be able to meet the projected demand with prescribed reliability criteria.

1.0 Introduction

Ministry of Power has notified Electricity (Amendment) Rules 2022, in December 2022. Rule 16 (I) of the said rules stipulates that "A guideline for assessment of resource adequacy during the generation planning stage (one year or beyond) as well as during the operational planning stage (up to one year) shall be issued by the Central Government in consultation with the Authority". Accordingly, the Resource Adequacy Guidelines have been notified in June, 2023, by Ministry of Power in consultation with Central Electricity Authority.

Resource Adequacy is generally defined as a mechanism to ensure that there is an adequate supply of generation resources to serve expected demand reliably at least cost. A key aspect of resource adequacy planning is to ensure that adequate generation capacities are available round-the-clock to reliably serve demand, under various scenarios. This naturally translates into the need for ensuring adequate reserve margin which could cater to varying levels of demand and supply conditions in the grid. In the wake of high RE generation, it is important to understand demand-supply situation in the grid precisely due to high seasonality and intermittency in RE generation. Resource Adequacy exercise may also help in assessment of capacity requirement to be tied up or contracted on long term, medium term, and short-term basis.

Further, Ministry of Power vide notification dated 20th October, 2023, had notified the RPO trajectory for the states/Discoms. Based on the trajectory specified, hydro, wind and other (solar, biomass etc.) RPO quantum in million units (MUs) has been calculated to find additional quantum of renewable capacity that the states/Discoms have to contract in addition to the existing/planned capacity to meet their RPO targets.

To support the state in fulfilling the Resource Adequacy Guidelines and complying with the Renewable Purchase Obligation (RPO) notification, CEA has carried out the RA study for the state of Odisha based on inputs furnished by GRIDCO. The study recommends an optimal resource mix up to FY 2035-36, taking into account technical and financial parameters associated with various capacities. It aims to optimize long-term power procurement while ensuring resource adequacy to meet demand on a 24x7 basis, considering variations in demand, RE generation, and forced outage of thermal capacities. The study also assesses the Planning Reserve Margin (PRM) required by the state to account for the aforementioned uncertainties, ensuring that demand can be reliably met throughout the year.

Prior to this, CEA had conducted the RA study for the state up to FY 2033-34, based on data furnished by GRIDCO and in accordance with the RPO trajectory specified in the Ministry of Power's Office Memorandum dated 20th October, 2023.

2.0 Highlights of the Previous RA Study (Up to FY 2033-34)

1. In the earlier Resource Adequacy (RA) study, financial year 2022-23 was considered as the base year, and the study covered the period from 2023-24 to 2033-34. The fuel-wise contracted capacity of Odisha as on 31st March, 2023, is given in Fig. 1.

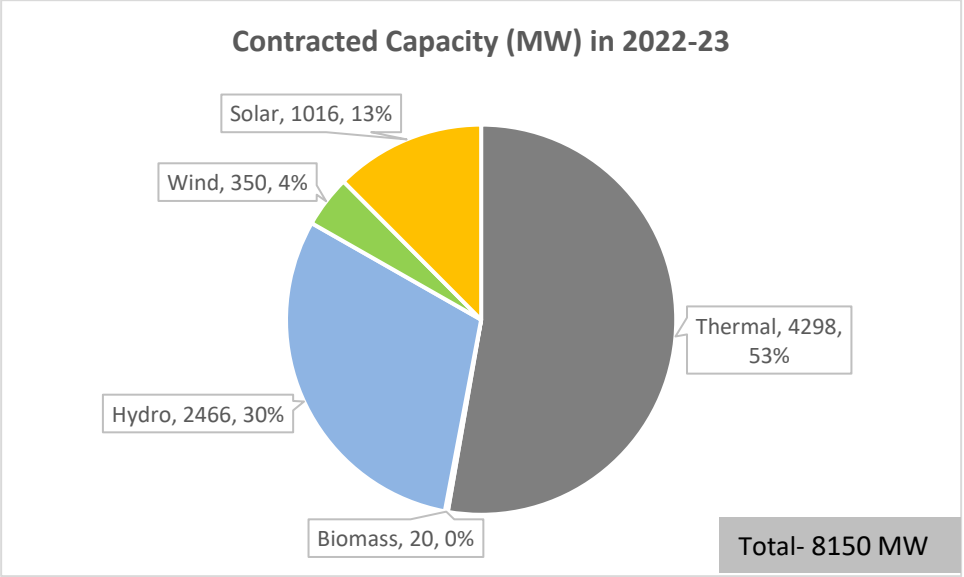


Figure 1: Fuel-wise Contracted Capacity (in MW) as on 31st March, 2023

2. The peak electricity demand and electrical energy projections that has been considered in the study is given in Table 1.

Table 1: Peak electricity demand & electrical energy projections as per 20th EPS Report

	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34
Electrical Energy Projections (MU)	43582	44985	46689	48627	50810	53180	56316	57891	59286	61611	64027
Year on Year Growth		3.22%	3.79%	4.15%	4.49%	4.66%	5.90%	2.80%	2.41%	3.92%	3.92%
Peak Electricity Demand Projections (MW)	6635	6918	7252	7630	8053	8514	9107	9456	9782	10166	10564
Year on Year Growth		4.27%	4.83%	5.21%	5.54%	5.72%	6.96%	3.83%	3.45%	3.93%	3.92%

3. To meet the above projected peak electricity demand and electrical energy requirement reliably, the source-wise projected capacity (in MW) as outlined in the previous report is given in Table 2.

Table 2: Source-wise projected capacities

YEAR	COAL	BIOMASS	HYDRO	WIND	SOLAR	PSP	DRE	SToA/ MToA*
2023-24	4570	20	2466	350	1016	0	0	2203
2024-25	4578	20	2482	1150	2755	0	550	2226
2025-26	4578	0	2582	2150	3555	0	799	2185
2026-27	4578	0	2811	2376	3619	0	1071	2529
2027-28	5503	0	2915	2376	3619	0	1367	1912
2028-29	6170	0	2960	2376	3619	0	1691	1757
2029-30	6170	0	3167	2376	4182	600	2066	1556
2030-31	6170	0	3267	2376	4824	920	2360	1462
2031-32	6170	0	3367	2376	5996	1420	2659	976
2032-33	6170	0	3467	2376	6655	1420	3014	1424
2033-34	6225	0	3567	2376	7455	1420	3393	1800

***** *The SToA/MToA value represents the peak power requirement in MW and it was recommended that this requirement may be met through power procurement from the market or through bilateral agreements.*

4. The year-wise planned and additional capacity contract addition (in MW) for the above tabulated cumulative capacity is given in Table 3.

Table 3: Year-wise planned and additional capacity contract addition

FY	Thermal		Hydro		SOLAR		Wind		PSP		Yearly STOA	DRE	Total	
	Planned	Additional	Planned	Additional	Planned	Additional	Planned	Additional	Planned	Additional	Additional	Additional	Planned	Additional
2023/24	271	0	0	0	0	0	0	0	0	0	2203	0	**271**	**2203**
2024/25	271	0	16.5	0	939	800	400	400	0	0	2226	550	**1626.5**	**3976**
2025/26	0	0	100	0	0	800	600	400	0	0	2185	249	**700**	**3634**
2026/27	0	0	128.5	100	0	64	0	226	0	0	2529	271	**128.5**	**3190**
2027/28	933	0	104	0	0	0	0	0	0	0	1912	297	**1037**	**2209**
2028/29	667	0	0	45	0	0	0	0	0	0	1757	324	**667**	**2126**
2029/30	0	0	107	100	563	0	0	0	600	0	1556	375	**1270**	**2031**
2030/31	0	0	0	100	300	341	0	0	320	0	1462	294	**620**	**2197**
2031-32	0	0	0	100	469	703	0	0	500	0	976	299	**969**	**2078**
2032/33	0	0	0	100	0	659	0	0	0	0	1424	355	**0**	**2538**
2033/34	0	55	0	100	0	800	0	0	0	0	1800	379	**0**	**3134**
Total	**2142**	**55**	**456**	**645**	**2271**	**4167**	**1000**	**1026**	**1420**	**0**	**20030**	**3393**	**7289**	**29316**

**Requirement is for a particular year*

3.0 Odisha RA Study (from 2025-26 to 2035-36)

3.1 Present Power Scenario in Odisha

The power supply position for Odisha from 2020-21 to 2024-25 is given in Table 4:

Table 4: Power Supply Position of Odisha

Power Supply Position						
Year	**Energy required (MU)**	**Energy supplied (MU)**	**Gap (MU)**	**Peak Demand (MW)**	**Peak Met (MW)**	**Demand not met (MW)**
2024-25	42882	42858	24	6905	6905	0
2023-24	41358	41333	25	6443	6443	0
2022-23	42631	42584	47	6566	6391	175
2021-22	38339	38332	7	5643	5643	0

2020-21	29848	29848	0	4984	4984	0

The data in Table 4 indicates that over the past five years, Odisha's electrical energy requirement and peak electricity demand have increased at a Compound Annual Growth Rate (CAGR) of 9.48% and 8.49%, respectively.

