



**Report on
Resource Adequacy Plan
(Generation)
for the Union Territory of
Jammu & Kashmir and Ladakh
(2025-26 to 2035-36)
(Version 2.0)**

November, 2025

**Government of India
Ministry of Power
Central Electricity Authority**

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Disclaimer

This Resource Adequacy study for the Union Territory of Jammu & Kashmir and Ladakh has been conducted based on data and inputs provided by Jammu & Kashmir SLDC. The findings, analysis and conclusions presented in this report are contingent upon the accuracy, completeness and timeliness of the information furnished by J&K SLDC. 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 Central Electricity Authority (CEA). CEA has facilitated this study and prepared the report solely to assist J&K SLDC 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 Jammu & Kashmir SLDC.

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 and energy requirements.

As per the Resource Adequacy Guidelines dated 28th June 2023, each Distribution Licensee shall undertake 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 also recently gazette 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 utility in fulfilling this requirement, CEA, in collaboration with the Union Territory, initially conducted a Resource Adequacy (RA) study with a planning horizon up to FY 2034-35, based on the data received from the J&K SLDC and in compliance with the RPO trajectory specified in the Ministry of Power's gazette notification 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 Union Territory and planning assumptions. The RPO requirement for the utility has also been assessed in accordance with the recent gazette notified trajectory.

The electrical energy requirement and peak electricity demand for Jammu & Kashmir and Ladakh is increasing with a CAGR of 4% and 6% respectively from 2025-26 to 2035-36 as forecasted by J&K SLDC. For satisfying resource adequacy i.e. meeting the electricity demand reliably and at affordable cost, the UTs needs to methodically plan its capacity expansion either by investing or by procuring power. In view of the reduction in cost of solar panels and newer technology options like 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.

A study has been carried out for Jammu & Kashmir and Ladakh considering the existing contract capacity and planned capacity addition. It was found that the Union Territory's likely contracted capacity may not be sufficient to meet the projected demand. Further, the total unserved energy in the year 2035-36 is expected to be about 9.5 BU which is about 29% of the annual projected electrical energy requirement during the year 2035-36.

To find out the least cost option for generation capacity expansion for the period 2025-26 to 2035-36, long-term study has been carried out with the 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, variation in RE 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 Jammu & Kashmir and Ladakh along with RPO constraints for solar and wind 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 is 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 11,001 MW which consists of 3239 MW from Coal, 129 MW from Gas, 68 MW from Nuclear, 3,666 MW from Hydro, 2,040 MW from Solar, 598 MW from Distributed Renewable Energy (DRE) and 1,261 MW of STOA/MTOA. 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 its existing/planned capacity to meet their RPO targets.

To support the utility in fulfilling the Resource Adequacy Guidelines and complying with the Renewable Purchase Obligation (RPO) notification, CEA has carried out the RA study for the UTs of Jammu & Kashmir and Ladakh based on inputs furnished by J&K SLDC. 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 assesses the Planning Reserve Margin (PRM) required by the UT 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 Union Territory up to FY 2034-35, based on inputs from J&K SLDC and in accordance with the prevailing RPO trajectory specified in the Ministry of Power’s Gazette notification dated 20th October, 2023.

2.0 Highlights of the Previous RA Study (Up to FY 2034-35)

1. In the earlier Resource Adequacy (RA) study, the financial year 2023-24 had been considered as the base year, and the study covered the period from 2024-25 to 2034-35. The fuel-wise contracted capacity by the Union Territory as on March 2024, is given in Fig 1.

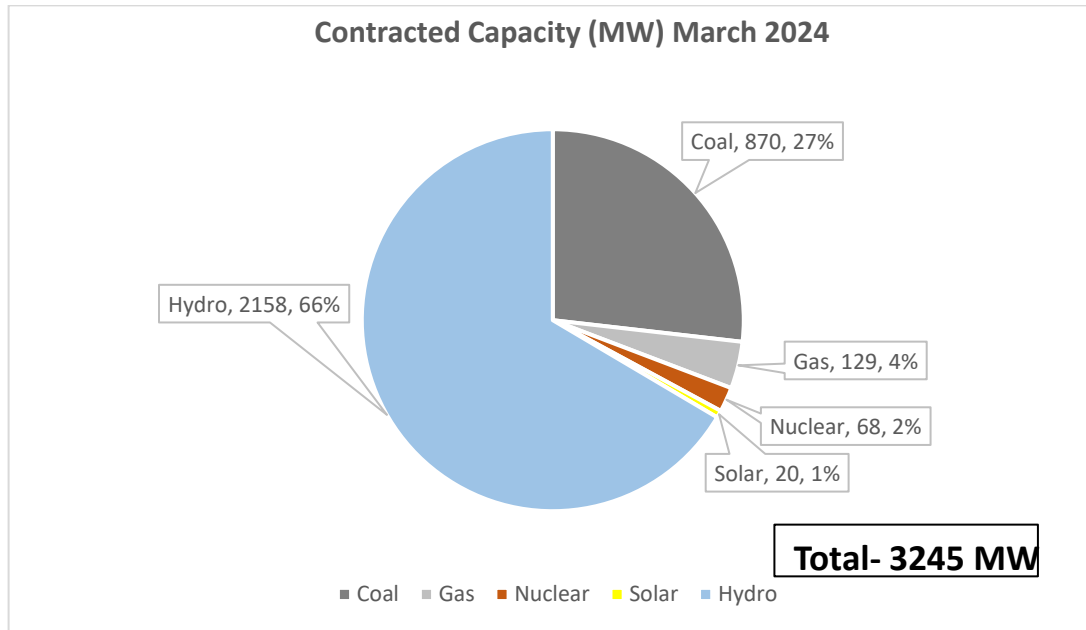


Figure 1: Contract Capacity (March 2024)

2. The hourly demand pattern for 2022-23 was analysed and had been considered as a base profile to forecast the demand for future years.
3. The peak electricity demand and electrical energy projections as per J&K SLDC had been considered in the study is given in Table 1.

Table 1: Peak electricity demand and Electrical Energy Requirement Projections as per J&K

	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35
Electrical Energy Requirement Projections (MU)	23196	24297	25268	26279	27136	28423	29560	30743	31745	33251	34582
Year on Year Growth (%)		4.75%	4.00%	4.00%	3.26%	4.74%	4.00%	4.00%	3.26%	4.74%	4.00%
Peak Electricity Demand Projections (MW)	3555	3769	3995	4235	4489	4758	5044	5346	5667	6007	6367
Year on Year Growth (%)		6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%

4. The actual peak electricity demand and electrical energy requirement of the UT in 2023-24 and 2024-25 as per the Power Supply Position (PSP) report of CEA is given in Table 2.

Table 2: Actual Peak Electricity Demand and Electrical Energy requirement

Year	Actual Electrical Energy Requirement (in MU)	Actual Peak Electricity Demand (in MW)
2023-24	20040	3181
2024-25	20374	3236

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 3.

Table 3: Projected contracted capacity (in MW)

Year	Coal	Hydro	Gas	Nuclear	Solar	DRE	MTOA/STOA
2024-25	870	2359	129	68	20	142	1350
2025-26	1262	2359	129	68	640	208	1134
2026-27	1262	3270	129	68	640	278	1116
2027-28	1262	3364	129	68	640	354	1195
2028-29	2829	3364	129	68	640	431	382
2029-30	3008	3364	129	68	640	521	295
2030-31	3166	3364	129	68	640	603	305
2031-32	3166	3364	129	68	940	689	368
2032-33	3166	3364	129	68	1240	777	428
2033-34	3500	3364	129	68	1540	881	684
2034-35	3700	3364	129	68	1840	987	700

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

Table 4: Year wise planned and additional capacity (in MW)

FY	Thermal		SOLAR		Hydro		DRE		Total		Yearly STOA
	Planned	Additional	Planned	Additional	Planned	Additional	Planned	Additional	Planned	Additional	Additional
2024-25	0	0	0	0	201	0	0	142	201	142	1350
2025-26	392	0	620	0	0	0	0	66	1012	66	1134
2026-27	0	0	0	0	911	0	0	70	911	70	1116
2027-28	0	0	0	0	94	0	0	75	94	75	1195
2028-29	0	1567	0	0	0	0	0	78	0	1645	382
2029-30	0	179	0	0	0	0	0	90	0	269	295
2030-31	0	158	0	0	0	0	0	81	0	239	305

2031-32	0	0	0	300	0	0	0	87	0	387	368
2032-33	0	0	0	300	0	0	0	87	0	387	428
2033-34	0	333	0	300	0	0	0	105	0	738	684
2034-35	0	201	0	300	0	0	0	106	0	607	700

3.0 RA Study for Jammu & Kashmir and Ladakh (from 2025-26 to 2035-36)

3.1 Present Power Scenario in Jammu & Kashmir and Ladakh

The power supply position for Jammu & Kashmir and Ladakh for 2021-22 to 2024-25 is given in Table 5.

