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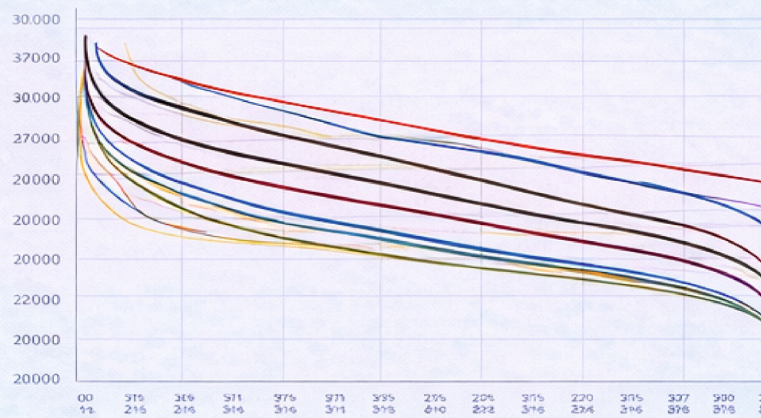
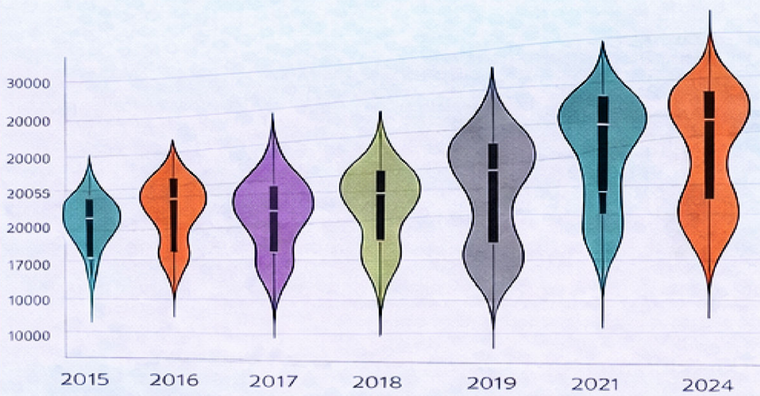
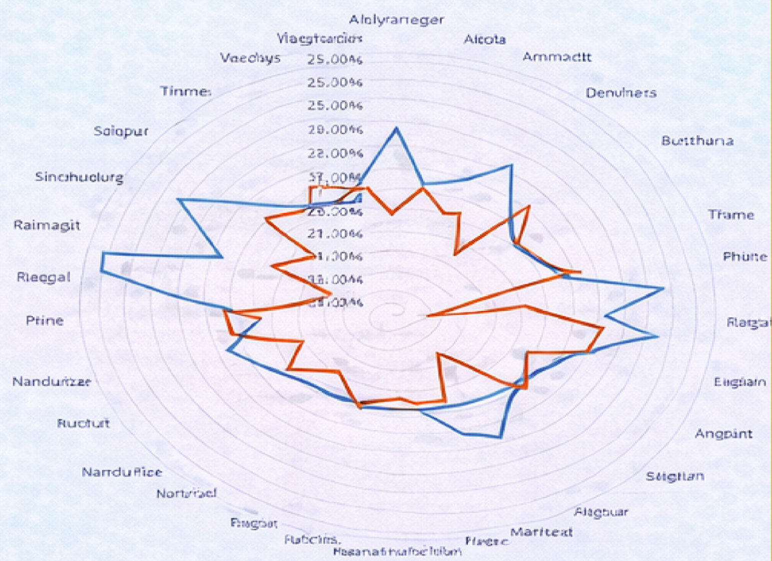
Maharashtra State Electricity Transmission Co. Ltd.

Decadal Assessment of Electricity Demand, District-wise Energy Consumption and Rooftop Solar Impact in Maharashtra







Maharashtra State Load Despatch Centre

January 2026

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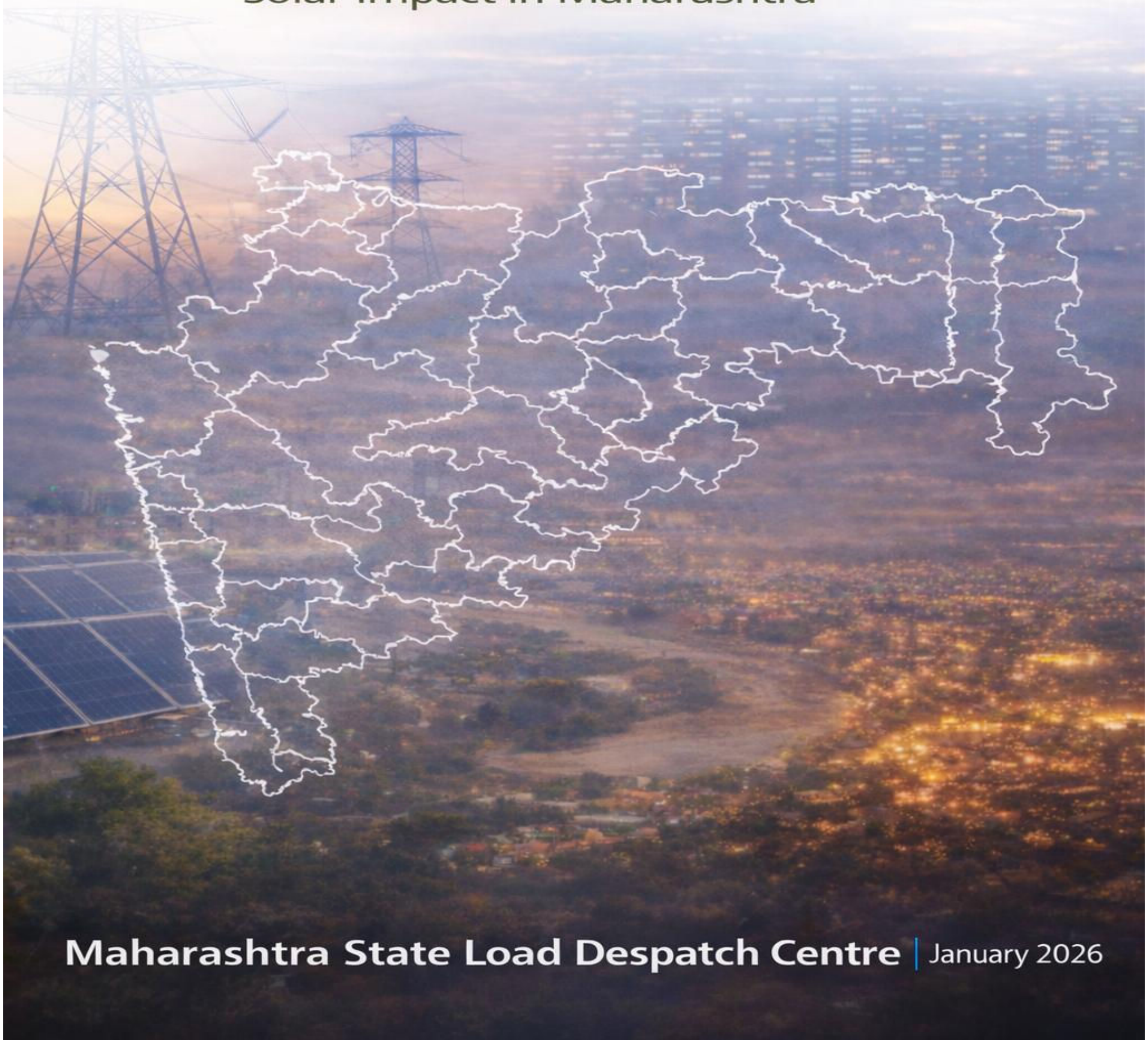

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(Maharashtra State Load Despatch Centre)

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Maharashtra State Electricity Transmission Co. Ltd.