As per the data provided by GRIDCO, as of March 2025, the total contracted capacity of Odisha is 8,927 MW. Out of the total contracted capacity (CC), the share of non-fossil fuel-based CC is about 45%.

The fuel-wise contracted capacity as on 31st March, 2025 is given in Table 5 and Fig. 2.

Table 5: Fuel-wise Contracted Capacity as on March 2025

Source	Contracted Capacity (MW)	Percentage
Coal	4958	55%
Hydro	2477	28%
Wind	350	4%
Solar	955	11%
DRE	187	2%
Total	**8927**	**100.0%**

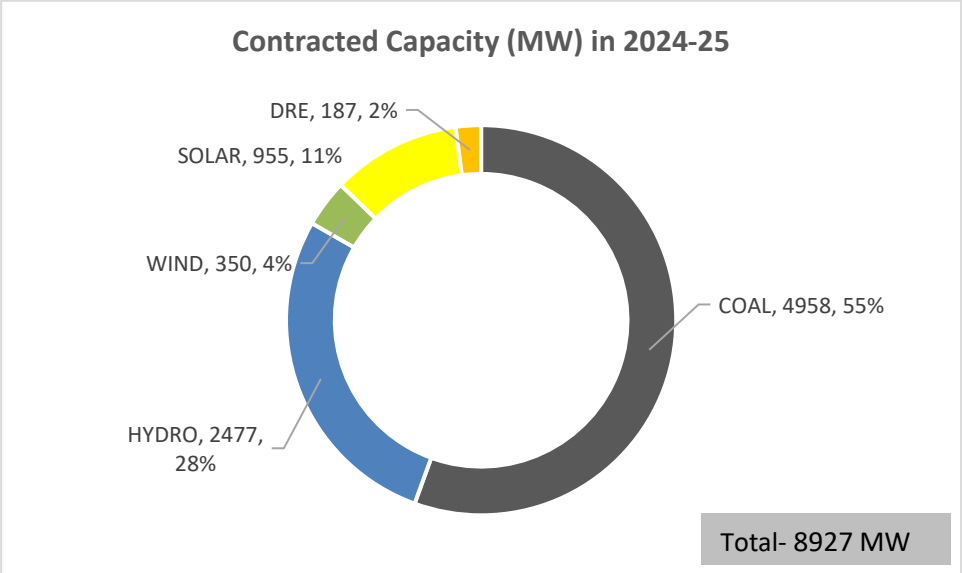


Figure 2: Fuel-wise Contracted Capacity (in MW) as on 31st March, 2025

3.2 Demand Analysis of the FY 2024-25

Hourly demand pattern of 2024-25 was analyzed and it was observed that the peak demand season for State of Odisha is typically during the months from April to June. Odisha witness peak electricity demand during non-solar hours.

The month-wise average hourly demand observed for the year 2024-25 is shown in Fig. 3.

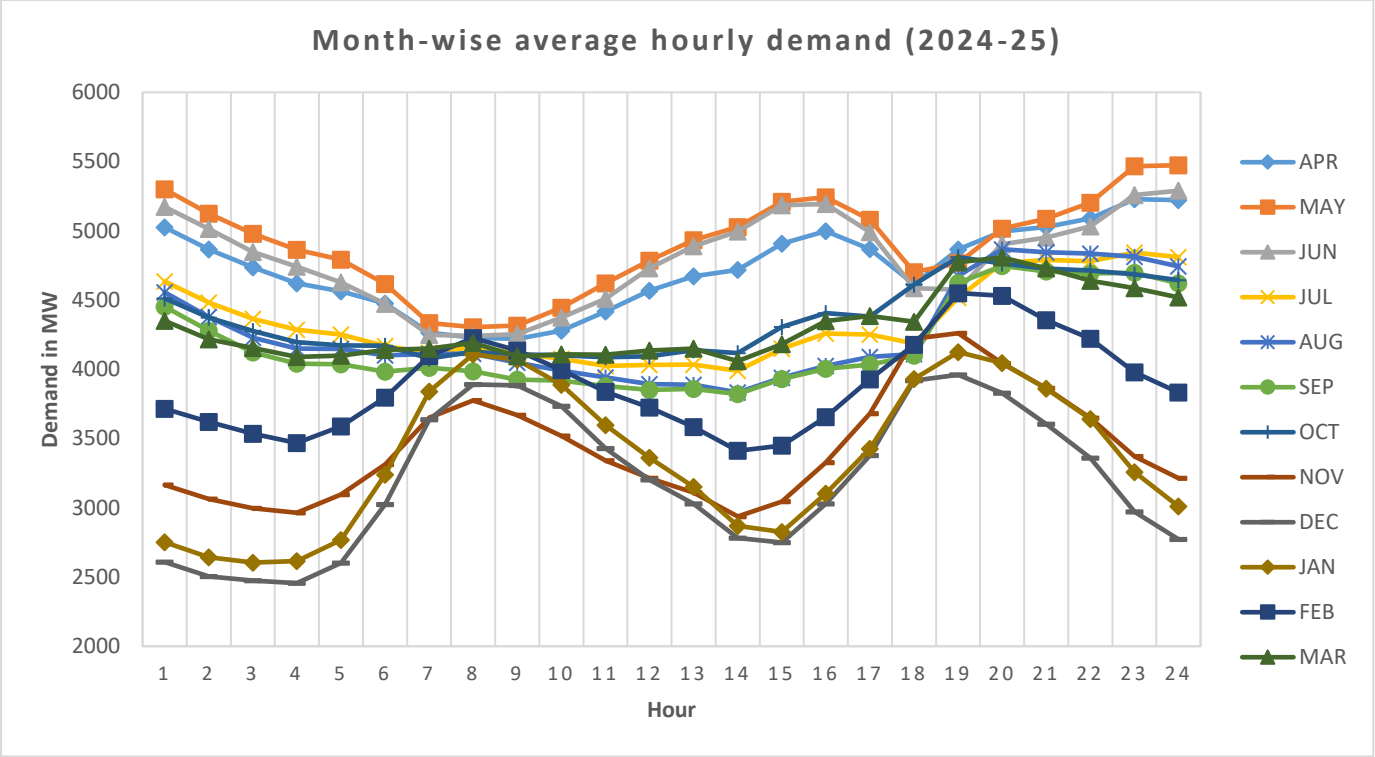


Figure 3: Month-wise Average Hourly Demand Variation for 2024-25

From the hourly demand data of 2024-25, the daily peak demand during solar hours and non-solar hours are plotted in Fig. 4.