Table 5: Power Supply Position of Jammu & Kashmir and Ladakh

Power Supply Position						
Year	Energy required (MU)	Energy supplied (MU)	Gap (MU)	Peak Demand (MW)	Peak Met (MW)	Demand not met (MW)
2021-22	19957	18434	1524	3076	2826	250
2022-23	19639	19322	317	3137	2967	170
2023-24	20040	19763	277	3181	3133	48
2024-25	20374	20283	91	3236	2836	400

As of June 2025, the total contracted capacity for Jammu & Kashmir and Ladakh is 3,345 MW. Out of the total contracted capacity (CC), the share of non-fossil fuel-based Contracted Capacity is 67%.

The fuel-wise contracted capacity as on June, 2025 is given in Table 6 and Figure 2.

Table 6: Fuel-wise Contracted Capacity as on June 2025

Source	Contracted Capacity (MW)	Percentage (%)
Coal	971	29%
Gas	129	4%
Nuclear	68	2%
Hydro	2157.6	64%
Solar	20	1%
Total	3345.6	100%

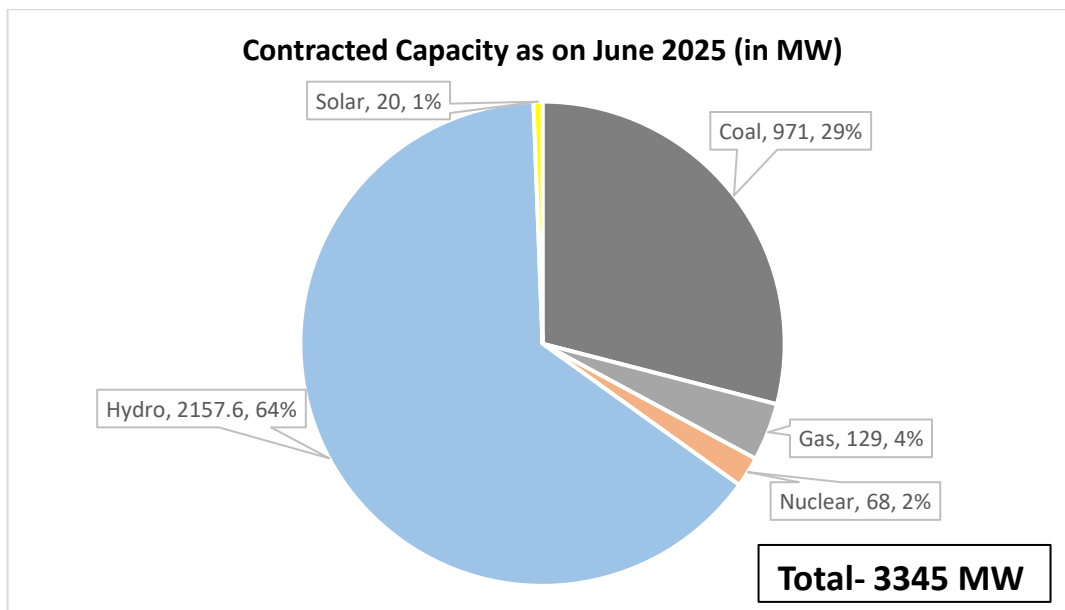


Figure 2 Fuel-wise Contracted Capacity (in MW) as on June, 2025

3.2 Demand Analysis of the FY 2024-25

Hourly demand pattern of 2024-25 was analyzed and it was observed that peak electricity demand in Jammu & Kashmir and Ladakh occurs in January month. Overall, the demand during the winter season is significantly higher than in the rest of the year.

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

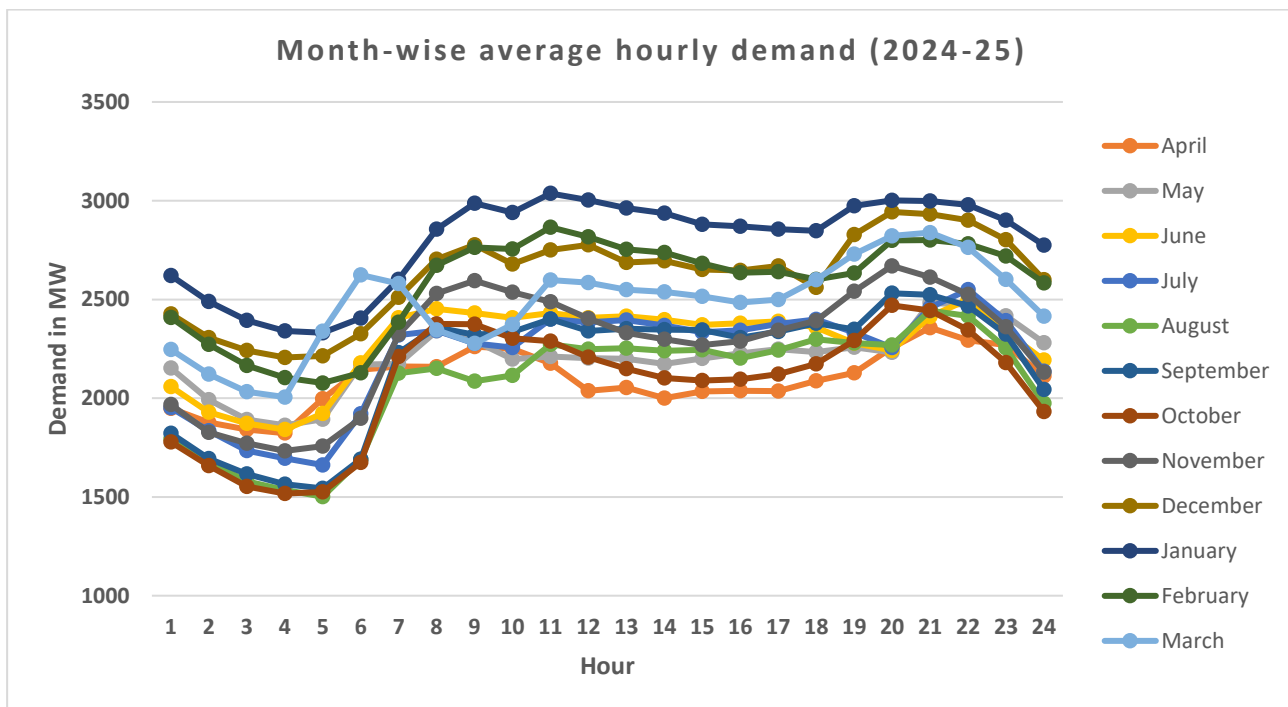


Figure 3: Average Hourly Demand Variation (Month-wise) for 2024-25

From the hourly demand data of 2024-25 the daily peak during solar hours (06:00 to 18:00 hrs) and non-solar hours are plotted in Figure 4.

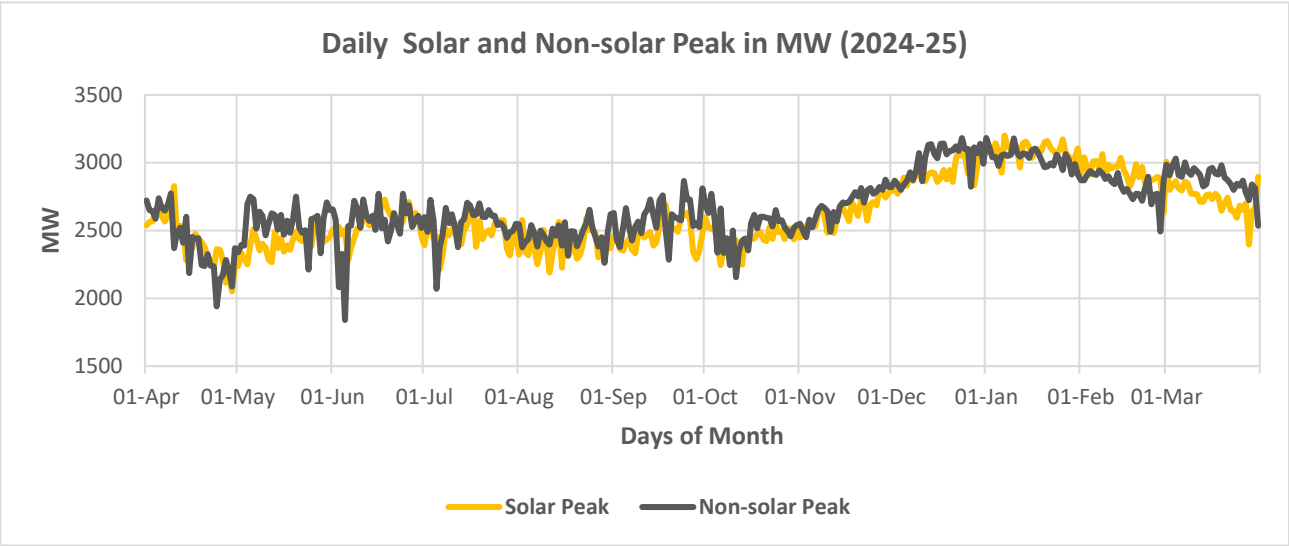


Figure 4: Solar and non-solar Peak in MW for the year 2024-25

As seen in Figure 4, the daily peak demand occurs during Winter months. In summer season, it can be observed that the peak demand occurs during non-solar hours.