CIN No. U40109 MH2005SGC153646

Foreword

I am pleased to note the publication of this report on the ten-year analysis of demand patterns, district-wise energy consumption, and rooftop solar impact in Maharashtra. Undertaking a long-duration, data-driven study of this nature is both timely and essential, particularly at a stage when the power sector is undergoing significant structural transformation. This is the first time such a comprehensive, long-duration demand and consumption analysis has been undertaken for the Maharashtra power system at the state level.

While such analyses are often initiated from an operational requirement, their relevance extends far beyond day-to-day system operation. A consistent and methodical understanding of how demand evolves across time and geography, can provide valuable inputs for state-level infrastructure planning, energy transition pathways, and coordinated development of transmission and distribution systems. Studies of this nature can become an important reference for policymakers, planners, and institutions involved in Maharashtra's broader development process.

I would like to congratulate the **Maharashtra State Load Despatch Centre team** for taking up this challenging task and successfully translating an idea into a comprehensive analytical document. Compiling and analysing large volumes of data over an extended period, alongside regular operational responsibilities, reflects the team's commitment and technical capability.

I hope this work sets the foundation for similar long-term analytical efforts in the future and contributes meaningfully to informed decision-making for the state.

Dr. Sanjeev Kumar (IAS)
(Chairman & Managing Director, MSETCL)

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Foreword

The reliable operation and planning of a power system depend fundamentally on a clear understanding of demand behaviour. In this context, the present report provides a valuable and structured analysis of how Maharashtra's system demand and consumption patterns have evolved over time.

From an operational and planning perspective, long-term demand analysis supports better assessment of peak behaviour, load distribution, regional concentration, and emerging changes in demand shape. The use of load duration curves, time-block analysis, and spatial consumption assessment in this report offers useful insights for transmission planning, system strengthening, and operational preparedness, particularly in the presence of increasing renewable and distributed generation.

I congratulate the **Maharashtra State Load Despatch Centre team** for proactively undertaking this first-of-its-kind study for the state. The effort demonstrates a forward-looking approach and a strong analytical orientation within the operational framework of the SLDC.

The methodologies and observations documented in this report can serve as a solid base for continuous monitoring of system behaviour and for strengthening coordination between operations and planning functions. I am confident that such studies, will enhance the robustness and resilience of Maharashtra's power system.

Shri. Satish Chavan
Director (Operations), MSETCL

Preface

The electricity sector is undergoing a phase of rapid and sustained change, driven by growth in demand, increasing penetration of renewable energy, evolving consumption patterns, and structural shifts at both the transmission and distribution levels. In such a dynamic environment, a clear understanding of **long-term demand behaviour**, supported by consistent data analysis, is essential for informed system operation, planning, and preparedness. Short-term assessments, while operationally useful, are often insufficient to capture deeper structural trends and emerging shifts in system behaviour.

Against this backdrop, the present study was conceived to undertake a **long-duration analysis of Maharashtra's power system demand,** complemented by district-wise energy consumption assessment and an evaluation of the growing impact of rooftop solar generation. A ten-year observation period allows meaningful differentiation between transient variations and sustained changes in demand patterns, providing a more robust basis for understanding system evolution. Such an analysis is particularly relevant for Maharashtra, given its diverse load mix, significant agricultural demand, rapid urbanisation, and increasing deployment of distributed and renewable generation.

This report represents the **first comprehensive effort of its kind in the state**, bringing together long-term demand analysis, spatial consumption patterns, and distributed solar impact within a single analytical framework. The study reflects a conscious move towards evidence-based understanding of system behaviour, using operational data and structured visualisation techniques to document how the system has evolved over time.

I would like to place on record my appreciation for the Maharashtra State Load Despatch Centre **team**, who readily responded to the idea of undertaking such a study and translated it into a comprehensive analytical exercise. The effort involved in compiling, validating, and analysing large volumes of data over

an extended period is substantial, and the commitment demonstrated by the team in executing this work alongside routine operational responsibilities is commendable.

It is my hope that this report will serve not only as a factual reference on historical demand behaviour, but also as a foundation for **continued and periodic analysis in the coming years.** As demand patterns evolve further with changes such as daytime supply to agricultural loads, increasing rooftop solar penetration, and growth in embedded generation, the methodologies and insights developed through this study can support both transmission and distribution planning, as well as enhance operational understanding of the Maharashtra power system.

Shashank Jewalikar
(Executive Director, MSLDC, Airoli)

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Executive Summary

Understanding the evolution of electricity demand over a long observation period is essential for reliable power system operation and planning, particularly in a large and diverse system such as Maharashtra. Short-duration or year-specific analyses are often insufficient to distinguish structural changes in demand from short-term variability arising from weather, economic cycles, or operational interventions. A long-term perspective enables identification of underlying trends, shifts in demand distribution, and gradual changes in consumption behaviour, which are critical inputs for transmission planning, operational preparedness, and system adequacy assessment.

In this context, the present report analyses **ten years of operational demand data (2015–2024)** for the Maharashtra power system, supplemented by **district-wise energy consumption data for 2022–2024** and an assessment of the **impact of rooftop solar generation from 2016–2025**. The analysis is based on data available with the State Load Despatch Centre and distribution utilities and documents observed system behaviour over time, without drawing predictive or policy-oriented conclusions.

A range of **visualisation techniques and analytical treatments** has been employed to examine demand behaviour across temporal and spatial dimensions. Load duration curves are used to analyse changes in peak, median, and base demand levels and to assess shifts in the overall demand distribution. Time-series and block-wise analyses capture intra-day, weekly, and seasonal variations, while comparisons of maximum and minimum demand days provide insight into system stress conditions and variability. Three-dimensional surface plots for selected high-consumption districts are used to visualise block-wise energy consumption evolution across the year, enabling identification of recurring load patterns and time-block concentration. District-wise and region-wise energy consumption analyses highlight spatial distribution and growth patterns, while rooftop solar trends are examined through cumulative and incremental capacity growth, along with peak-day impact assessments at the state and district levels.

Such long-horizon, multi-dimensional demand analysis is consistent with practices adopted by system operators and planning agencies in India and internationally, where load duration curves, demand segmentation, and spatial consumption studies are routinely used to understand evolving system behaviour in the presence of increasing renewable and distributed generation.

The analysis indicates a sustained increase in Maharashtra's electricity demand over the past decade across **peak, median, and base demand conditions**, with load duration curves showing a gradual upward shift in demand distribution. Intra-day and seasonal analyses reveal consistent time-block concentration of peak demand, with variations across seasons and years. District-wise energy consumption exhibits significant spatial concentration, with the **Mumbai Metropolitan Region and Pune region** together accounting for a substantial share of total state consumption and demonstrating higher absolute growth compared to several other districts. Region-wise comparisons further highlight differences in consumption characteristics across Konkan, Western Maharashtra, Northern Maharashtra, Vidarbha, and Marathwada.

Maharashtra's demand profile is characterised by a **significant agricultural load component,** which has traditionally been supplied in a controlled and rotational manner across daytime and night-time hours.

This operational practice has historically functioned as an indirect form of demand-side management and has strongly influenced observed system demand patterns. With the implementation of schemes such as **MSKVY 2.0,** agricultural loads are increasingly being supplied during daytime hours. While the full impact of this transition may not yet be clearly visible within the period of observation, early indications of changing demand patterns are evident, underscoring the need for continued monitoring using consistent analytical frameworks.

At the same time, **rooftop solar capacity has grown significantly in recent years,** with its impact on grid demand becoming clearly visible, particularly during the last two years of the study period. Traditionally, the demand observed by the system operator—namely, the demand served through the **intra-state transmission system (InSTS)—**has been considered representative of total state demand. However, the growing penetration of renewable generation embedded within the distribution network, including agricultural solar feeders under MSKVY 2.0, rooftop solar installations, and co-located captive power plants, is now catering to an increasing share of electricity demand. As a result, the demand reflected at the transmission system level no longer fully represents total underlying consumption. Despite this, the demand catered through the InSTS has continued to increase, indicating sustained growth in overall electricity requirements.