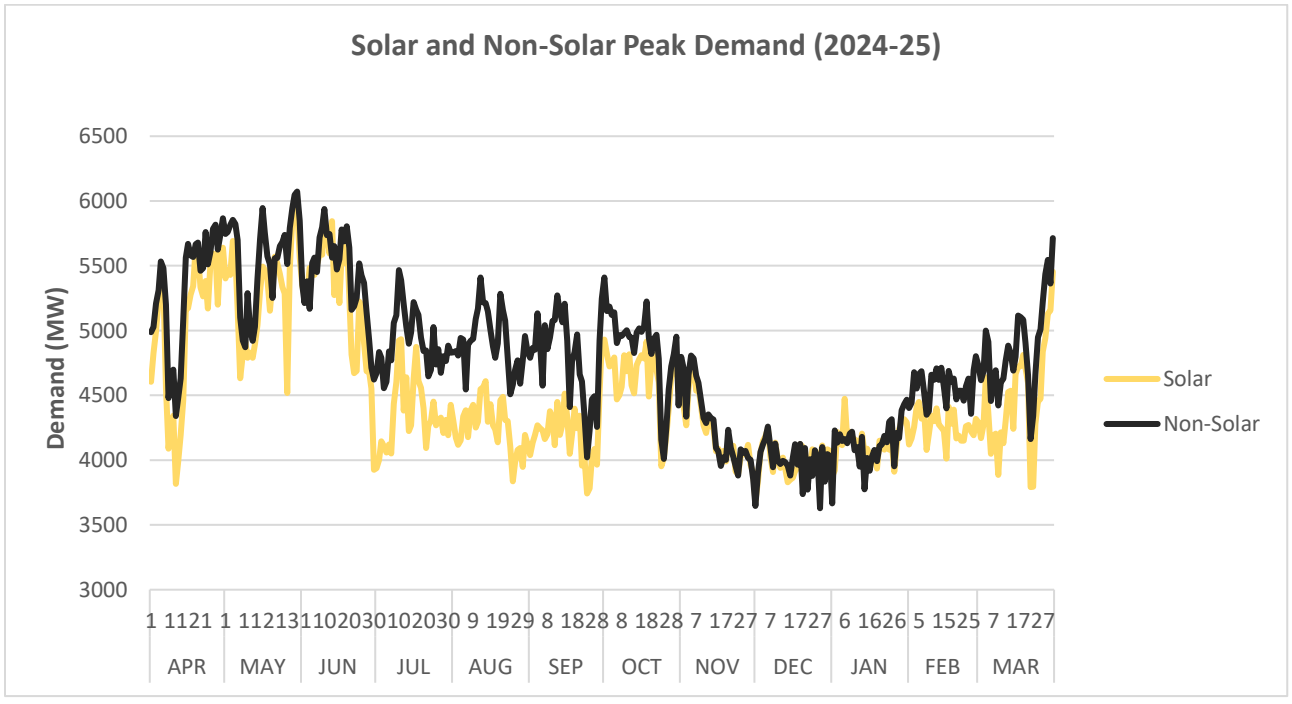


Figure 4: Solar and non-solar peak in MW for the year 2024-25

The hourly demand pattern of 2024-25 was analysed for finding out the number of occurrences of the peak and near peak demand. Such instances are critical for study purpose as it is necessary to ensure resource adequacy during such instances with an optimal mix of long-term, medium-term and short-term contracts. Frequency Distribution of hourly demand profile for 2024-25 is shown in Fig. 5.

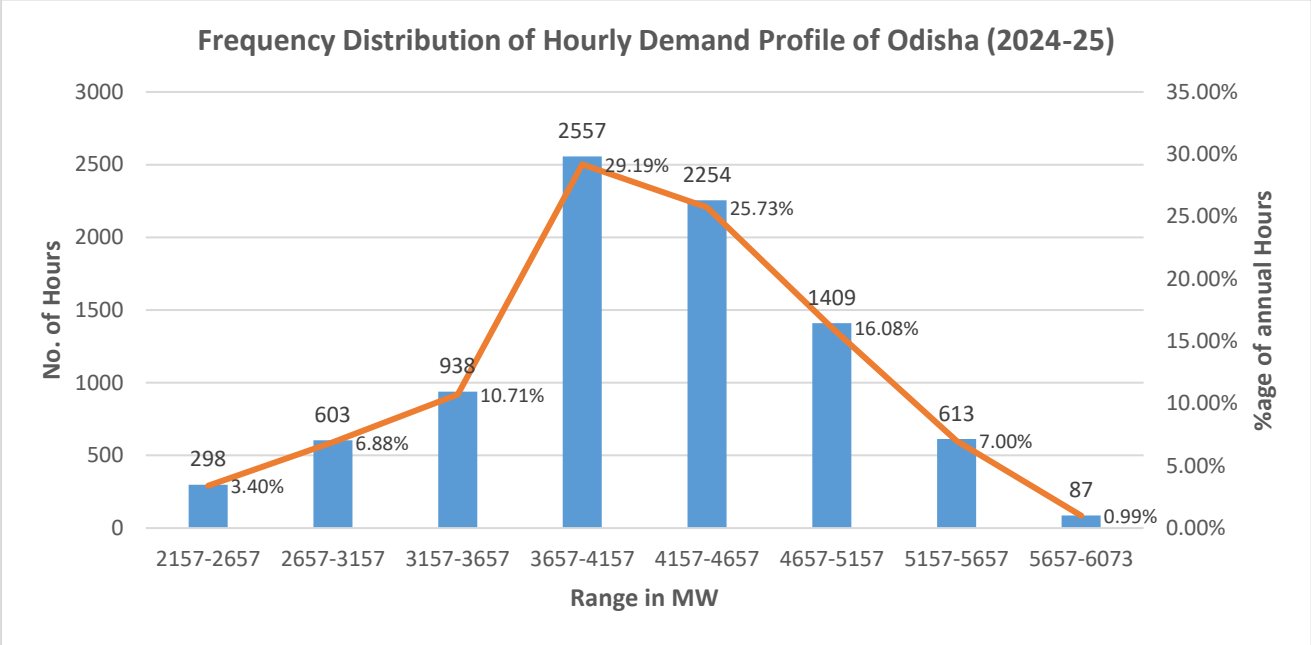


Figure 5: Frequency Distribution of hourly demand profile of 2024-25

4.0 Principles of Generation Planning

The objective of Generation Planning process is to obtain an optimal generation capacity mix in the least cost manner to meet the electricity demand at every instance of time while ensuring the most efficient use of resources.

The major aspects considered in the planning process are:

i) To Supply 24x7 reliable power to the consumers
ii) To achieve objectives of all policies of the Government of India such as RPO trajectory, RE capacity addition plan etc.
iii) To achieve sustainable development.
iv) To fulfil desired operational characteristics of the system such as reliability and flexibility.
v) Most efficient use of resources.
vi) Fuel availability

4.1 Generation Expansion Planning Tool -ORDENA

The studies have been carried out using a generation expansion planning model namely ORDENA. ORDENA is a mixed integer linear optimization program that minimizes the Net Present Value (NPV) of investment and operation costs subject to several constraints. The major constraints include balancing electricity supply and demand, resource supply limits, planning and operating reserve limits, and policy targets. These constraints are met considering a broad portfolio of conventional generation, renewable generation, and storage.

ORDENA has a reliability module to determine the trustworthiness of the system using Monte Carlo simulations. The software is also capable of carrying out hourly/sub-hourly economic generation dispatch considering all the technical constraints associated with various generation technologies.

The schematic diagram of the software is given in Fig. 6.

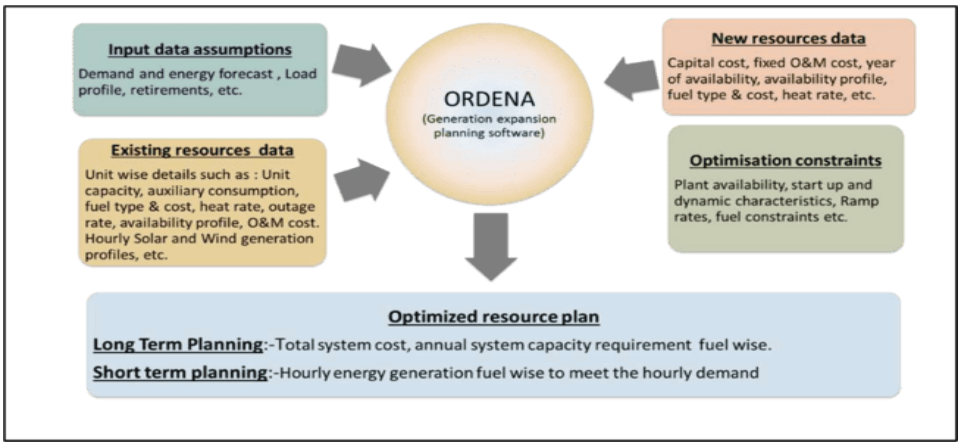


Figure 6: Schematic Diagram

5.0 Reliability Analysis

One of the main criteria of resource adequacy studies is to determine the reliability of the system to meet the demand adequately at every instance of time. This reliability is measured via two indices i.e. LOLP (Loss of Load Probability) and EENS (Expected Energy Not Served). These indices have been defined in resource adequacy guidelines as below:

- **Loss of Load Probability (LOLP)**: Measure of the probability that a system's load may exceed the generation and firm power contracts available to meet that load in a year. E.g., 0.0274 % probability of load being lost.
- **Expected Energy Not Served (EENS):** Expected amount of energy (MWh) that may not be served for each year within the planning period under study. It is a summation of the expected number of megawatt hours of demand that may not be served for the year. This is an energy-centric metric that considers the magnitude and duration of energy being not served, calculated in

Mega Watt hours (MWh). The metric can be normalized (i.e., divided by total system energy requirement) to create a Normalized Energy Not Served (NENS) metric.