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.

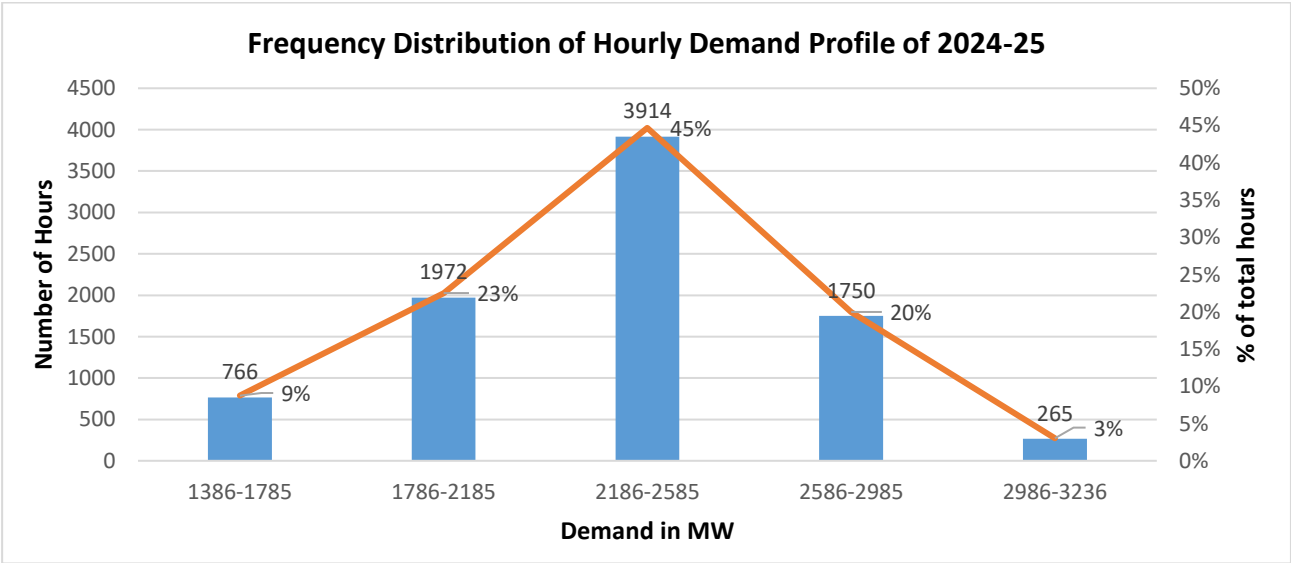


Figure 5 Frequency Distribution of Hourly Demand Profile of 2024-25

4.0 Principles of Generation Planning

The objective of the Generation Planning process is to obtain an optimal generation capacity mix in the least cost manner to meet the demand at every instance of time while ensuring the most efficient use of resources. Planning is therefore an activity encompassing balancing demand and supply at all instances of time and at all locations, which makes it a regular ongoing process.

The major aspects considered in the planning process are:

- i) To Supply 24x7 reliable power to consumers
- ii) To achieve objectives of all policies of the Government of India such as RPO trajectory, RE capacity addition 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 were 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 operating 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 Exhibit.

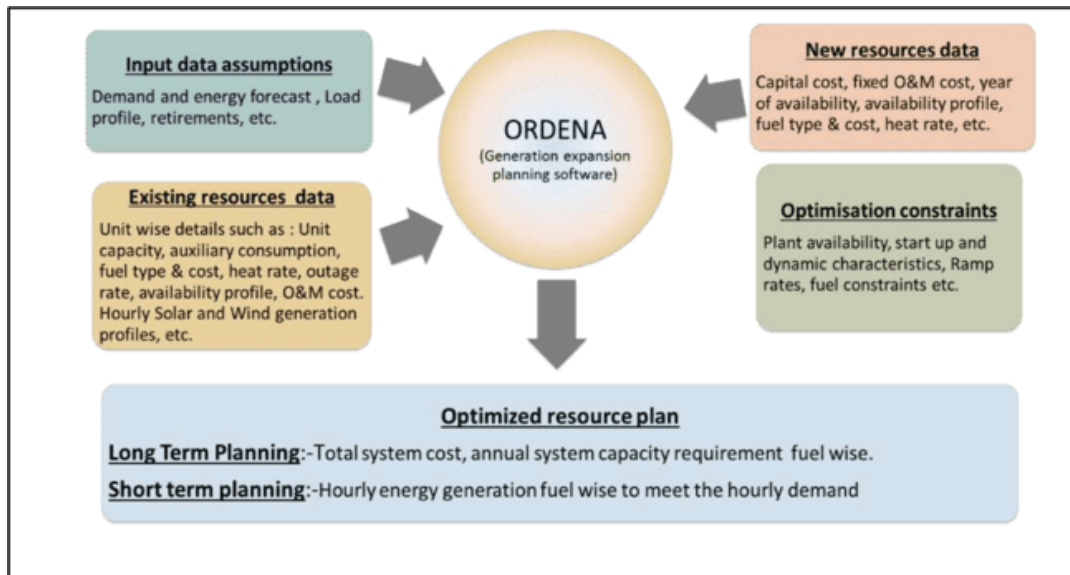


Exhibit: Schematic Diagram-Ordena

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 instant 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 load in MWh) 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 number of random samples of these variables are simultaneously simulated to ascertain system reliability indices (i.e. Loss of load probability LOLP & Energy Not Served (ENS)) and the system robustness in case of variation of the above 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 expressed as a certain percent of projected peak load of the system.

5.1 Demand variation

The variation in electricity demand pattern for the past two years has been analyzed. The hourly demand variation for consecutive years (i.e., 2023-24 and 2024-25 considering 2023-24 as base) has been analyzed. The Demand pattern variation of 2023-24 and 2024-25 is shown below.

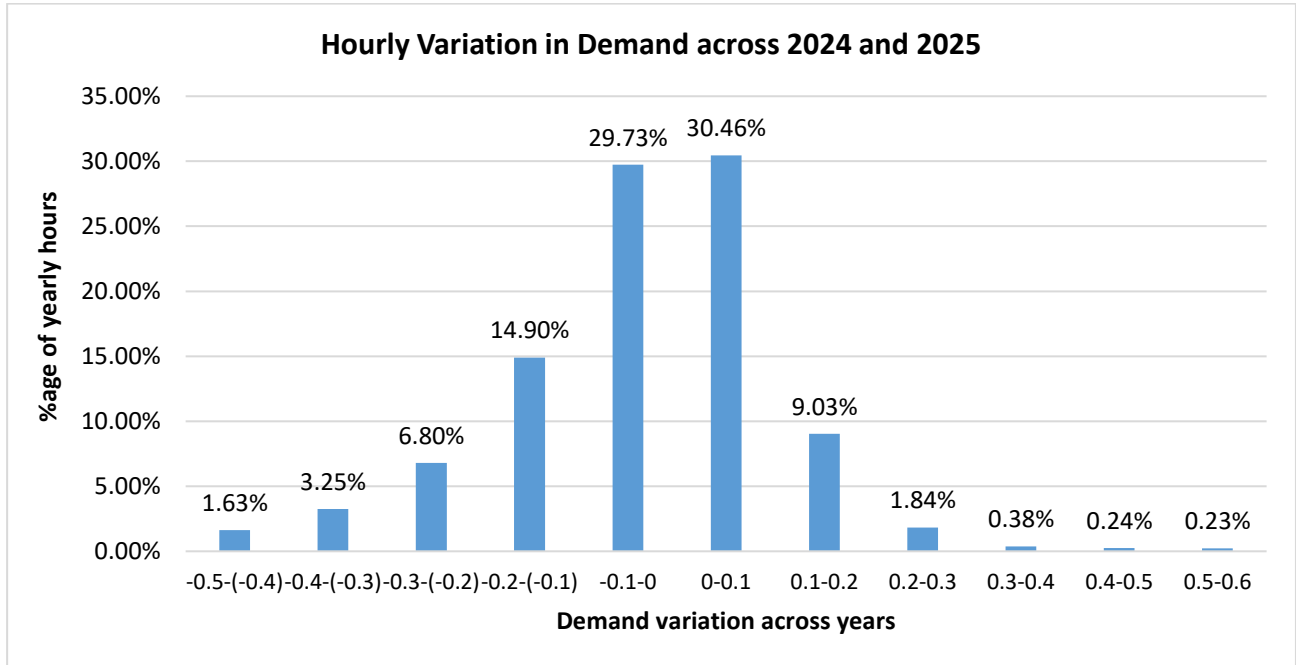


Figure 6 Hourly Variation in Demand across years

It can be observed that the hourly demand typically varies by $\pm 10\%$ for 60% 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 varying the projected hourly demand for the future years by $\pm 10\%$ by introducing a random variable (with normal distribution) for demand as per observed behavior over the years.