As agricultural loads progressively shift towards daytime supply and distributed generation continues to expand, further changes in demand shape, peak timing, and intra-day load distribution are expected. The analytical methods and visualisation approaches developed in this report therefore provide a foundation for **ongoing, year-on-year observation** of system behaviour. Overall, the report serves as a factual and analytical reference to support **state-level transmission and distribution planning,** as well as operational understanding of Maharashtra's evolving power system.

Table of Contents

List of Figures

List of Tables

1. Demand Duration Curve Trends: State, MSEDCL, Mumbai & Net Demand

1.1 Introduction:

Electrical demand is defined as the rate at which electrical power is consumed over a specified time interval by all designated loads within a clearly defined area. For practical applications, demand is typically measured in megawatts (MW). Demand duration curve or Load duration curve is a graphical representation of observed demand / load variation as a function of time.

In this chapter, time duration curves—representing electrical demand versus the percentage of time that the demand level is equalled or exceeded—have been utilized to analyse demand patterns. The study encompasses a detailed assessment of the following demand groups traditionally observed in Maharashtra power system over the period from 2015 to 2024:

- **State Demand**: The total electrical demand recorded at transmission interface across the entire state (*Hourly Daily System Report (DSR) Data at MSLDC, Airoli is considered*).
- **MSEDCL Demand**: The demand attributable to the Maharashtra State Electricity Distribution Company Limited (MSEDCL) (*Hourly DSR Data is considered*).
- **Mumbai Demand**: The electrical demand within the Mumbai region. (*TATA, AEML, and BEST demand on hourly basis outlined in DSR is considered*).
- **Net Demand**: The Net Demand is considered as the total state demand excluding the RE (Wind + Solar) demand.

1.2 State Demand (2015-2024)

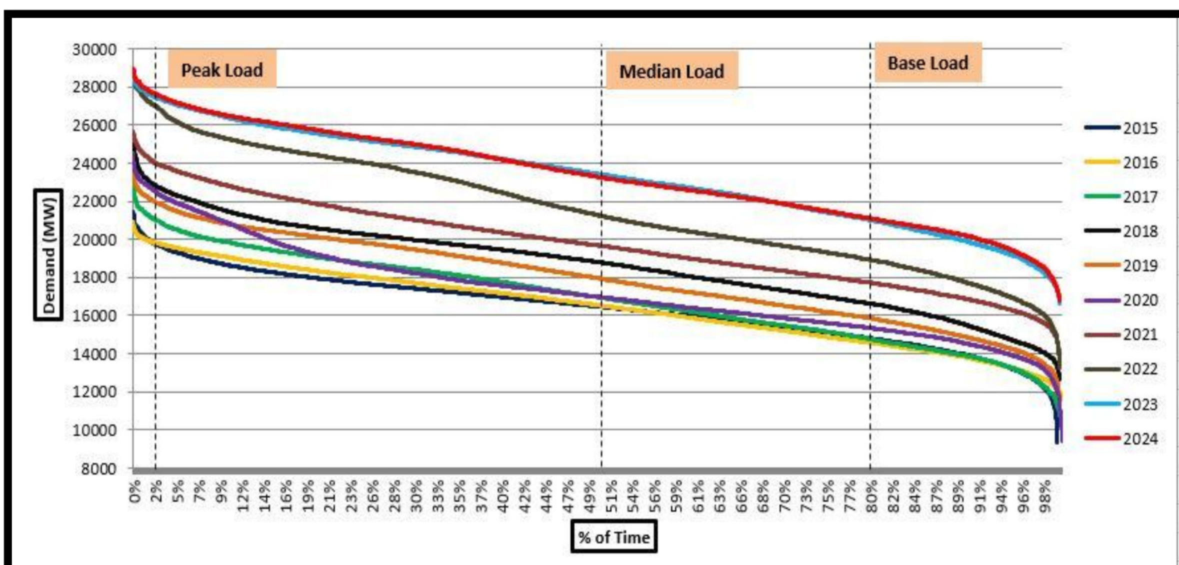
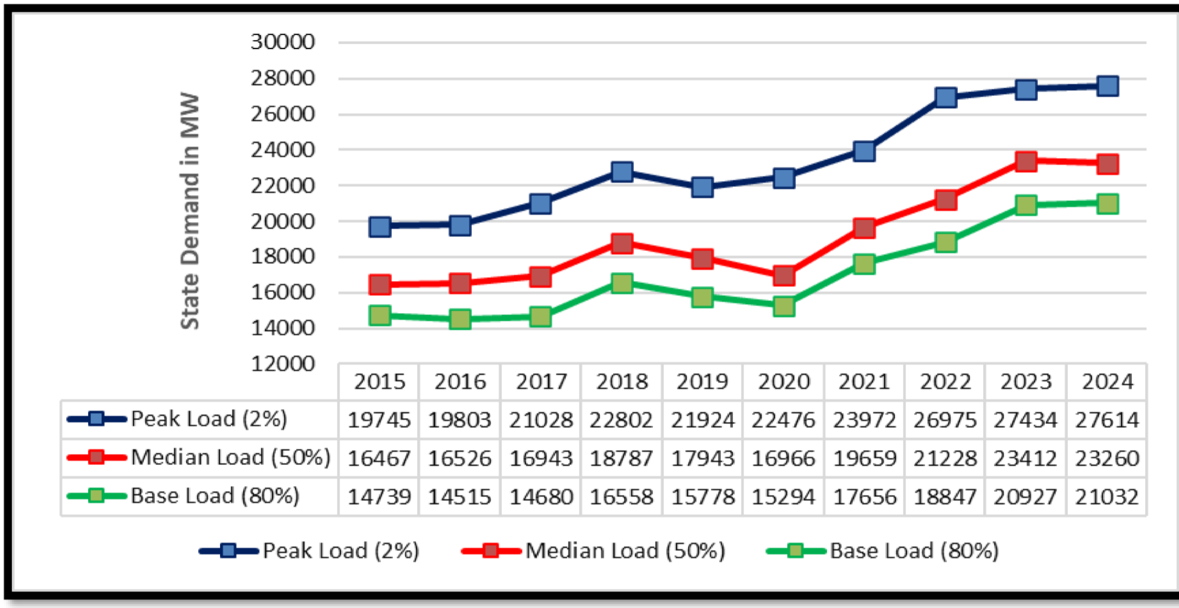


Figure 1: State Demand Time Duration Plots

Figure 1 presents the State Demand Load Duration Curves for the period 2015–2024, illustrating the year wise spread of demand values over time.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Peak Load (2%)	19745	19803	21028	22802	21924	22476	23972	26975	27434	27614
Median Load (50%)	16467	16526	16943	18787	17943	16966	19659	21228	23412	23260
Base Load (80%)	14739	14515	14680	16558	15778	15294	17656	18847	20927	21032

Figure 2: State Demand (in MW) Profile in Peak Load, Median Load & Base Load Scenarios

a. Peak Load (2%)

For the purpose of this analysis, peak load is considered as the load level that is equalled or exceeded for 2% of the time in a load duration curve. It represents the demand levels that the power system must be capable of serving, even if such instances are infrequent. Ensuring the availability of adequate generation capacity to meet these peak moments is critical for maintaining grid reliability and resource adequacy in the Maharashtra power system.

As illustrated in Figure 2, Maharashtra's peak load has increased from 19,745 MW in 2015 to 27,614 MW in 2024, representing 39.85% growth over the decade.

b. Median Load (50%)

For the purpose of this analysis, median load is considered as the load level that is equalled or exceeded for 50% of the time in a load duration curve. It serves as a reliable indicator of average operating conditions and provides insight into the consistent, underlying power demand on the system.

Between 2015 and 2024, the median load in Maharashtra increased from 16,467 MW to 23,260 MW, representing a growth of 41.25%.

c. Base Load (80%)

For the purpose of this analysis, base load is considered as the level of electrical demand that is equalled or exceeded for 80% of the time. It represents the minimum sustained demand on the power system and is typically met by continuously operating base load power plants, such as coal-fired and hydroelectric stations. From 2015 to 2024, Maharashtra's base load increased from 14739 MW to 21,032 MW, representing a growth of 42.7%.