Monte Carlo /Stochastic simulation has been used to factor-in the uncertainty associated with various generation resources and demand. It is an approach which is used to predict the probability of a variety of outcomes when the potential for random variables is present, as compared to deterministic modelling of economic dispatch model. Monte Carlo simulation helps in analysing the randomness associated with RE energy resource, demand pattern changes and forced outages of plant. A large no. of random samples of these variables is simultaneously simulated to ascertain system reliability indices (i.e. Loss of load probability LOLP & Energy Not Served (ENS)) & the system robustness in case of above variation of system parameters.

Planning Reserve Margin (PRM): To meet the prescribed standard of LOLP / NENS conditions, sufficient reserve margins need to be maintained in the system for adequately addressing the demand and supply variations. Planning Reserve Margin (PRM) is the predominant metric used to ensure adequacy of generation resources in the system. PRM in a power system is generally expressed as a certain percent of the projected peak electricity demand.

5.1 Variation in electricity demand

The variation in demand pattern for last two years viz. 2023-24 and 2024-25 (considering 2023-24 as the base) has been analyzed. The demand pattern variation across 2023-24 and 2024-25 is shown in Fig. 7.

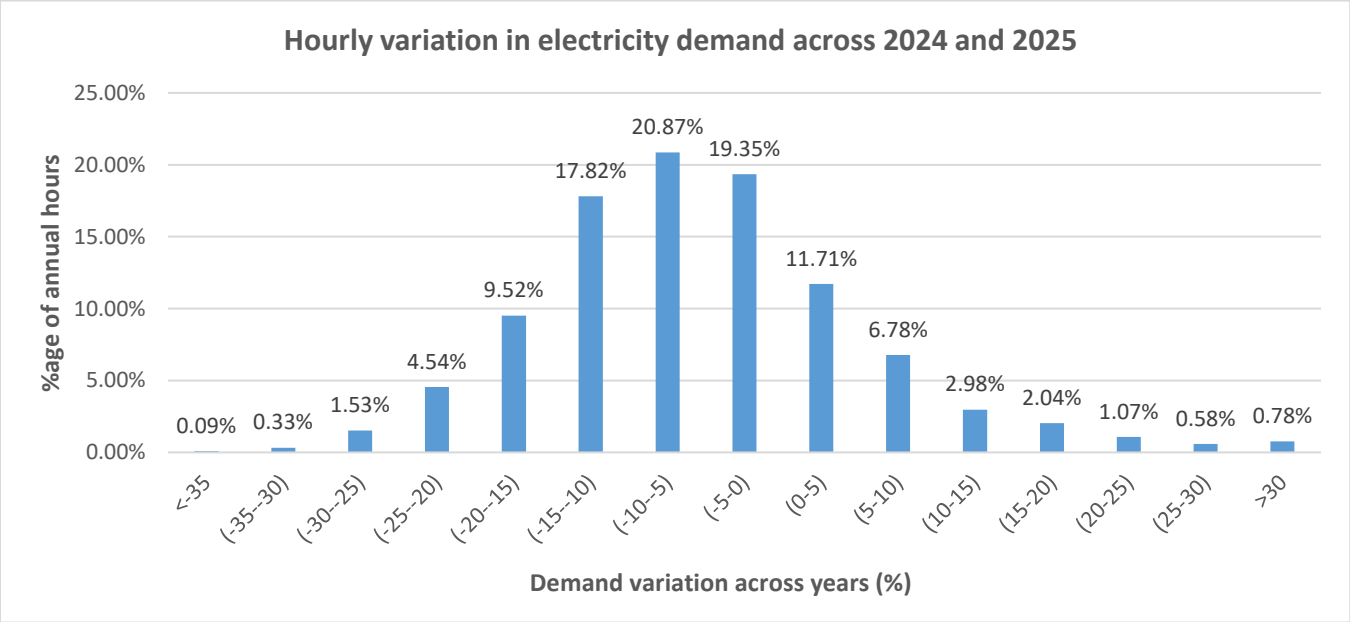


Figure 7: Hourly Variation in electricity demand across years

It can be observed that the hourly demand typically varies within ±10% for ~58% of instances. This variation is primarily due to temperature, weather parameter or any random outages of

transmission line and generating units etc. This variation has been captured in the reliability study by incorporating a variation of ±10% in the projected hourly demand for the future years by introducing a random variable (with normal distribution) for demand as per observed behavior over the years.

5.2 Variation in RE Generation

In the Long-term capacity expansion planning studies, a particular profile for Solar and Wind is considered based on the observed generation data to determine the optimal capacity mix. However, due to intermittent nature of these sources, generation from these non-dispatchable sources may vary across years. As per the analyses carried out based on historical generation data, solar and wind-based generation has been varied by ± 10% and ± 50% respectively to incorporate the variation in these generation sources and plan for requisite measures to mitigate such behavior.

5.3 Forced Outage of Thermal Generators

The average forced outage rate of thermal generators is typically 10% with ±5% variation. The same has been incorporated in the model.

Based on these variations, reliability studies have been carried out to ascertain robustness of the system.

6.0 Inputs/Assumptions for the Study

i) The peak electricity demand and electrical energy requirements of Odisha (excluding demand of open access consumers) furnished by GRIDCO has been considered for the study and are given in Table 6:

Table 6: Electricity demand projections as per GRIDCO

	Peak Electricity Demand		Electrical Energy Requirement	
	Projections (in MW)	Y-o-Y Growth	Projections (in MU)	Y-o-Y Growth
2025-26	6276		38873	
2026-27	6514	3.79%	39952	2.78%
2027-28	6830	4.85%	41324	3.43%
2028-29	7138	4.51%	43095	4.29%
2029-30	7511	5.23%	46129	7.04%
2030-31	7930	5.58%	48220	4.53%
2031-32	8319	4.91%	50082	3.86%
2032-33	8716	4.77%	51860	3.55%
2033-34	9132	4.77%	53701	3.55%
2034-35	9567	4.76%	55607	3.55%
2035-36	10023	4.77%	57581	3.55%

ii) Future demand profile till the year 2035-36 has been projected using the demand profile for the year 2024-25 as the base profile.

iii) The actual solar, wind and hydro generation profiles have been referred from National Electricity Plan 2023 (Vol I Generation).

iv) The capital cost of candidate plants for coal, solar, and battery/PSP technologies is detailed in the Annexure and are in alignment with current market trends and recent price discovery.

v) The planned capacity has been considered based on the tie-up information as furnished by Odisha. The same is summarised in Table 7 and details are furnished in Annexure.

Table 7: Source-wise planned capacity addition/retirement

Fig.in MW

FY	HYDRO (Conventional/Small)	Thermal	Solar	DRE	Wind	PSP	Battery (MW/MWh)
2025-26	161	338	773	572	102	0	0
2026-27	36	0	0	338	793	0	0
2027-28	19	469	70	0	0	0	125/500
2028-29	104	330	167	0	148	0	0
2029-30	94	1302	600	0	853	500	0
2030-31	0	793	1540	0	0	500	0
2031-32	107	0	300	0	0	600	0
2032-33	0	-334@	0	0	0	600	0
2033-34	0	0	0	0	0	500	0
2034-35	63	0	0	0	0	0	0
2035-36	0	0	0	0	0	0	0
Total	**584**	**2898**	**3450**	**910**	**1895**	**2700**	**125/500**

@retirement

vi) **Renewable Purchase Obligation (RPO) trajectory**: Ministry of Power vide gazette notification dated 20th October, 2023, had notified the source wise minimum share of consumption of non-fossil sources (renewable energy) by designated consumers, till the year 2029-30 as given in Table 8.

Table 8: Renewable Purchase Obligation (RPO) trajectory (%) as per MoP order

Sl. No.	Year	Wind renewable energy	Hydro renewable energy	Other renewable energy	Distributed renewable energy	Total renewable energy
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	2024-25	0.67	0.38	27.35	1.5	29.91
2.	2025-26	1.45	1.22	28.24	2.1	33.01
3.	2026-27	1.97	1.34	29.94	2.7	35.95
4.	2027-28	2.45	1.42	31.64	3.3	38.81
5.	2028-29	2.95	1.42	33.1	3.9	41.36
6.	2029-30	3.48	1.33	34.02	4.5	43.33

Further, in view of the country's energy transition goals as well as the long-term net zero target of 2070, it is estimated that the share of RE generation in the generation mix will continue to proportionally increase beyond 2029-30. Therefore, the RPO trajectory is assumed to rise steadily beyond 2029-30. Further, the DRE percentage has been assumed to be 4.5 % beyond 2029-30. Hence, the suggested trajectory of Renewable Purchase Requirement up to FY 2035-36 is given in Table 9.