5.2 Variation in RE

In the long-term capacity expansion planning studies, a particular profile for Solar is considered based on the observed solar generation data to determine the optimal capacity mix. However, due to intermittent nature of these sources, the generation from these non-dispatchable sources may vary across years. As per the analyses carried out based on historical generation data, solar and hydro based generation has been varied by $\pm 10\%$ and wind generation has been varied by $\pm 50\%$ 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 $\pm 5\%$ 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 electrical energy requirement of Jammu & Kashmir and Ladakh, furnished by J&K SLDC and projections available in the 20th EPS (Electric Power Survey) Mid-term review is tabulated below.

Table 7 Future Demand Projection as provided by J&K SLDC and as per mid-term review of 20th EPS Report

Year	Projections by J&K SLDC				Projections as per mid-term review of 20 th EPS			
	Peak Electricity Demand		Electrical Energy Requirement		Peak Electricity Demand		Electrical Energy Requirement	
	Projections (MW)	Y-o-Y Growth	Projections (MWh)	Y-o-Y Growth	Projections (MW)	Y-o-Y Growth	Projections (MWh)	Y-o-Y Growth
2025-26	3769		22006		3624		22216	
2026-27	3995	6.00%	22886	4.00%	3813	5.22%	23372	5.20%
2027-28	4235	6.00%	23801	4.00%	3964	3.96%	24559	5.08%
2028-29	4489	6.00%	24754	4.00%	4117	3.87%	25780	4.97%
2029-30	4758	6.00%	25744	4.00%	4262	3.52%	26966	4.60%
2030-31	5044	6.00%	26773	4.00%	4395	3.12%	28096	4.19%
2031-32	5346	6.00%	27844	4.00%	4517	2.79%	29176	3.84%
2032-33	5667	6.00%	28958	4.00%	4651	2.96%	30346	4.01%
2033-34	6007	6.00%	30116	4.00%	4780	2.77%	31501	3.80%
2034-35	6367	6.00%	31321	4.00%	4903	2.57%	32633	3.60%
2035-36	6749	6.00%	32574	4.00%	5045	2.89%	33576	2.89%

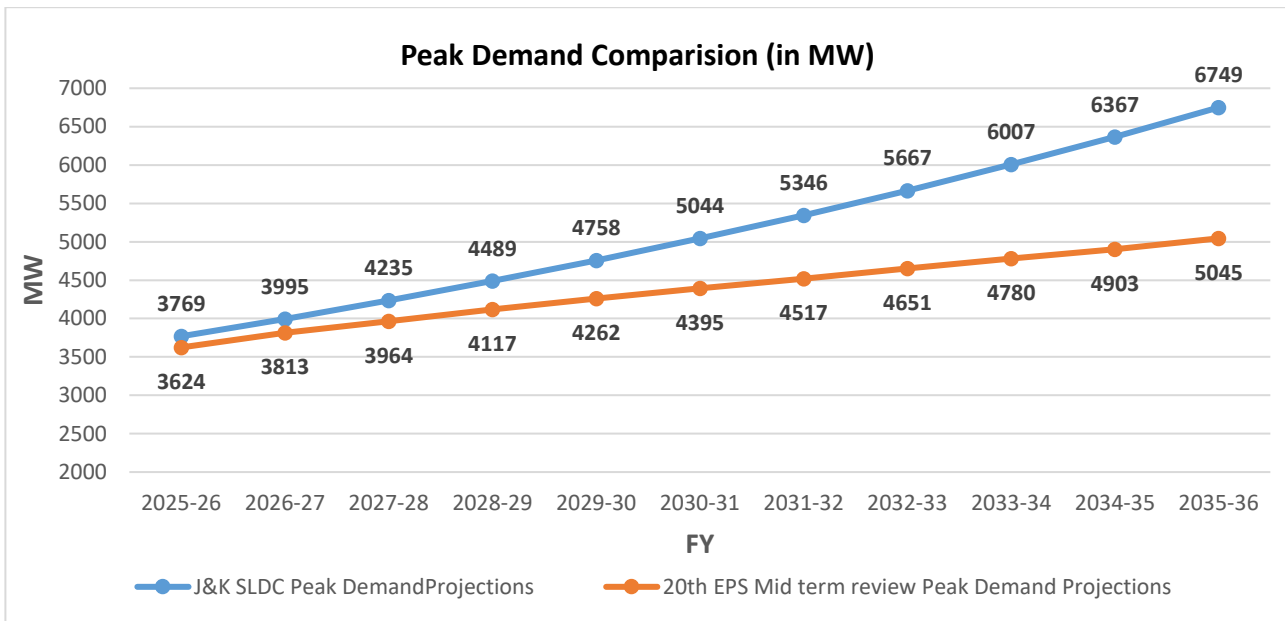


Figure 7 Comparison of Peak Demand Projections of 20th EPS mid-term review vs J&K SLDC

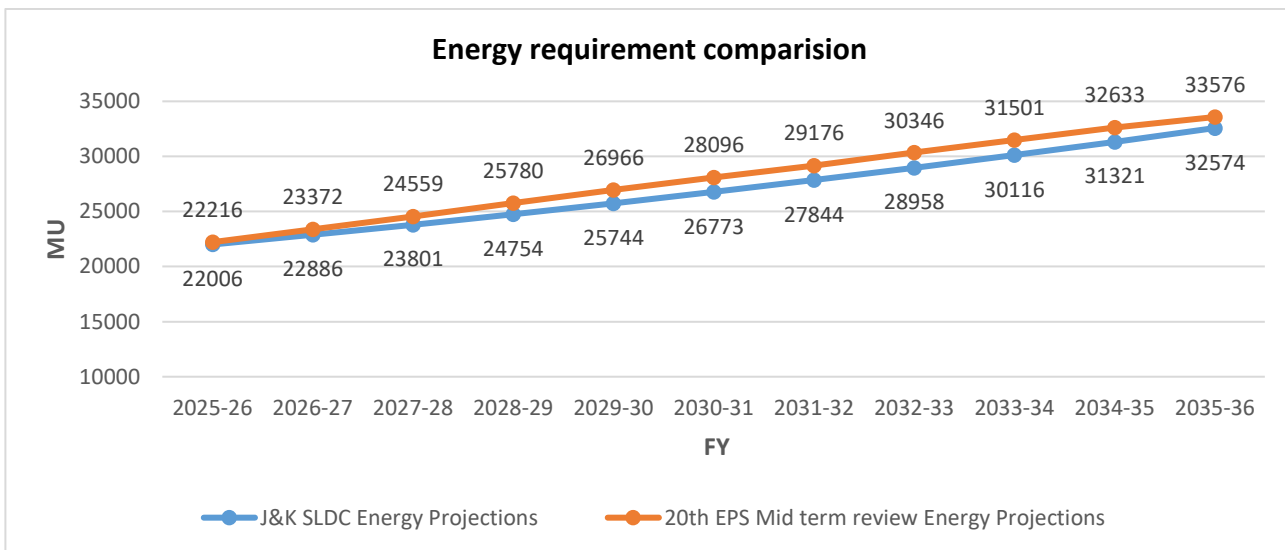


Figure 8 Comparison of Electrical Energy Requirement Projections of 20th EPS mid-term review vs J&K SLDC

The energy requirement projections of J&K SLDC is almost similar to 20th EPS mid-term review. However, the peak electricity demand projections of J&K SLDC is slightly higher than that of 20th EPS mid-term review. Peak electricity demand and electrical energy requirement projections from J&K SLDC have been considered in the study.

- 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 and CUFs have been considered as per the National Electricity Plan 2023 (Vol I Generation).
- iv) The capital costs of candidate plants for coal, wind, solar, and storage technologies is detailed in the Annexure and are aligned with current market trends and recent price discovery.