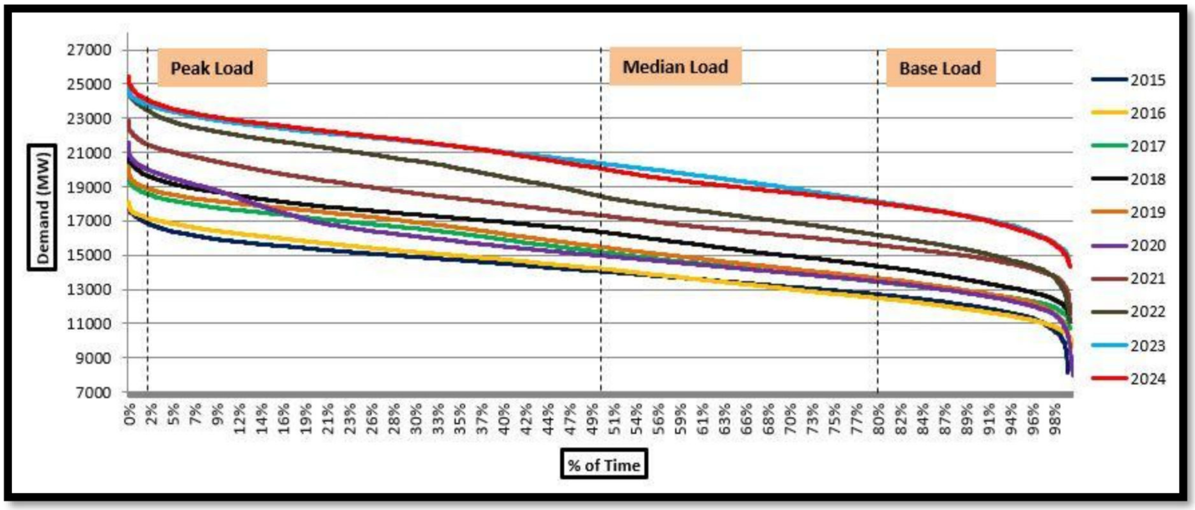
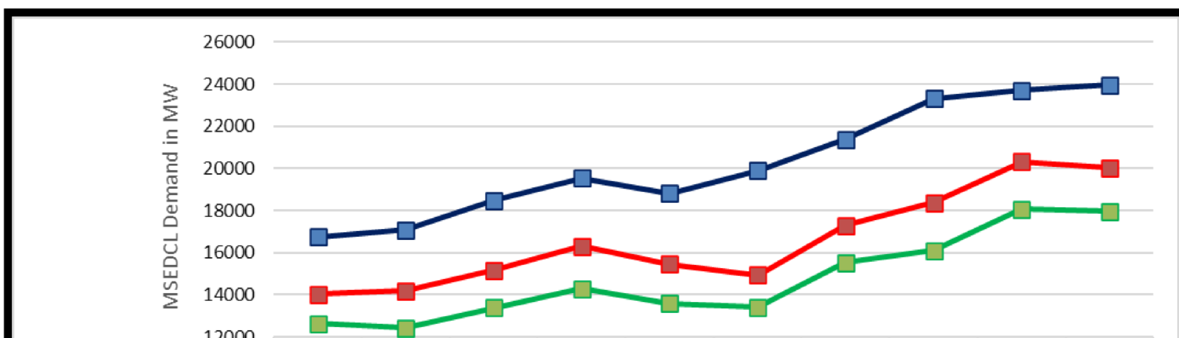


Figure 3: MSEDCL Demand Time Duration Plots

1.3 MSEDCL Demand (2015-2024)



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Peak Load (2%)	16750	17090	18490	19542	18815	19905	21386	23313	23701	23953
Median Load (50%)	14035	14186	15165	16325	15453	14947	17295	18388	20332	20028
Base Load (80%)	12647	12436	13387	14296	13599	13405	15542	16112	18060	17978

Figure 4: MSEDCL Demand Profile in Peak Load, Median Load & Base Load Scenarios

Figure 4 & 5 illustrates an overall increase in MSEDCL demand from 2015 to 2024, similar to the upward trend observed in State demand (in Figure 1). The MSEDCL demand closely mirrors the general demand pattern of State demand. Peak Load grew from 16,750 MW (2015) to 23,953 MW (2024) — a total increase of 43.0% over the decade.

- Median Load increased from 14,035 MW (2015) to 20,028 MW (2024) — an overall rise of 42.7%.
- Base Load rose from 12,647 MW (2015) to 17978 MW (2024) — an increase of 42.2%.
- The changes in the year 2024 as compared to 2023 need further analysis. This time also corresponds with increasing of resources in the distribution grid. Some analysis of such effects is carried out in a separate chapter.

1.4 Mumbai Demand (2015-2024)

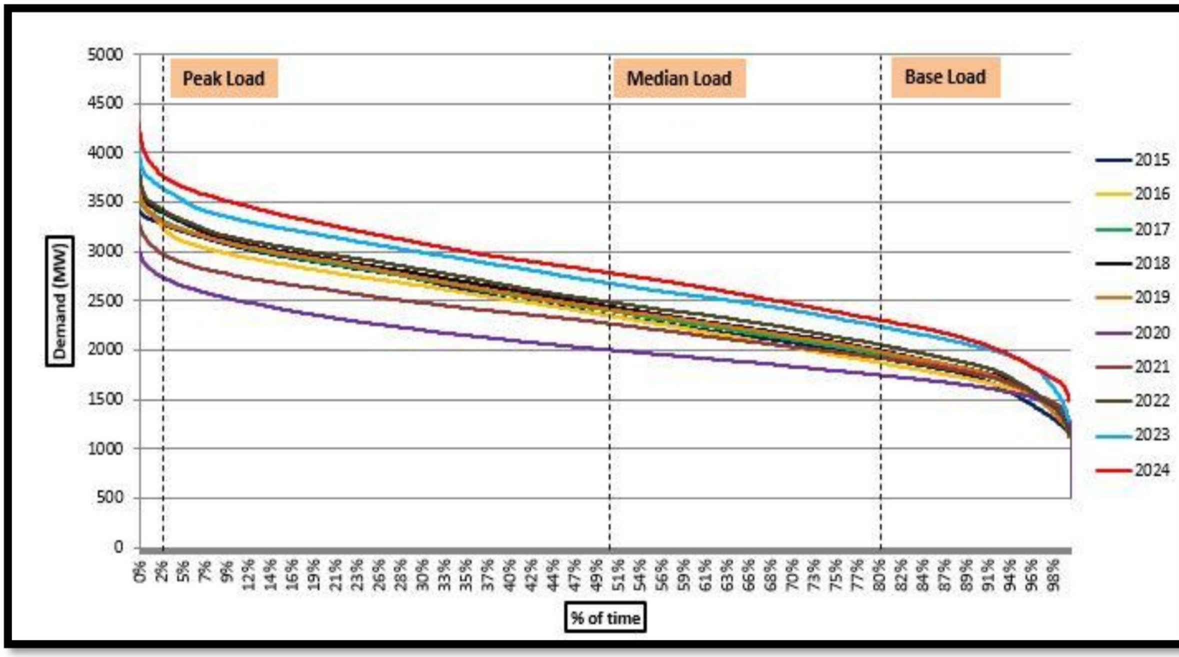
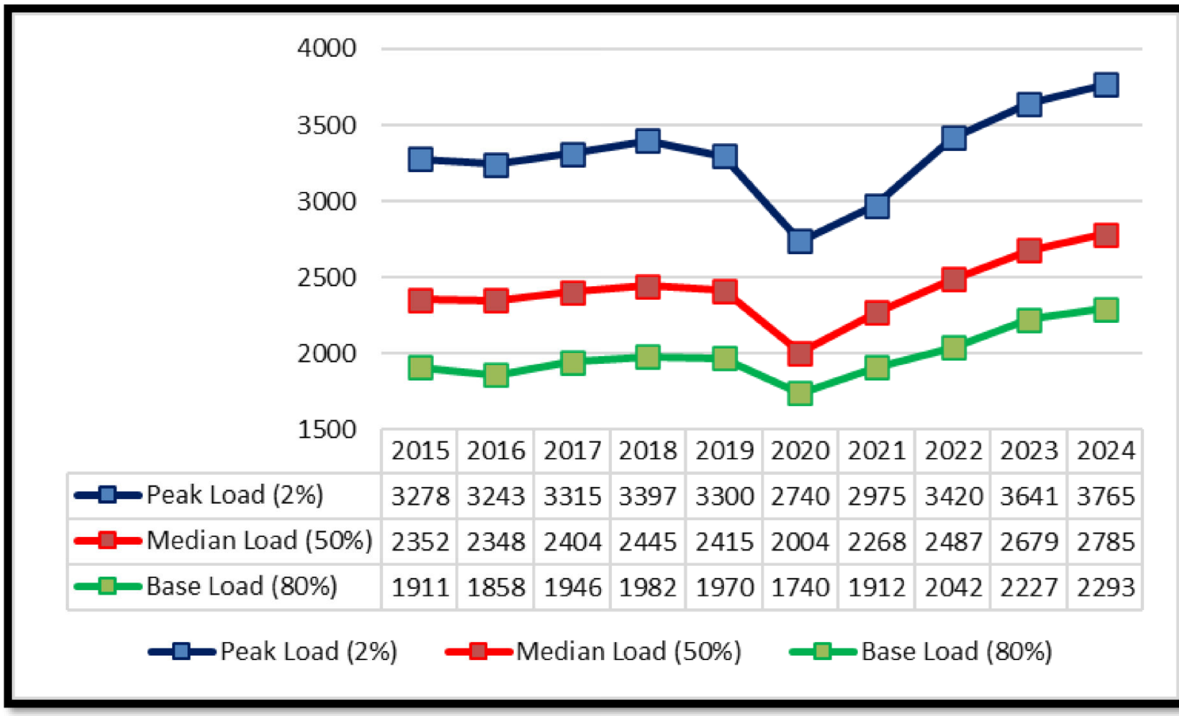