Table 9: Renewable Purchase Obligation (RPO) trajectory (in %) considered for the study

Sl. No.	Year	Wind renewable energy	Hydro renewable energy	Other renewable energy	Distributed renewable energy	Total renewable energy
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	2024-25	0.67	0.38	27.35	1.50	29.91
2.	2025-26	1.45	1.22	28.24	2.10	33.01
3.	2026-27	1.97	1.34	29.94	2.70	35.95
4.	2027-28	2.45	1.42	31.64	3.30	38.81
5.	2028-29	2.95	1.42	33.10	3.90	41.36
6.	2029-30	3.48	1.33	34.02	4.50	43.33
7.	2030-31	41.00			4.50	45.50
8.	2031-32	42.50			4.50	47.00
9.	2032-33	43.80			4.50	48.30
10.	2033-34	45.00			4.50	49.50
11.	2034-35	46.50			4.50	51.00
12.	2035-36	47.50			4.50	52.00

Based on the trajectory specified, RPO quantum in million units (MUs) from hydro, wind, other (Solar, biomass etc.) and distributed renewable energy (DRE) is calculated and given in Table 10.

Table 10: Total Energy required to meet RPO (MU)

Sl. No.	Year	Wind renewable energy (MU)	Hydro renewable energy	Other renewable energy	Distributed renewable energy	Total renewable energy
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	**2025-26**	563.7	474.3	11385.9	816.3	12832.0
2.	**2026-27**	787.1	535.4	12501.0	1078.7	14362.7
3.	**2027-28**	1012.4	586.8	13756.8	1363.7	16037.8
4.	**2028-29**	1271.3	611.9	15104.8	1680.7	17824.1
5.	**2029-30**	1605.3	613.5	16731.0	2075.8	19987.7
6.	**2030-31**	20855.2			2169.9	21940.1
7.	**2031-32**	22411.7			2253.7	23538.5
8.	**2032-33**	23881.5			2333.7	25048.4
9.	**2033-34**	25373.7			2416.5	26582.0
10.	**2034-35**	27108.4			2502.3	28359.6
11.	**2035-36**	27351.0			2591.1	29942.1

As indicated in Table 11, the state with its existing and envisaged future capacity additions will not be able to meet its RPO requirements from the year 2025-26 onwards.

Table 11: Renewable Energy Deficit/Surplus

FY	RE Generation required to meet RPO		RE Generation available/met (From existing/ planned contracts)		RPO Surplus (+)/ Deficit (-)
	(MU)	(%)	(MU)	(%)	(%)
2025-26	12832.0	33.01	11822	30.4	-2.6
2026-27	14362.7	35.95	14252	35.7	-0.3
2027-28	16037.8	38.81	14486	35.1	-3.7
2028-29	17824.1	41.36	15581	36.2	-5.2
2029-30	19987.7	43.33	18992	41.2	-2.1
2030-31	21940.1	45.5	21895	45.4	-0.1
2031-32	23538.5	47.0	22881	45.7	-1.3
2032-33	25048.4	48.3	22881	44.1	-4.2
2033-34	26582.0	49.5	22881	42.6	-6.9
2034-35	28359.6	51.0	23053	41.5	-9.5
2035-36	29942.1	52.0	23053	40.0	-12.0

7.0 Outcome of the model

7.1 Unserved Energy Projections

Initially, the study has been carried out considering only the existing and planned capacity contracts. From the study, it has been observed that the existing and planned capacities may be sufficient to meet the demand reliably. However, the state may not be able to fulfill its Renewable Purchase Obligations from the year 2025-26 onwards.

7.2 Investment options to meet the unserved energy

As the State's existing and planned capacity contracts may be sufficient to meet the demand, only RE- based investment options (i.e., candidate capacities) have been given to the model to find the least cost optimal capacity mix required to meet the demand while fulfilling the RPO obligations. The capacity projections (existing, planned, to be tied up) for Odisha are given in Table 12.

Table 12: Year-wise contracted capacity projections (existing, planned, to be tied up) (in MW)

Year	COAL	HYDRO	WIND	SOLAR	PSP	BATTERY	DRE	MTOA/STOA
2025-26	5296	2638	452	1728	0	0	759	0
2026-27	5296	2674	1245	1728	0	0	1097	20
2027-28	5766	2693	1245	1798	0	125	1097	0
2028-29	6096	2797	1393	1965	0	125	1370	0
2029-30	7397	2891	2245	2565	500	125	1693	0
2030-31	8191	2891	2245	4105	1000	125	1769	0
2031-32	8191	2998	2245	4405	1600	125	1838	0
2032-33	7856	2998	2245	5105	2200	125	1903	0
2033-34	7856	2998	2245	5805	2700	125	1970	0
2034-35	7856	3061	2245	6505	2700	125	2040	0
2035-36	7856	3061	2245	7205	2700	125	2113	0

The projected contracted capacity mix, year-wise is given in Figure 8.

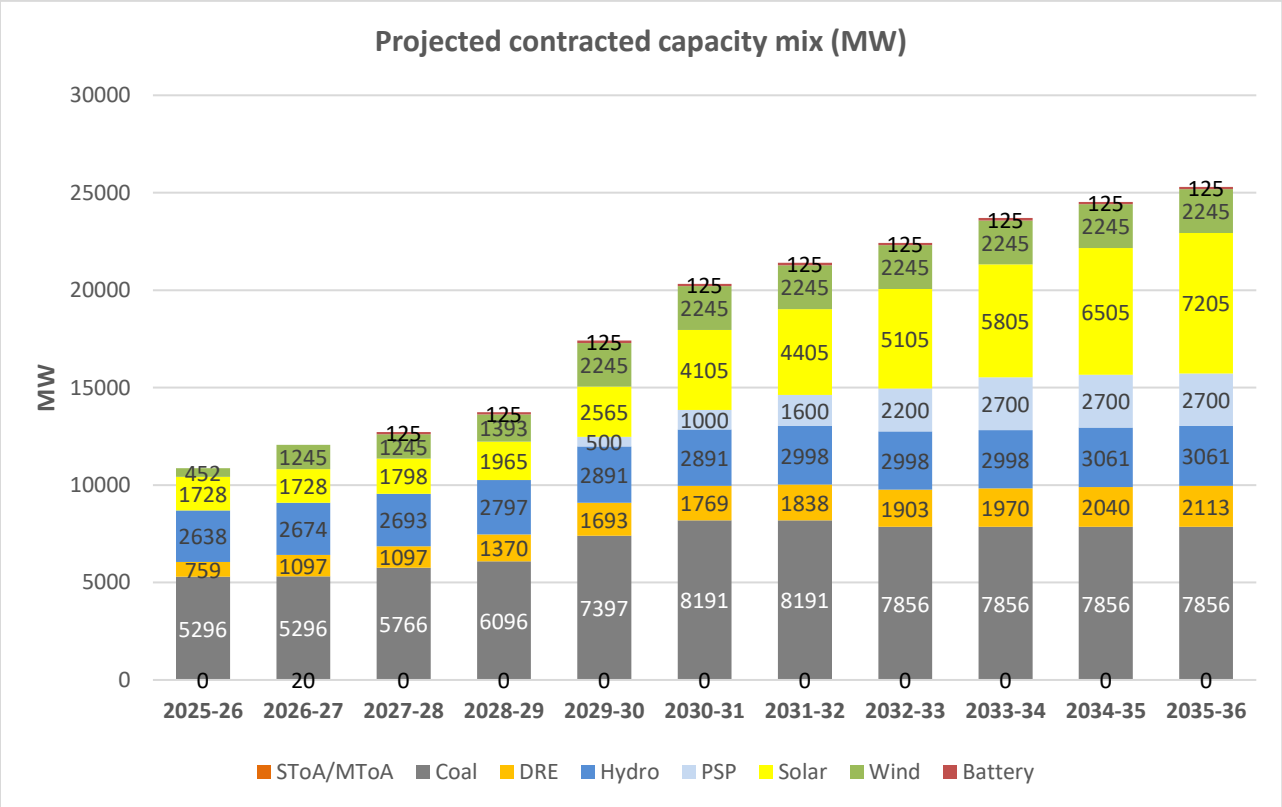


Figure 8: Year-wise Projected Contracted Capacity Mix (MW)

The STOA/MTOA requirement can be fulfilled through power procurement from market or bilateral agreements. The STOA/MTOA value reflects the peak value requirement and seasonal banking requirements in terms of MW.