- v) The year-wise planned capacity tie-up as per J&K SLDC is given below.

Table 8 Source wise planned capacity addition (MW) as per J&K SLDC

FY	Hydro	Nuclear	Solar
2025-26	0	0	1000
2026-27	393	0	0
2027-28	289	0	10
2028-29	0	0	0
2029-30	1003	33	0
2030-31	0	0	0
2031-32	0	0	0
2032-33	0	0	0
2033-34	0	0	0
2034-35	0	0	0
2035-36	0	0	0
Total	1685	33	1010

- 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.

Table 9 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.	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. Jammu & Kashmir and Ladakh being a hilly Union Territory, the share of DRE in the RPO trajectory has been taken as half of the share as stipulated in RPO order dated 20th October, 2023. The other half of the DRE component has been considered to be met from RE generation from other sources. Therefore, the RPO trajectory is assumed to rise steadily beyond 2029-30. Hence, the suggested trajectory of Renewable Purchase Requirement up to FY 2035-36 is presented in Table 10.

Table 10 Renewable Purchase Obligation (RPO) trajectory considered for the study

Sl. No.	Year	Wind renewable energy	Hydro renewable energy	Other renewable energy	Distributed renewable energy	Total renewable energy
1.	2024-25	0.67%	0.38%	28.10%	0.75%	29.91%
2.	2025-26	1.45%	1.22%	29.29%	1.05%	33.01%
3.	2026-27	1.97%	1.34%	31.29%	1.35%	35.95%
4.	2027-28	2.45%	1.42%	33.29%	1.65%	38.81%
5.	2028-29	2.95%	1.42%	35.05%	1.95%	41.36%
6.	2029-30	3.48%	1.33%	36.27%	2.25%	43.33%
7.	2030-31	43.25%			2.25%	45.50%
8.	2031-32	44.75%			2.25%	47.00%
9.	2032-33	46.05%			2.25%	48.30%
10.	2033-34	47.25%			2.25%	49.50%
11.	2034-35	48.25%			2.25%	50.50%
12.	2035-36	49.25%			2.25%	51.50%

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 tabulated below:

Table 11 Total Electrical 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.	2025-26	319.1	268.5	6445.5	231.1	7264.1
2.	2026-27	450.9	306.7	7161.0	309.0	8227.5
3.	2027-28	583.1	338.0	7923.5	392.7	9237.3
4.	2028-29	730.2	351.5	8676.1	482.7	10240.5
5.	2029-30	895.9	342.4	9337.2	579.2	11154.7
6.	2030-31	11579.5			602.4	12181.9
7.	2031-32	12460.3			626.5	13086.8
8.	2032-33	13335.2			651.6	13986.8
9.	2033-34	14230.0			677.6	14907.6
10.	2034-35	15112.4			704.7	15817.2
11.	2035-36	16042.7			732.9	16775.6

Table 12 Renewable Energy other than DRE

FY	RE Generation required to meet RPO	RE Generation required to meet RPO	RE Generation available/met (From existing/ planned Contracts)	RPO met (%)	RPO Surplus (+) / Deficit (-)
	(MU)	(%)	(MU)	(%)	(%)
2025-26	7033.0	31.96%	10256.8	46.61%	15.73%
2026-27	7918.6	34.60%	11449.8	50.03%	22.72%
2027-28	8844.6	37.16%	12568.5	52.81%	21.84%
2028-29	9757.8	39.42%	12568.5	50.77%	17.31%
2029-30	10575.5	41.08%	15842.9	61.54%	20.39%
2030-31	11579.5	43.25%	15842.9	59.17%	15.85%
2031-32	12460.3	44.75%	15842.9	56.90%	12.08%
2032-33	13335.2	46.05%	15842.9	54.71%	8.59%
2033-34	14230.0	47.25%	15842.9	52.61%	5.27%
2034-35	15112.4	48.25%	15842.9	50.58%	2.25%
2035-36	16042.7	49.25%	15842.9	48.64%	-0.69%

Table 13 Renewable Energy from DRE

FY	DRE required to meet RPO	DRE required to meet RPO	DRE available	DRE available	Surplus (+)/ Deficit (-)
	(MU)	(%)	(MU)	(%)	(%)
2025-26	231.1	1.05%	0	0 %	-1.05%
2026-27	309.0	1.35%	0	0 %	-1.35%
2027-28	392.7	1.65%	0	0 %	-1.65%
2028-29	482.7	1.95%	0	0 %	-1.95%
2029-30	579.2	2.25%	0	0 %	-2.25%
2030-31	602.4	2.25%	0	0 %	-2.25%
2031-32	626.5	2.25%	0	0 %	-2.25%
2032-33	651.6	2.25%	0	0 %	-2.25%
2033-34	677.6	2.25%	0	0 %	-2.25%
2034-35	704.7	2.25%	0	0 %	-2.25%
2035-36	732.9	2.25%	0	0 %	-2.25%

As indicated in the above tables, the UT will be able to meet its RPO requirements of RE other than DRE except in 2035-36 based on the existing and planned contracts. However, the UTs will not be able to fulfil RPO requirement from DRE from 2025-26 to 2035-36.

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 as per J&K SLDC. Considering the existing and planned capacity contracts, the UTs will not be able to meet its electrical energy requirement and the total unserved energy for the year 2035-36 has

been estimated as 9.5 BU. The year-wise likely unserved energy with the existing and planned capacities is given in figure 9.

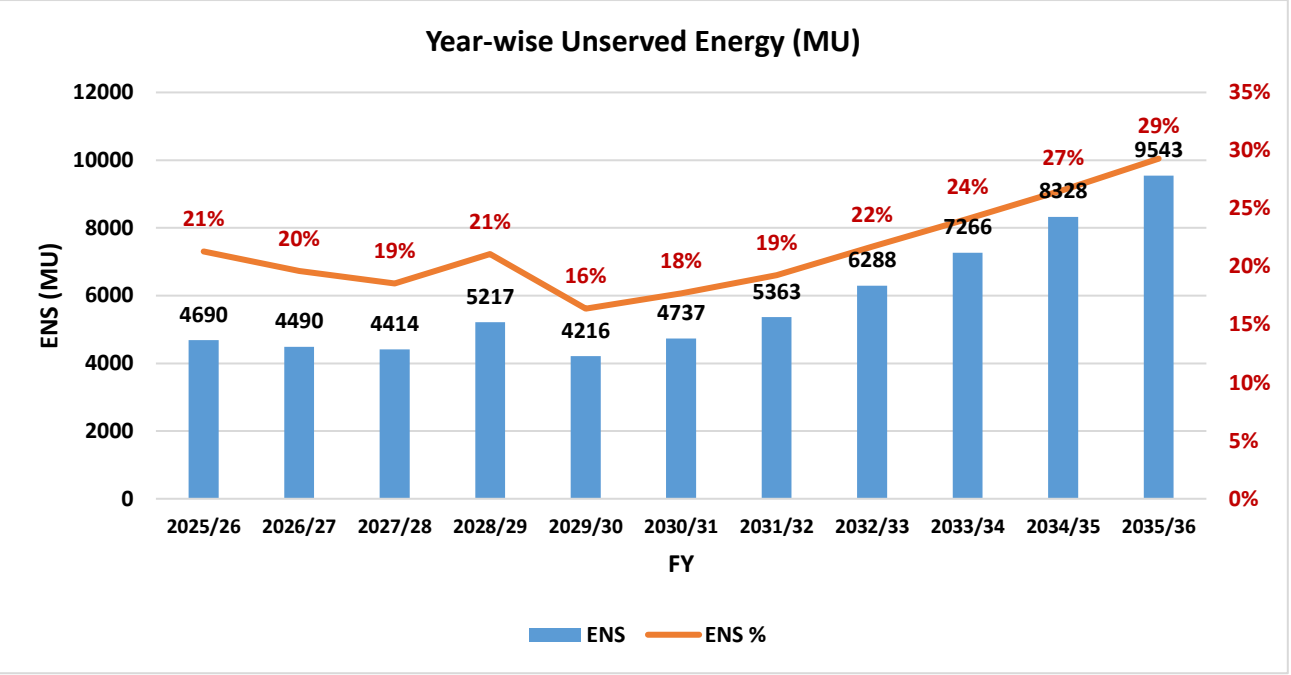


Figure 9 Yearly likely unserved energy (in MU) with the existing and planned capacities

The study has also analyzed the daily and monthly pattern of unserved energy in the year 2035-36 and it can be seen that contracted capacity (existing and planned) is unable to meet the projected electricity demand.