Figure 5: Mumbai Demand Time Duration Plots

The Figure-5 illustrates the Mumbai Demand Load Duration Curves for the period 2015–2024. Unlike broader State and MSEDCL trends, Mumbai's 2020 demand dip was more pronounced.



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Peak Load (2%)	3278	3243	3315	3397	3300	2740	2975	3420	3641	3765
Median Load (50%)	2352	2348	2404	2445	2415	2004	2268	2487	2679	2785
Base Load (80%)	1911	1858	1946	1982	1970	1740	1912	2042	2227	2293

Figure 6: Mumbai Demand Profile in Peak Load, Median Load & Base Load Scenarios

- The peak load increased from 3,278 MW in 2015 to 3,765 MW in 2024, marking a total growth of 15.6% (513 MW).
- The median load rose from 2,352 MW in 2015 to 2,785 MW in 2024, an overall increase of 18.2% (431 MW).
- The base load increased from 1,911 MW in 2015 to 2,293 MW in 2024, a total rise of 20.0% (382 MW).

1.5 Net Demand Trends (2015-2024)

In power system demand analysis, excluding renewable energy (Wind and Solar) generation from the total state demand is a critical step for understanding the residual demand that must be met by dispatchable resources**.** This **net demand** represents the portion of system demand that remains after accounting for RE generation (Wind and Solar) and must be served by thermal, hydro, gas-based, or other dispatchable resources.

It allows system operators to accurately forecast and plan for the capacity needed from firm resources to ensure grid stability and security. Year-on-year increase in net demand for the period under observation, suggests that despite the increasing penetration of renewable energy, the reliance on conventional energy sources (thermal, hydro, nuclear) was growing in absolute terms. This could be due to a rise in total electricity consumption that outpaces the growth of RE generation, leading to higher net demand met by conventional sources. It may also indicate limitations in the integration or availability of RE during certain hours or seasons, requiring conventional generation to fill the gap. Variability in wind and solar generation, limited energy storage capability, and prevailing grid constraints can restrict full utilization of available renewable energy, thereby increasing reliance on thermal and hydro generation sources.

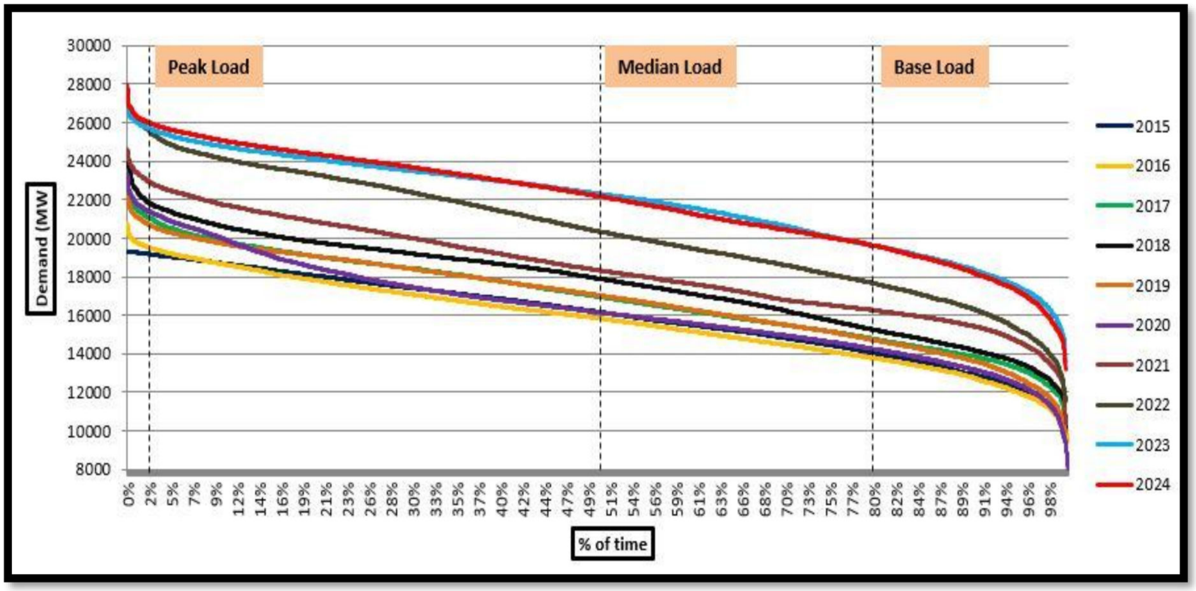
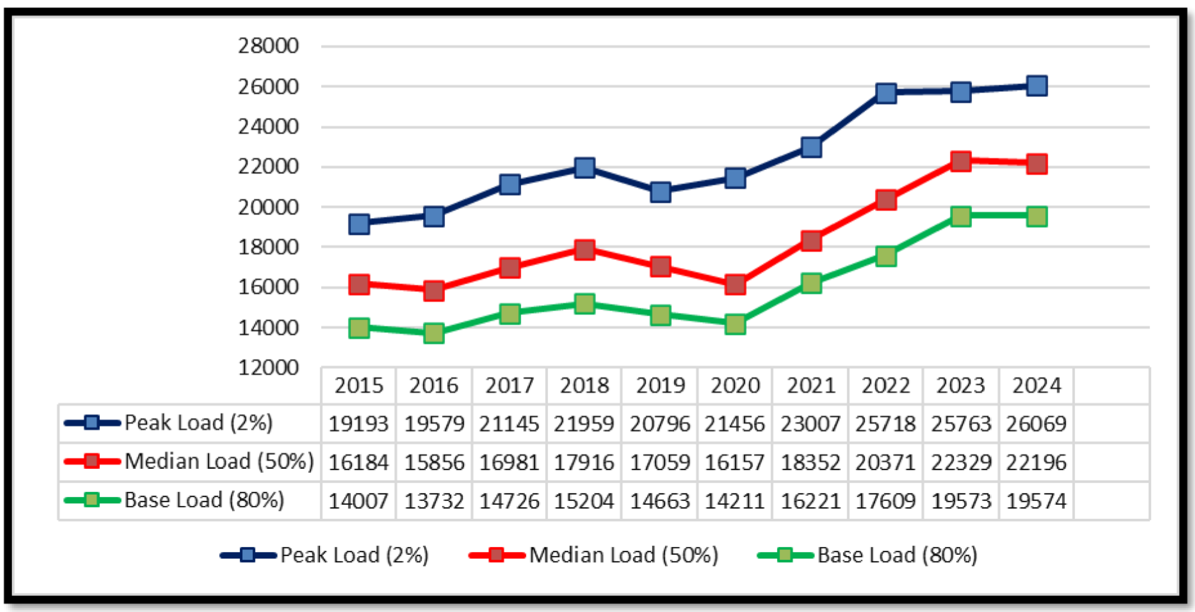