Reliability studies have been conducted based on the projected capacity for the year 2035-36. The analysis confirms that the projected capacity meets the reliability criteria specified in the National Electricity Plan (NEP), with the Loss of Load Probability (LoLP) and Not-Served Energy (NENS) remaining within the permissible limits of 0.2% and 0.05%, respectively (as specified in the National Electricity Plan (NEP)).

The Resource adequacy studies have projected likely optimal capacity mix for future years till 2035-36 which shall be able to meet anticipated electricity demand reliably. Based on the study, the likely total projected contracted capacity for the year 2035-36 is around 25,305 MW which consists of 7,856 MW from coal; 3,061 MW from hydro; 7,205 MW from solar; 2,245 MW from wind; 2,113 MW from Distributed Renewable Energy (DRE) source and 2,825 MW from Storage (BESS & PSP). This capacity shall be able to meet the projected demand with prescribed reliability criteria and to comply with the stipulated Renewable Purchase Obligation (RPO) targets. Based on the capacity addition, the planning reserve margin works out to ~18%. Capacity mix required by 2035-36 is shown in Figure 9.

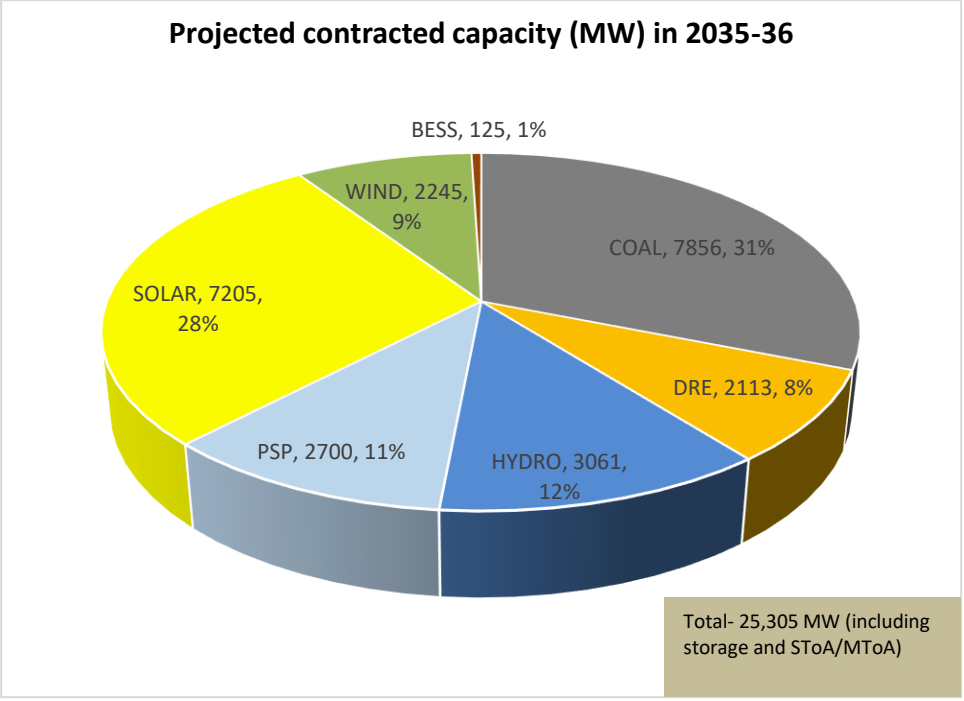


Figure 9: Contracted Capacity Mix in 2035-36

It is important to note that any deviations in the commissioning schedule of the planned capacity could result in a situation where the state is unable to meet the projected peak electricity demand and electrical energy requirements identified in this study with the available resources. Such changes may also lead to an increase in the cost of meeting the state's power demand reliably.

As per the study, the state likely needs to contract the following capacities (planned and additional) every year till 2035-36 to meet its demand reliably as shown in Table 13.

Table 13: Year-wise Capacity Addition/Retirement (in MW)

	Coal	Hydro	Solar		Wind	PSP
Year	Planned Contracts	Planned Contracts	Planned Contracts	Additional Requirement	Planned Contracts	Planned Contracts
2025-26	338	161	773	0	102	0
2026-27	0	36	0	0	793	0
2027-28	469	19	70	0	0	0
2028-29	330	104	167	0	148	0
2029-30	1302	94	600	0	853	500
2030-31	793	0	1540	0	0	500
2031-32	0	107	300	0	0	600
2032-33	-334	0	0	700	0	600
2033-34	0	0	0	700	0	500
2034-35	0	63	0	700	0	0
2035-36	0	0	0	700	0	0
Total	**2898**	**584**	**3450**	**2800**	**1896**	**2700**

	Distributed RE		BESS	Total		STOA /MTOA*
Year	Planned Contracts	Additional Requirement	Planned Contracts	Planned Contracts	Additional Requirement	Additional Requirement
2025-26	572	0	0	1946	0	0
2026-27	338	0	0	1167	0	20
2027-28	0	0	125	683	0	0
2028-29	0	273	0	749	273	0
2029-30	0	322	0	3349	322	0
2030-31	0	77	0	2833	77	0
2031-32	0	68	0	1007	68	0
2032-33	0	65	0	266	765	0
2033-34	0	68	0	500	768	0
2034-35	0	70	0	63	770	0
2035-36	0	72	0	0	772	0
Total	**910**	**1015**	**125**	**12563**	**3815**	

*Yearly requirement

The projected gross generation mix for the state is shown in Figure 10 and 11.

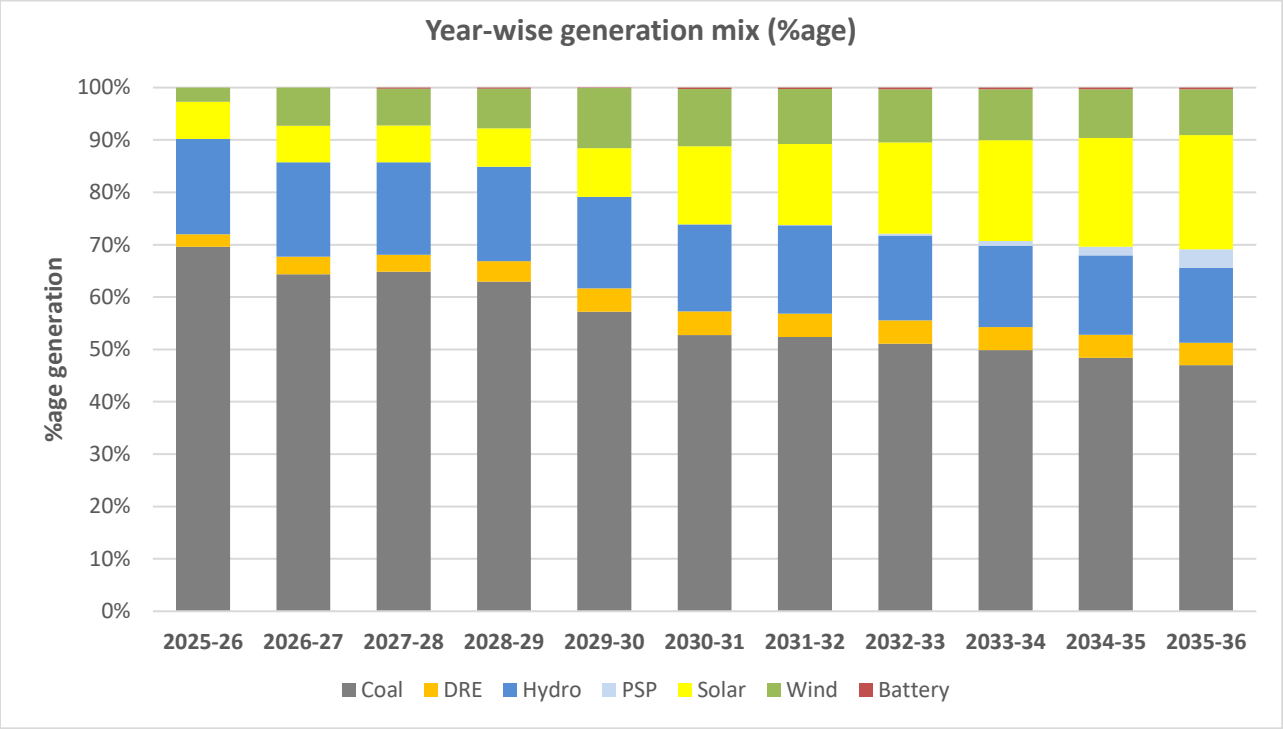


Figure 10: Year-wise projected net generation mix (in %)