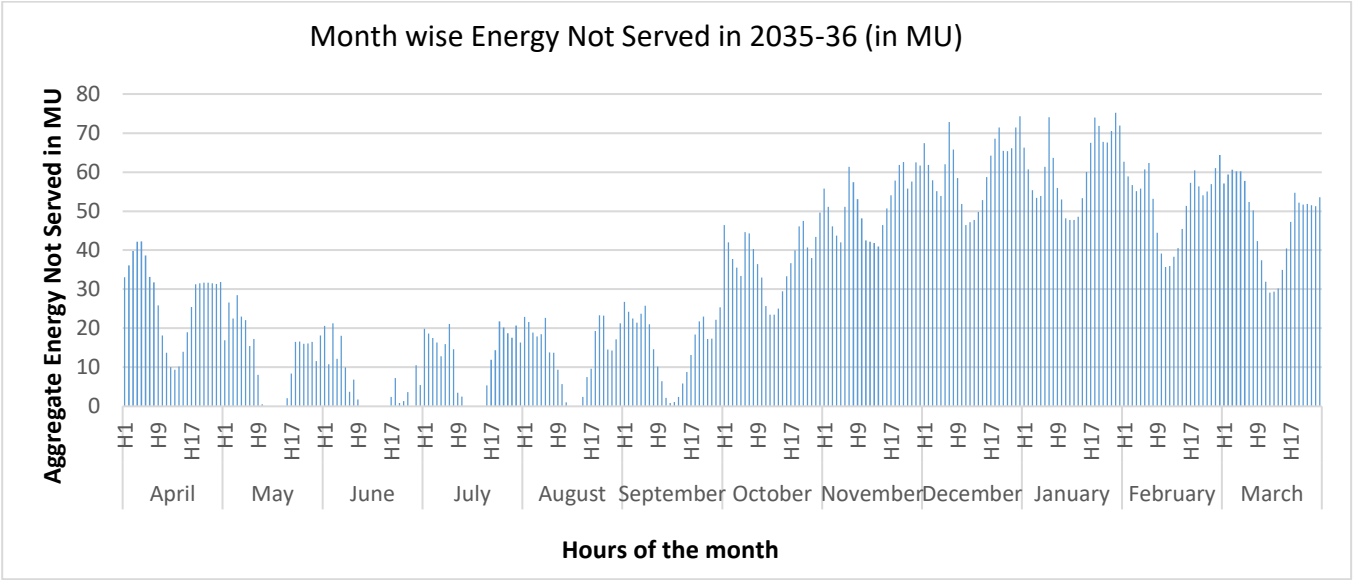


Figure 10 Block-wise Unserved Energy Pattern in MU (2035-36)

The unmet demand occurs during both solar and non-solar hours throughout the year.

7.2 Options to meet the unserved energy

To meet this unserved energy, options (i.e., candidate capacities) are given to the model to find the least cost optimal capacity mix required to meet the demand with RPO obligations. The capacity projections for Jammu & Kashmir and Ladakh are given below:

Table 14: Year-wise contracted capacity projections (existing + planned + additional) (in MW)

Year	COAL	GAS	NUCLEAR	HYDRO	SOLAR	DRE	STOA
2025-26	971	129	68	1981	1030	188	1332
2026-27	971	129	68	2374	1030	252	1264
2027-28	971	129	68	2663	1040	320	1286
2028-29	1471	129	68	2663	1040	394	1146
2029-30	1971	129	68	3666	1040	472	493
2030-31	2471	129	68	3666	1040	491	220
2031-32	2692	129	68	3666	1240	511	288
2032-33	2831	129	68	3666	1440	531	500
2033-34	2991	129	68	3666	1640	553	714
2034-35	3158	129	68	3666	1840	575	942
2035-36	3239	129	68	3666	2040	598	1261

The projected year-wise contracted capacity mix is given in the figure below:

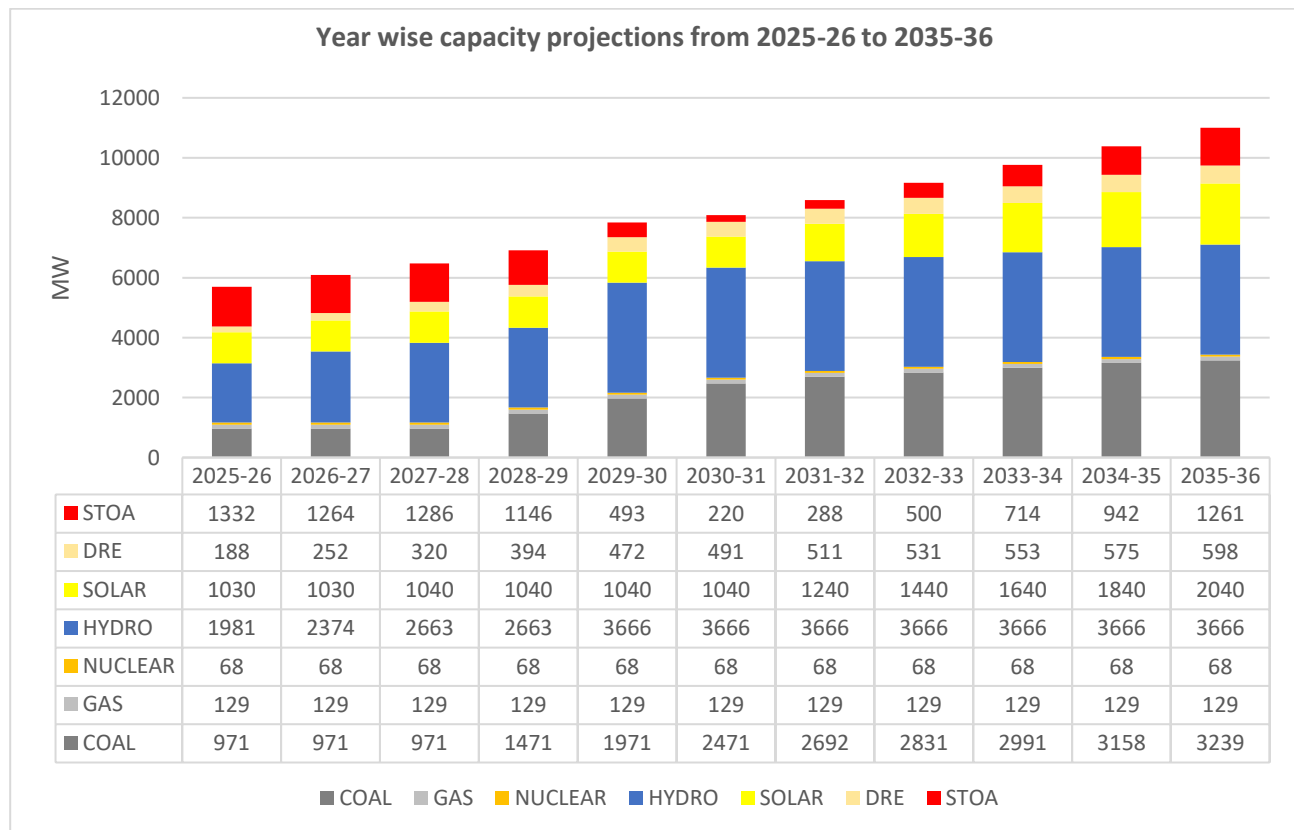


Figure 11 Projected Contracted Capacity Mix Year-wise (MW)

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 Normalised Energy Not Served (NENS) remaining within the permissible limits of 0.2% and 0.05%, respectively [as specified in the National Electricity Plan (NEP)].

As per the Resource Adequacy studies, the likely total projected contracted capacity for the year 2035-36 is around 11,001 MW which consists of 3239 MW from coal, 129 MW from gas, 68 MW from nuclear, 3666 MW from hydro, 2040 MW from solar, 598 MW from DRE and 1261 MW from MTOA/STOA. This capacity shall be able to meet the projected demand with prescribed reliability criteria.

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

The Planning Reserve Margin (PRM) for Jammu & Kashmir and Ladakh has been assessed at 5.5 %. Furthermore, the projected/contracted capacity is in compliance with the stipulated Renewable Purchase Obligation (RPO) targets.