Figure 7: Net Demand Time Duration Plots



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Peak Load (2%)	19193	19579	21145	21959	20796	21456	23007	25718	25763	26069
Median Load (50%)	16184	15856	16981	17916	17059	16157	18352	20371	22329	22196
Base Load (80%)	14007	13732	14726	15204	14663	14211	16221	17609	19573	19574

Figure 8: Net Demand Profile in Peak Load, Median Load & Base Load Scenarios

- The peak load increased from 19193 MW in 2015 to 26069 MW in 2024, marking a total growth of 35.8% (6876 MW).
- The median load rose from 16184 MW in 2015 to 22196 MW in 2024, an overall increase of 37.2% (6012 MW).

- The base load increased from 14007 MW in 2015 to 19574 MW in 2024, a total rise of 39.7% (5567 MW).

The reversal of trend from 2023 to 2024 needs to be looked in continuation with years ahead as the renewable energy penetration increases.

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2. Year-wise Hourly State Demand Distribution using Violin Plots

2.1 Introduction:

This chapter examines the hourly distribution of Maharashtra's state demand using violin plots, providing a detailed view of how State demand varies across 24 hours over the period 2015–2024. Unlike simple averages or peak values, violin plots capture the full distribution of demand, highlighting typical demand levels, variability, and the presence of extreme values within each hour. In addition, the chapter presents year-wise state demand distributions for each hour.

2.2 Understanding of the Violin Plot

1. Shape of the Violin

- Wider areas = More data points (i.e., demand values occur more frequently).
- Narrow areas = Fewer data points (rare demand values).

2. White Dot in the Center (If inner='quartile')

- The median demand for that hour.
- A key indicator of central tendency.

3. Thick Black Bar (Interquartile Range, IQR)

- 25th to 75th percentile — shows the spread of middle 50% of demand values.
- Wider spread = more variability.
- 25th percentile (first quartile, Q1): 25 % of all demand observations lie *below* this value, and 75 % lie above it.
- Median (50th percentile): half the observations lie below and half above.
- 75th percentile (third quartile, Q3): 75 % of observations fall below and 25 % above.

4. Tails

- Show minimum and maximum demand values (outliers may also be visible depending on the data).