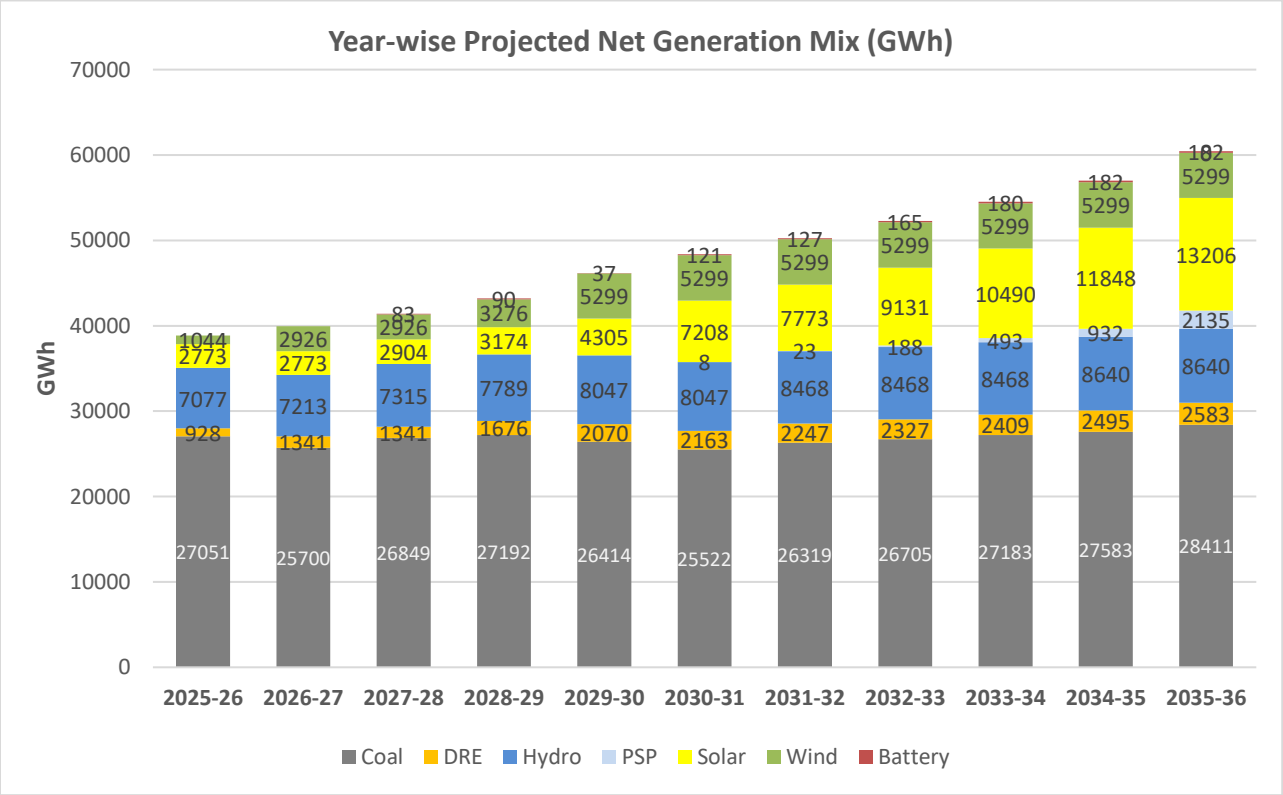


Figure 11: Year-wise projected net generation (in GWh)

7.3 Surplus Coal Capacity (in MW)

Generally, surplus capacity is available with the state due to variation in electricity demand, RE availability etc. The pattern of surplus capacities has been observed as shown in Figure 12. From the figure below, it is observed that Odisha is expected to have a minimum surplus coal-based capacity ranging between 240 MW and 2250 MW during the period from June to January. This surplus capacity may be banked or shared with other states whose demand profile complements that of Odisha.

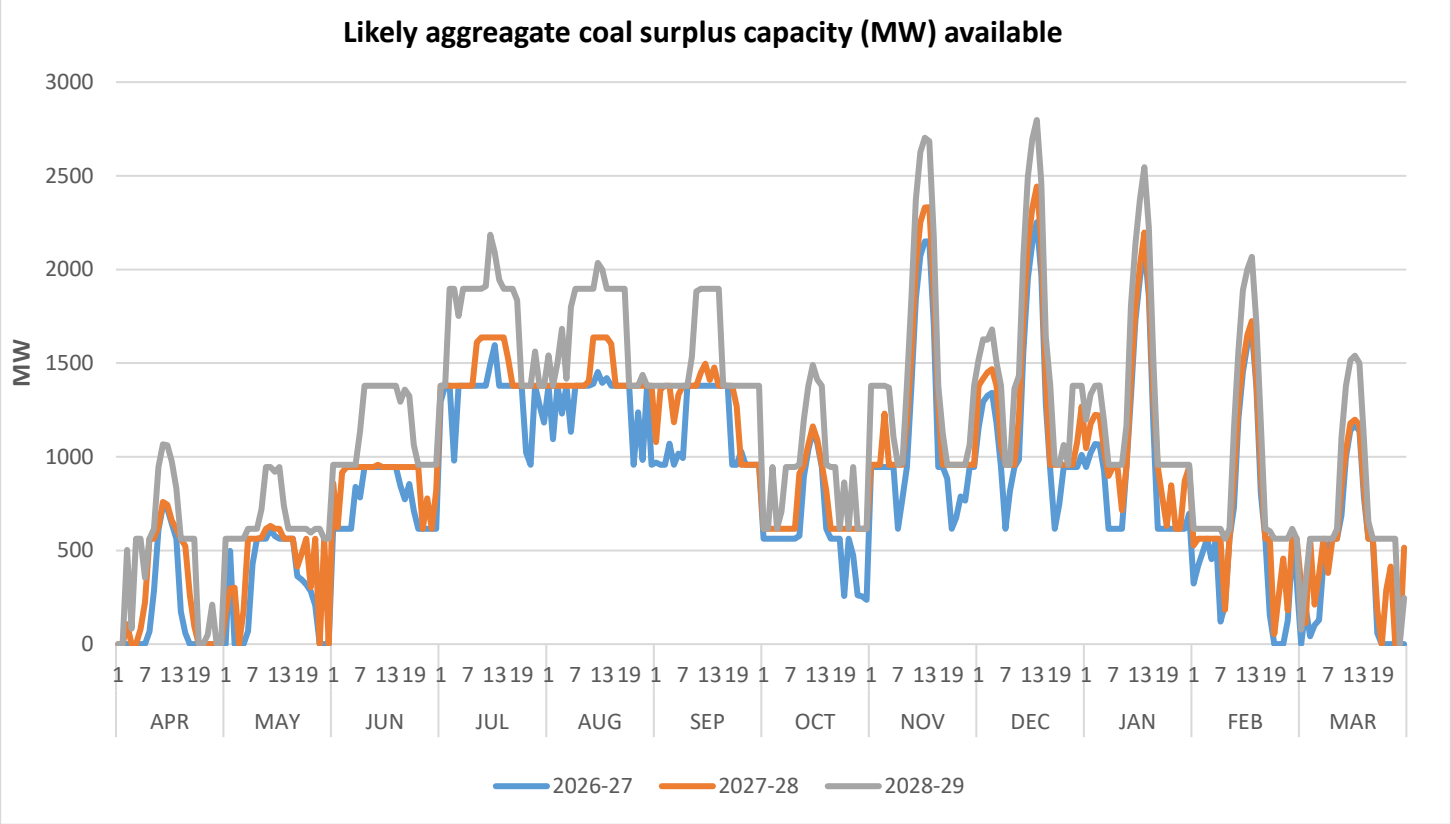


Figure 12: Surplus Coal Capacity Year-wise (MW)

8.0 Conclusions

Based on the Resource Adequacy studies of Odisha up to the year 2035-36, the following conclusions may be drawn:

1. The study has been done based on the hourly electricity demand pattern of the year 2024-25. It has been observed that the peak demand season is typically from April to June with peak demand occurring during non-solar hours.
2. The study has considered electrical energy and peak demand requirement projections as per the projections furnished by GRIDCO (Odisha), which envisages that the annual energy

requirement of the state is likely to grow at a CAGR of 4.01% while the peak electricity demand for the state is likely to grow at a CAGR of 4.79% for the period of 2025-26 to 2035-36.