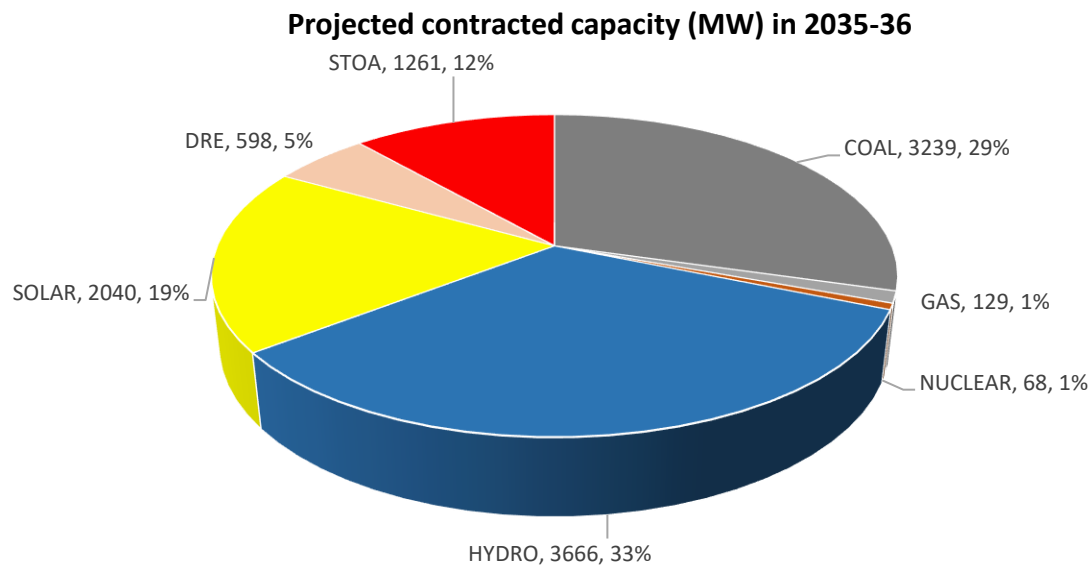


Figure 12 Projected Contracted Capacity Mix in 2035-36

As per the study, the utility needs to contract following capacities (already planned by J&K and Ladakh and additional requirement) per year till 2035-36 to meet its demand reliably.

Table 15 Year wise Capacity Addition (in MW)

	Coal	Hydro	Solar		DRE	MTOA/STOA
Year	Additional Requirement	Planned Contracts	Planned Contracts	Additional Requirement	Additional Requirement	Additional Requirement
2025-26	0	0	1000	0	188	1332
2026-27	0	393	0	0	64	1264
2027-28	0	289	10	0	68	1286
2028-29	500	0	0	0	73	1146
2029-30	500	1003	0	0	79	493
2030-31	500	0	0	0	19	220
2031-32	221	0	0	200	20	288
2032-33	139	0	0	200	20	500
2033-34	160	0	0	200	21	714
2034-35	167	0	0	200	22	942
2035-36	80	0	0	200	23	1261
TOTAL	2268	1685	1010	1000	598	9447

The share of non-fossil fuel-based capacity in the generation mix is projected to remain between 49%-65% from 2025-26 to 2035-36. The projected gross generation mix for the Union Territories is shown in Figure 13.

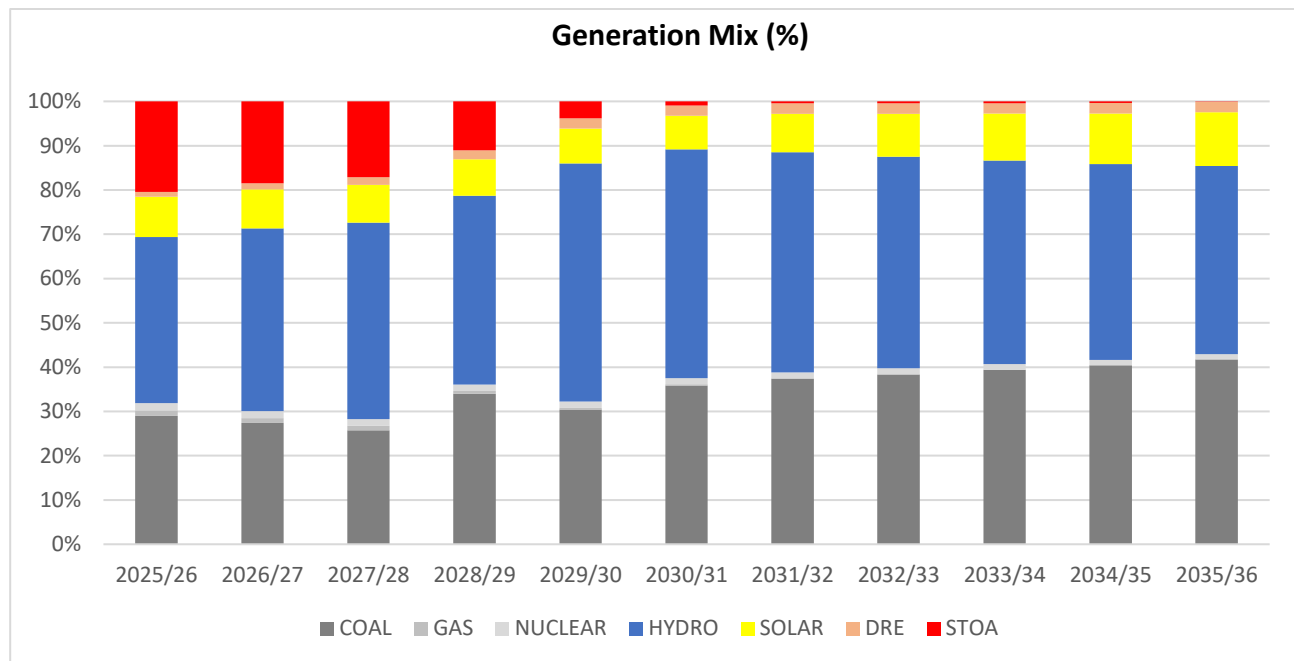


Figure 13 Year-wise projected gross generation mix (in %)

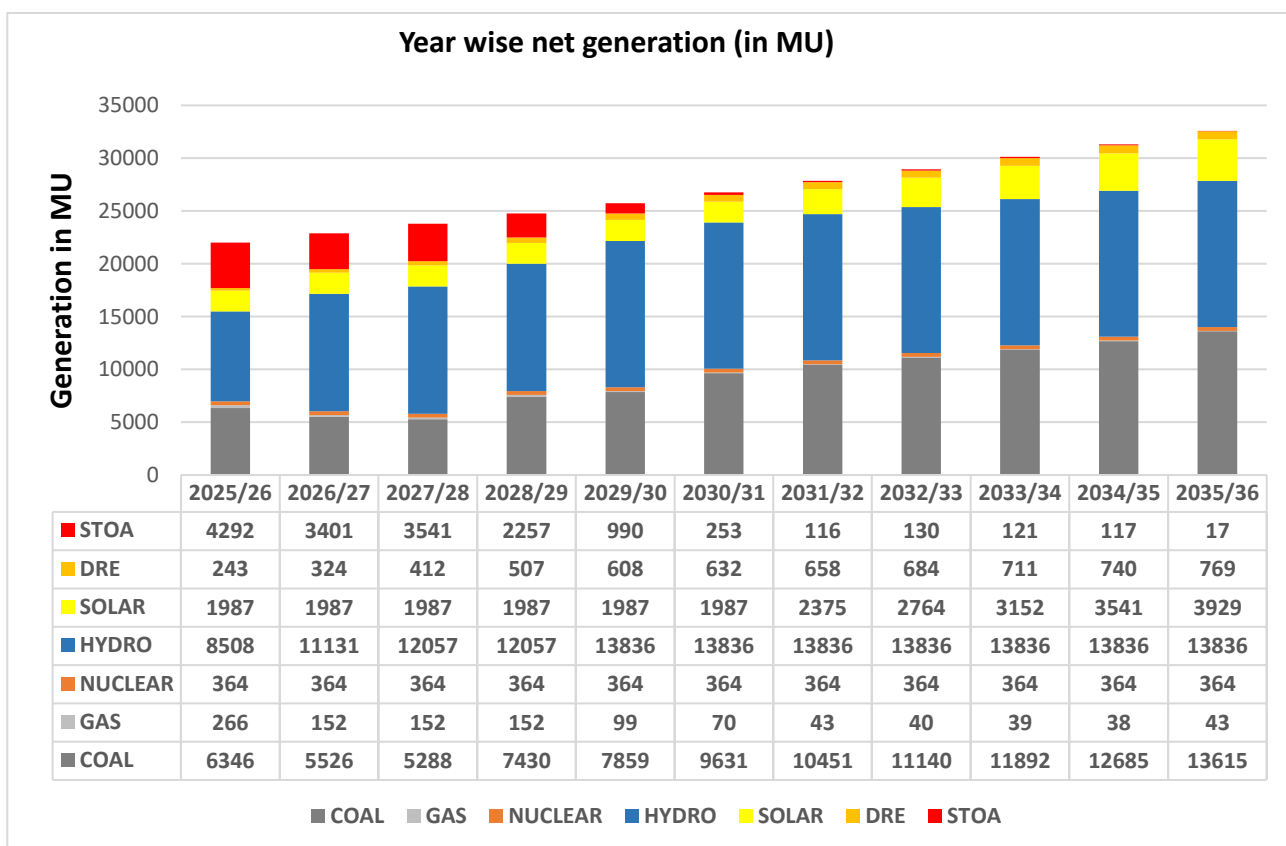


Figure 14 Year-wise projected gross generation (in GWh)

7.3 Day-wise Surplus Coal Capacity (in MW)

Surplus capacity is available with the Union Territory due to RE availability, Demand variation etc. The pattern of surplus capacities is given below. This capacity can be shared with other states/ Discoms and reduce the fixed cost burden on the utility resulting in reduction in the cost to consumer. The UT has likely surplus capacity of around 700-900 MW during May to June months and 500 MW from July to September in 2028-29 as shown below which can be shared with other states/ Discoms.