2.3 Hourly State Demand Distribution – (2015–2024)

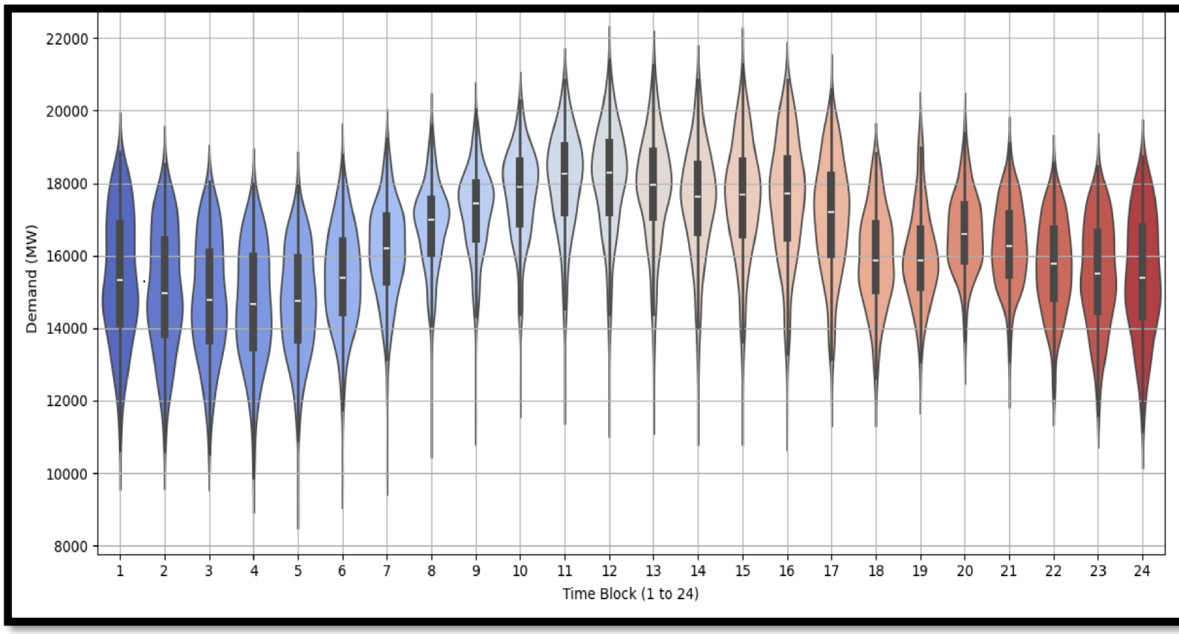

Figure 9: Hourly State Demand Distribution – 2015

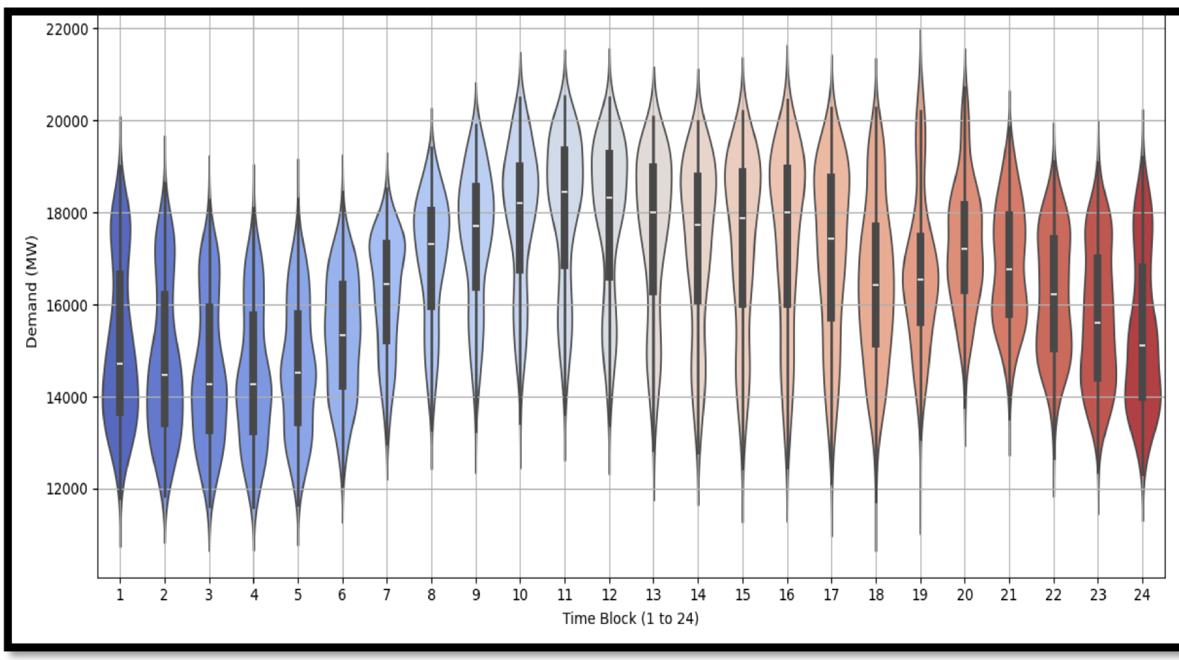

Figure 10 : Hourly State Demand Distribution – 2016

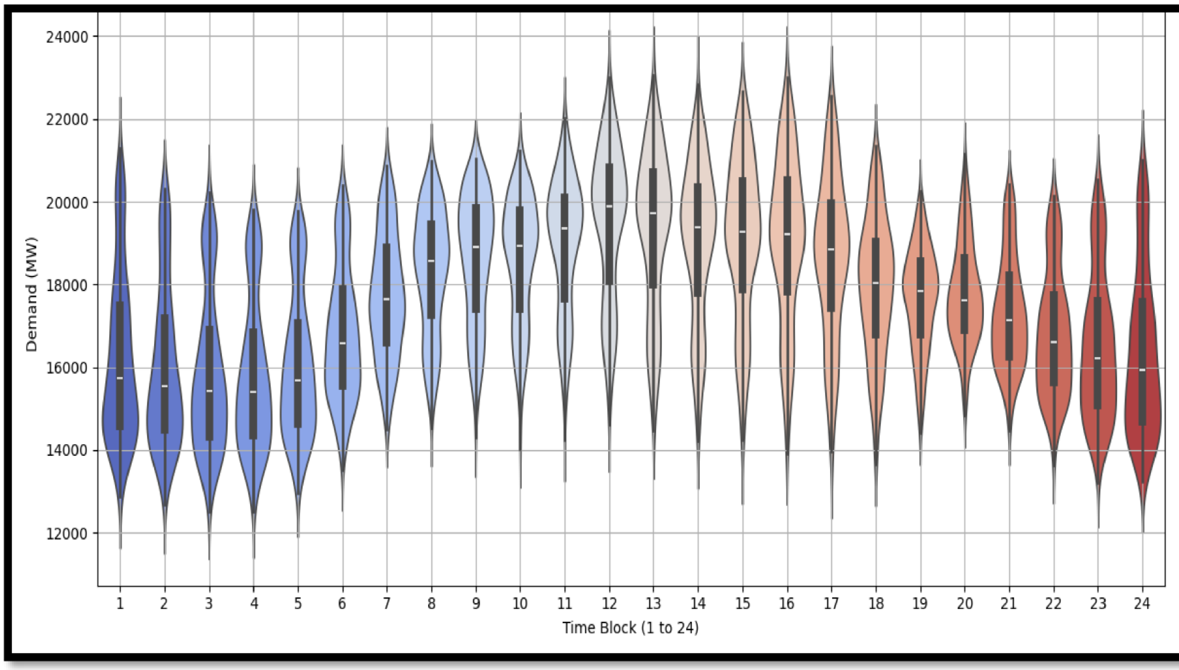

Figure 11: Hourly State Demand Distribution – 2017

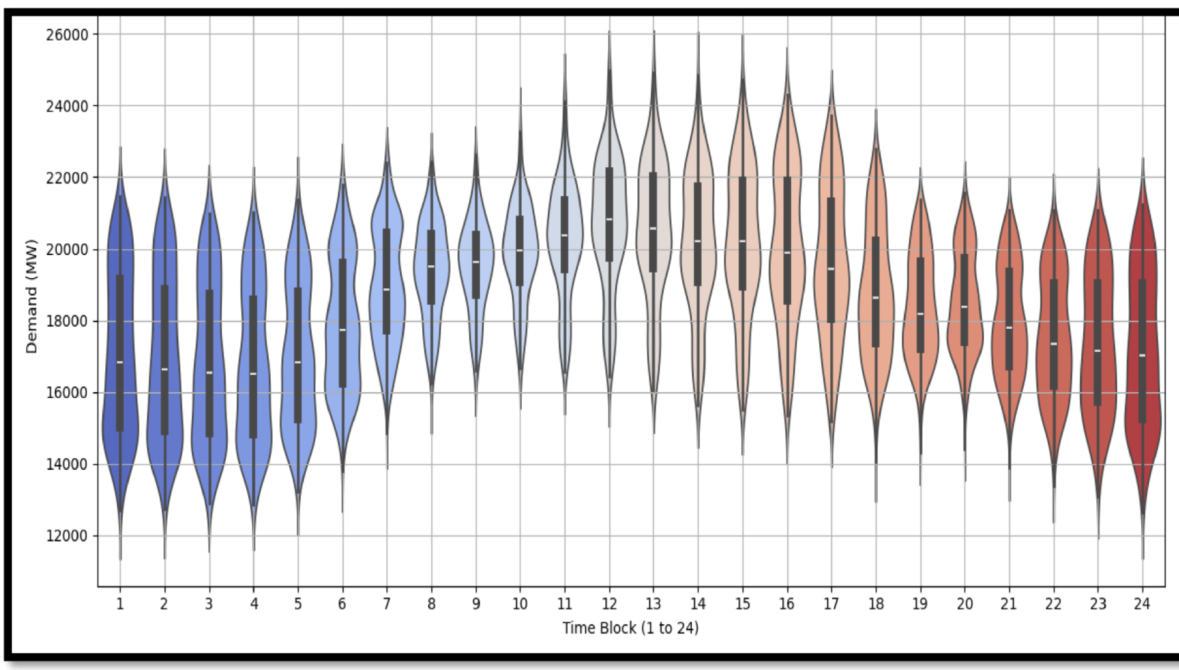

Figure 12: Hourly State Demand Distribution – 2018