3. Odisha, with its existing and planned capacity addition, is likely to meet its projected demand reliably. However, as per the study, the state, with its existing and planned capacity addition is likely to fall short in meeting its Renewable Purchase Obligation.
4. In order for the state to fulfill its Renewable Purchase Obligation, the state, in addition to the existing and already planned contracts, needs to tie up approximately 2,800 MW of solar-based capacity, 1015 MW of Distributed Renewable Energy (DRE)-based capacity by 2035-36 (refer Table 13). The projected capacity and generation mix outlined in the report meet the state's RPO requirements for the years 2026-27 to 2035-36.
5. As per studies, the state is expected to have a minimum surplus coal-based capacity ranging between 240 MW and 2250 MW during the period from June to January. This surplus capacity may be banked or shared with other states whose demand profile complements that of Odisha.
6. The Planning Reserve Margin (PRM) for Odisha has been assessed at ~18 %. Further, the study indicates year-wise short-term/medium-term/bilateral requirements inclusive of the PRM capacity to meet the demand optimally.
7. Timely commissioning of planned capacities is critical for ensuring that the state meets its projected peak electricity demand and electrical energy requirements reliably. Any deviation from the planned schedule may lead to resource shortfalls and could significantly increase the cost of reliably meeting the state’s power demand.

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Annexure

Details of upcoming capacities/retirements considered in the study

Sl. No.	Tied capacity name	Type of generation	Expected COD	Odisha's share (in MW)	Remarks
1.	MAADURGA Thermal Power Company Limited	Thermal	2025-26	25	Medium Term contract till 2028-29
2.	Ind-Bharath (U#2)	Thermal	2025-26	42	
3.	NTPC N. Karanpura (U#3)	Thermal	2025-26	132	
4.	NTPC Barh-I (U#3)	Thermal	2025-26	139	
5.	NTPC Barh-I (U#1)	Thermal	2027-28	139	
6.	TTPS Expansion (U#1)	Thermal	2027-28	330	
7.	TTPS Expansion (U#2)	Thermal	2028-29	330	
8.	NTPC Darlipali Stg. II (U#3)	Thermal	2029-30	400	
9.	NLCIL Talabira, Phase I (U#1, #2)	Thermal	2029-30	267	
10.	OPGC Stg III	Thermal	2029-30	660	
11.	NLCIL Talabira, Phase I (U#3)	Thermal	2030-31	133	
12.	OPGC Stg III	Thermal	2030-31	660	
13.	TSTPP- I	Thermal	2031-32	-334	Retirement
14.	Punatsangchhu - II (1020 MW)	Hydro	2025-26	104	
15.	Shahid Laxman SHEP	Hydro	2025-26	25	
16.	Sravani SHEP	Hydro	2025-26	15	
17.	Kharagpur SHEP	Hydro	2025-26	17	
18.	Kiru	Hydro	2026-27	23	
19.	Rattle HEP	Hydro	2026-27	13	
20.	Teesta-VI	Hydro	2027-28	19	
21.	Teesta-IV	Hydro	2028-29	104	
22.	SHEP (RENA)	Hydro	2029-30	94	
23.	Diwang HEP	Hydro	2031-32	107	
24.	Kharag HEP	Hydro	2034-35	63	
25.	SECI ISTS Manufacturing Scheme (500 MW)	Solar	2025-26	333	
26.	NTPC ISTS Solar Project (400 MW)	Solar	2025-26	400	
27.	NHPC Solar	Solar	2025-26	40	
28.	Konark Suryanagari Solarisation (OREDA)	Solar	2027-28	10	
29.	GEDCOL Chiplima	Solar	2027-28	10	
30.	OPGC Solar	Solar	2027-28	50	
31.	SECI ISTS Manufacturing Scheme (500 MW)	Solar	2028-29	167	
32.	Solar power generation inside State	Solar	2029-30	600	

Sl. No.	Tied capacity name	Type of generation	Expected COD	Odisha's share (in MW)	Remarks
33.	Solar power generation inside State	Solar	2030-31	1540	
34.	Solar power generation inside State	Solar	2031-32	300	
35.	SECI – Tranche XI	Wind	2025-26	2	
36.	SECI – Tranche XIII (100 MW of SJVN)	Wind	2025-26	100	
37.	SECI – Tranche XII (178 MW out of 284 MW)	Wind	2026-27	178	
38.	SECI – Tranche XI	Wind	2026-27	9	
39.	SECI – Tranche XIII (Rest 500 MW)	Wind	2026-27	500	
40.	SECI – Tranche XII (106 MW of Torrent)	Wind	2026-27	106	
41.	JSW Wind	Wind	2028-29	50	
42.	ONGC Tripura PCL	Wind	2028-29	50	
43.	HPCL	Wind	2028-29	48	
44.	Intrastate Wind	Wind	2029-30	853	
45.	DRE	DRE	2025-26	572	
46.	DRE	DRE	2026-27	338	
47.	Battery (4 Hr)	BESS	2027-28	125	
48.	Closed loop PSP	PSP	2029-30	500	
49.	Closed loop PSP	PSP	2030-31	500	
50.	Upper Indravati PSP	PSP	2031-32	600	
51.	Upper Kolab PSP	PSP	2032-33	600	
52.	Balimela PSP	PSP	2033-34	500	

Assumption for Resource Adequacy Studies

1. Electricity Demand & peak requirement: As per information furnished by the State.
2. Demand Profile: Based on hourly demand profile of 2024-25.
3. Existing & Planned Capacity: As per the information shared by the state.
4. Cost parameters: based on information in National Electricity Plan.

RE CUF considered

Hydro	Wind	Solar (existing)	Solar (planned)	DRE
44-48 %	24%	18%	23.5	14%

Technical Parameters

Technology	Type	Availability (%)	Ramping (%/min)	Min. Technical. (%)
Coal/ Lignite	Existing/Planned	85	1	55

Technology	Type	Availability (%)	Ramping (%/min)	Min. Technical. (%)
	Candidate	88	1	55
Gas	Existing	90	5	40
Nuclear	Existing/Planned	68	Const. Load	-
Biomass	Existing/Planned	60	2	50
Hydro	Existing/Planned/ Candidate	As per available hourly generation profile	100	-
Solar	Existing/Planned		-	-
	Candidate		-	-
Wind	Existing/Planned		-	-
	Candidate		-	-
Pumped storage	Existing/Planned	95	50	-
	Candidate		50	-
Battery Energy Storage	Candidate	98	NA	-

Technology	Type	Heat Rate (MCal/MWh)		Aux. Consum. (%)	Min. online time (hr)	Min. offline time (hr)
		At max loading	At min loading			
Coal	Existing/ Planned	2300 to 2879	2438 to 3052	7.0	6	4
	Candidate (SC & USC)	2060 to 2125	2183 to 2253	6.5	6	4
Gas	Existing	2000 to 2900	2260 to 3277	2.5	4	3
Nuclear	Existing/ Planned	2777	2777	10	6	4
	Candidate	2777	2777	10	-	-
Biomass	Existing/ Planned	4200	4450	8	6	4
	Candidate	4200	4450	8	6	4
Hydro	Existing/ Planned	-	-	0.7	-	-
	Candidate	-	-	0.7	-	-

Technology	Type	Heat Rate (MCal/MWh)		Aux. Consum. (%)	Min. online time (hr)	Min. offline time (hr)
		At max loading	At min loading			
Pumped Storage	Existing/ Planned	-	-	pump efficiency 80 %	-	-
	Candidate	-	-		-	-
Battery Energy Storage	Candidate	-	-	Round trip losses 12%	-	-

Transmission Parameters

A single node has been considered for the purpose of study with all generating units and demand connected to the node. No transmission bottleneck has been considered for the study. Interstate ATC limit has not been considered in the study.

Financial Parameters

Following cost parameters have been assumed:

Resource	Capex* (in ₹/MW)	O&M Fixed Cost (in ₹/MW)	Construction Time (in years)	Amortization /Life time (in years)
Coal	11.5 Cr	19.54 Lakh	4	25
Solar	5 Cr	1 % of Capex	0.5	25
Battery Energy Storage (2-Hour)	5.13 Cr to 3.13 Cr	1 % of Capex	0.5	14
Battery Energy Storage (4-Hour)	8.22 Cr to 4.72 Cr	1 % of Capex	0.5	14
Battery Energy Storage (5-Hour)	9.77Cr to 5.51 Cr	1 % of Capex	0.5	14
Battery Energy Storage (6-Hour)	11.31 Cr to 6.30 Cr	1 % of Capex	0.5	14