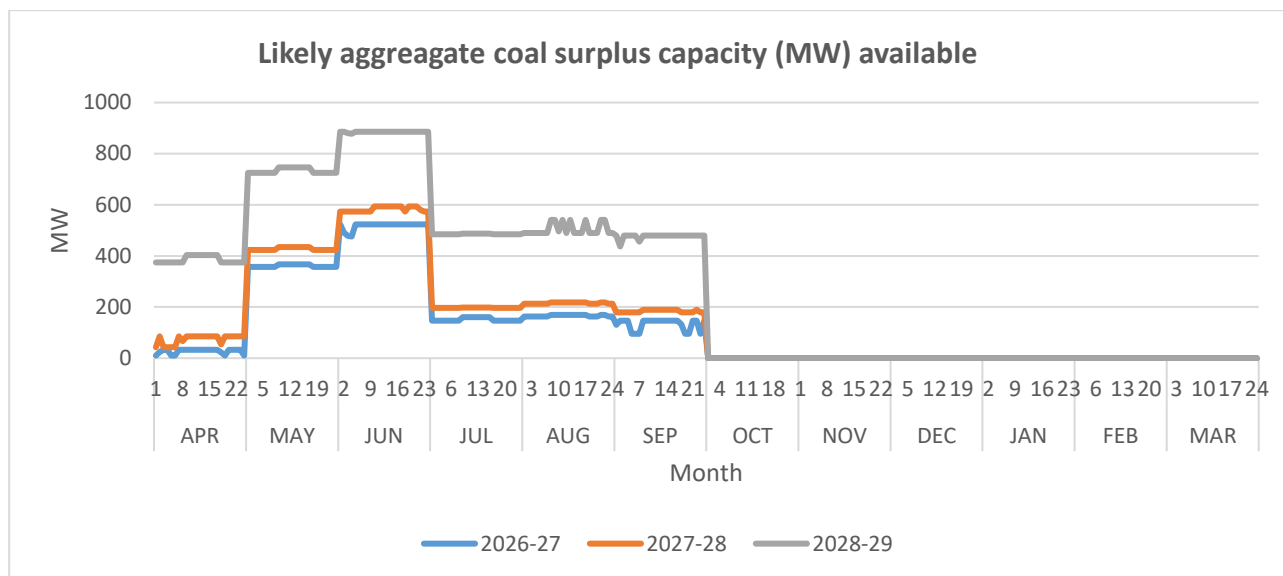


Figure 16 Surplus Coal Capacity Year-wise (MW)

8.0 Conclusions

Based on the Resource Adequacy studies of Jammu & Kashmir and Ladakh up to the year 2035-36, the following conclusions may be drawn:

1. The study has been done based on the hourly demand pattern of the year 2024-25. Based on the demand pattern, it is seen that the peak demand season is typically in December and January months.
2. The study has considered electrical energy requirement projections as per J&K SLDC, which envisages that the annual electrical energy requirement of the UT is likely to grow at a CAGR of 4 % while the peak electricity demand for the utility is likely to grow at a CAGR of 6 % for the period of 2025-26 to 2035-36.
3. Considering only the existing and planned capacity addition by J&K SLDC, Jammu & Kashmir and Ladakh is likely to witness energy deficit ranging from 3.5 to 9.5 BUs in different years from 2025-26 to 2035-36.

4. The Resource adequacy studies have projected likely optimal capacity mix for future years till 2035-36 which is 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 11,001 MW which consists of 3,239 MW from coal, 129 MW from gas, 68 MW from nuclear, 3,666 MW from hydro, 2,040 MW from solar, 598 MW from Distributed Renewable Energy (DRE), and 1,261 MW of MTOA/STOA. Being hydro reach State the requirement of 3239 MW from coal-based capacity may be judiciously contracted on seasonal basis.
5. The contracted capacity in June, 2025 comprises of 67% from non-fossil sources. In 2035-36, the non-fossil based (that includes nuclear, hydro, solar, wind and DRE) capacity are likely to constitute around 58 % of the total contracted capacity.
6. The UT needs to contract STOA/MTOA of around 220 MW to 1332 MW in different years as outlined in the report. 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.
7. The projected capacity and generation mix outlined in the report meet the utility's RPO requirements for the years 2025-26 to 2035-36.
8. The Planning Reserve Margin (PRM) for Jammu & Kashmir and Ladakh has been assessed at 5.5 %. Further, the study indicates year-wise short-term/medium-term/bilateral requirements to meet the demand optimally.
9. Accurate demand assessment is fundamental to capacity expansion modelling and directly impacts the Resource Adequacy (RA) study outcomes. To achieve realistic and data-driven results, States/Discoms are strongly encouraged to adopt scientific tools and robust methodologies for demand forecasting.
10. Timely commissioning of planned capacities is critical to ensuring that the UT can meet the projected peak demand and energy requirements identified in this study. Any deviation from the planned schedule may lead to resource shortfalls and could significantly increase the cost of reliably meeting the UT's power demand.

Planned Future Contracted (MW) considered in the study

Sr. No.	Tied capacity name	Type of generation	Expected COD	Tentative share of J&K and Ladakh (in MW)
1.	NTPC SOLAR	Solar	2025-26	320
2.	SJVNL SOLAR	Solar	2025-26	300
3.	SECI Solar Manufacture Linked	Solar	2025-26	100
4.	NHPC SOLAR	Solar	2025-26	280
5.	CVPPPL PAKALDUL HEP	Hydro	2026-27	350
6.	CVPPPL KWAR HEP	Hydro	2027-28	100
7.	RHPCL Ratle HEP	Hydro	2029-30	450
8.	CVVPL Kiru HEP	Hydro	2026-27	82
9.	Karnah	Hydro	2024-25	12
10.	Parnai	Hydro	2027-28	37.5
11.	Mohra	Hydro	2027-28	10.5
12.	GT Pampore Solar	Solar	2027-28	5
13.	Sumbal Solar	Solar	2027-28	5
14.	SJVNL Vishnughad Pipalkoti	Hydro	2026-27	23.6
15.	Chenani Canal Top	Solar	2026-27	6
16.	New Ganderbal	Hydro	2027-28	93
17.	Lower Kalnai	Hydro	2027-28	48
18.	BHEP Floating	Solar	2027-28	10
19.	Tapovan Vishnughad HEP	Hydro	2029-30	46
20.	Kirthai-I	Hydro	2029-30	390
21.	ANS-I(IPP)	Hydro	2029-30	40
22.	ANS-I(IPP)	Hydro	2029-30	23
23.	Phagla	Hydro	2029-30	14
24.	Kishenganga-II	Hydro	2029-30	40

Assumption for Resource Adequacy Studies

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

RE CUF considered

Hydro	Wind	Solar	DRE
43 %	24%	20-22%	14%

Technical Parameters

Technology	Type	Availability (%)	Ramping (%/min)	Min. Technical . (%)
Coal/ Lignite	Existing/Planned	85	1	55
	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	-
BESS	Candidate	98	NA	-

Technology	Type	Heat Rate (MCal/MWh)		Aux. Consum. (%)
		At max loading	At min loading	
Coal	Existing/ Planned	2300 to 2879	2438 to 3052	7.0
	Candidate (SC & USC)	2060 to 2125	2183 to 2253	6.5
Gas	Existing	2000 to 2900	2260 to 3277	2.5
Nuclear	Existing/ Planned	2777	2777	10
	Candidate	2777	2777	10
Biomass	Existing/ Planned	4200	4450	8
	Candidate	4200	4450	8
Hydro	Existing/ Planned	-	-	0.7
	Candidate	-	-	0.7
Pumped Storage	Existing/ Planned	-	-	pump efficiency 80 %
	Candidate	-	-	
BESS	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	4.5 Cr	1 % of Capex	1	25
Wind (Onshore)	7.5 Cr	1% of Capex	1.5	25
BESS (4-Hour)	4.98 Cr to 3.00 Cr	1 % of Capex	0.5	14