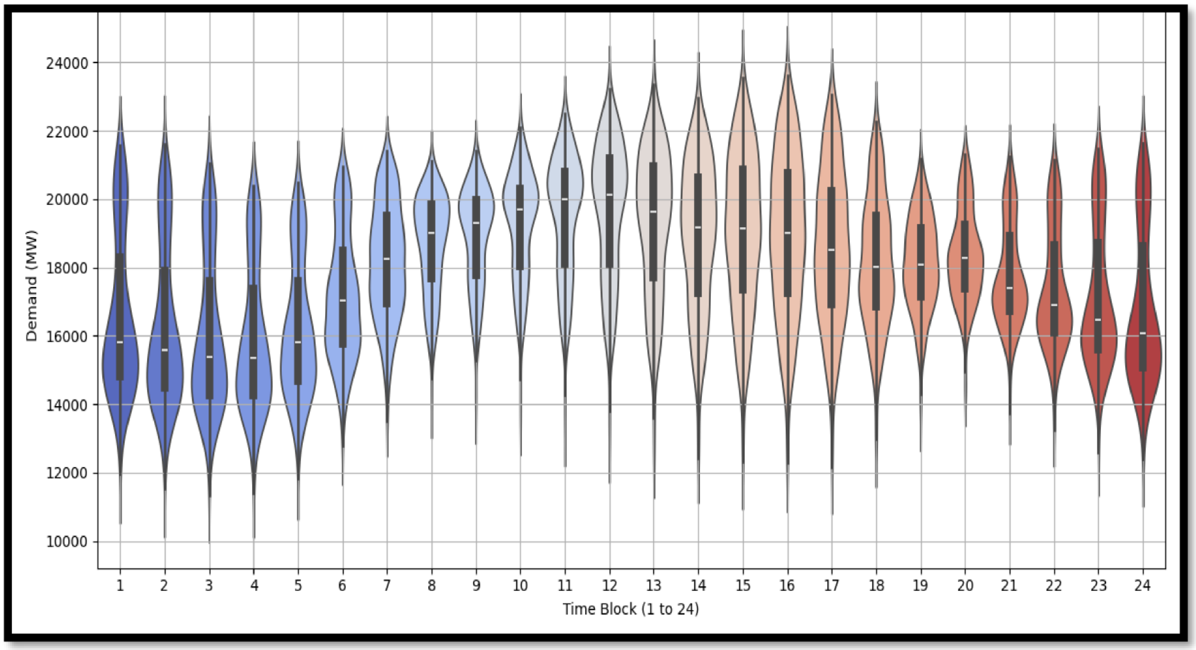

Figure 13: Hourly State Demand Distribution – 2019

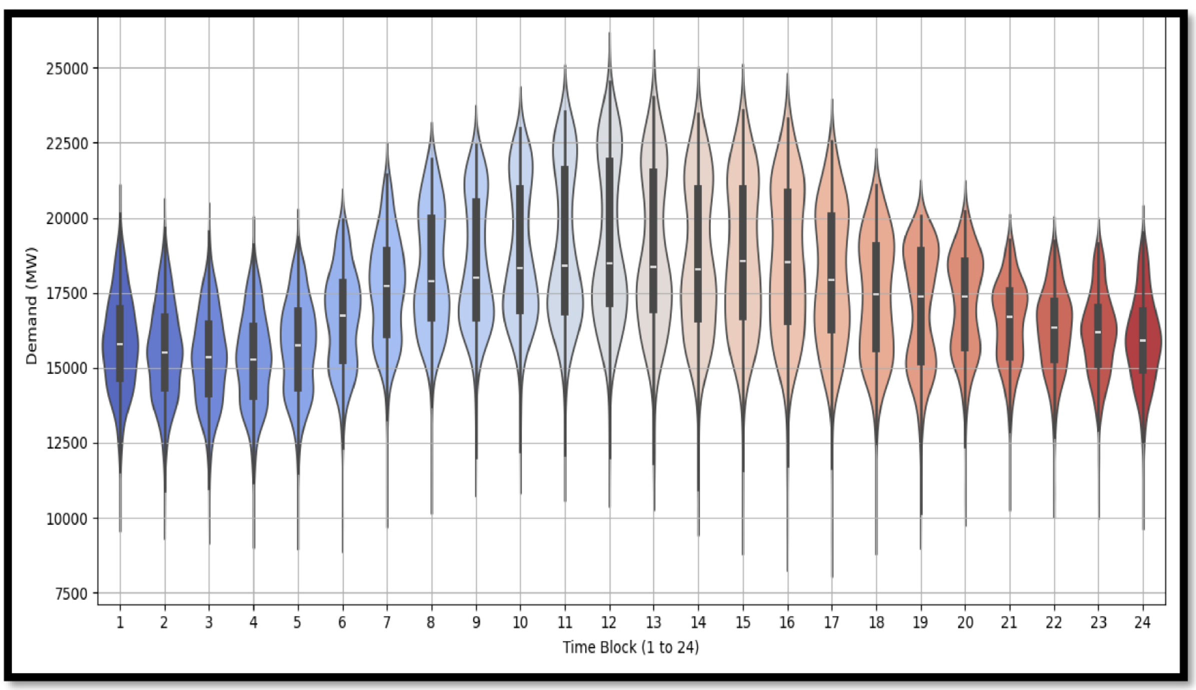

Figure 14: Hourly State Demand Distribution – 2020

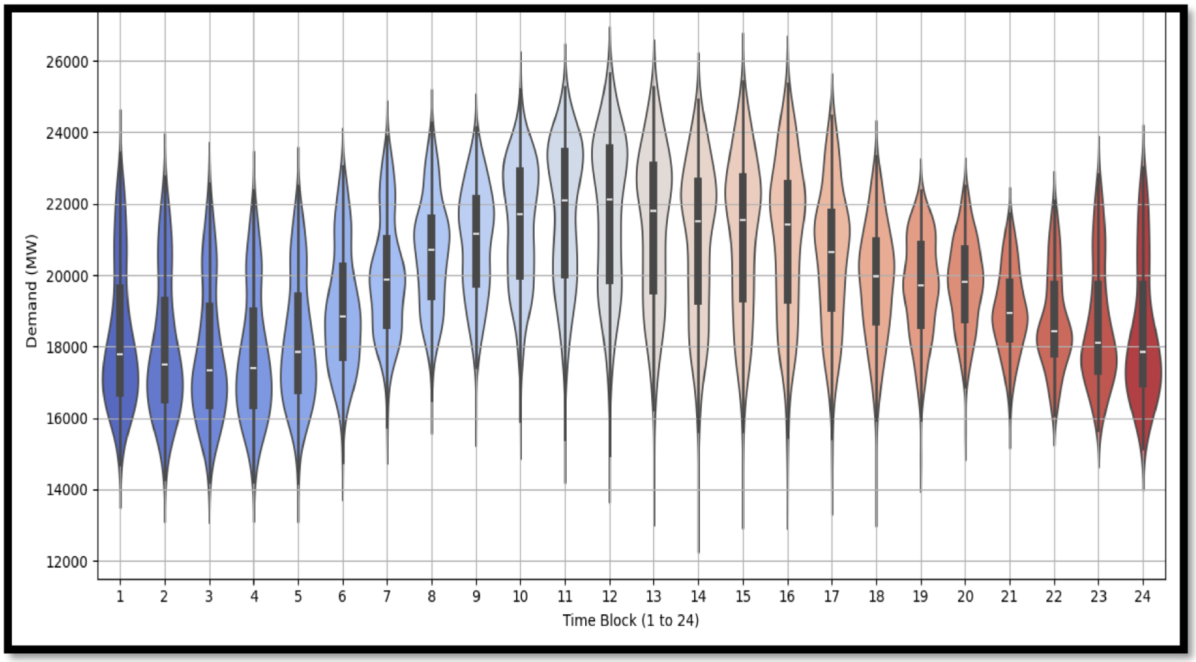

Figure 15 : Hourly State Demand Distribution – 2021

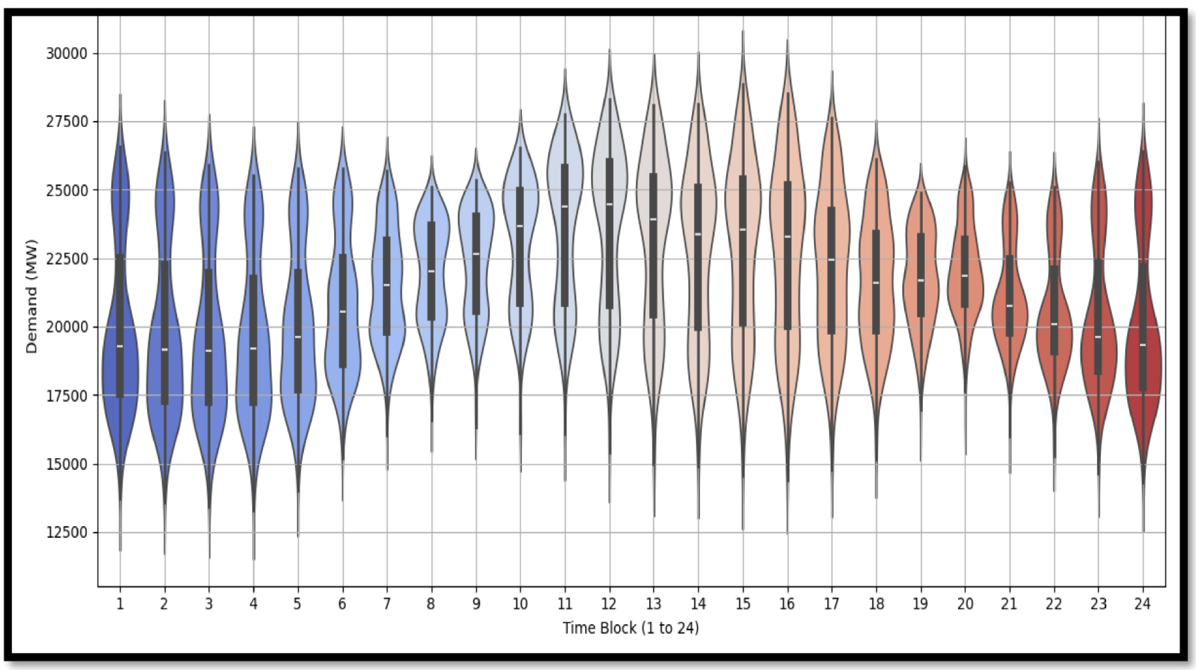

Figure 16 : Hourly State Demand Distribution – 2022

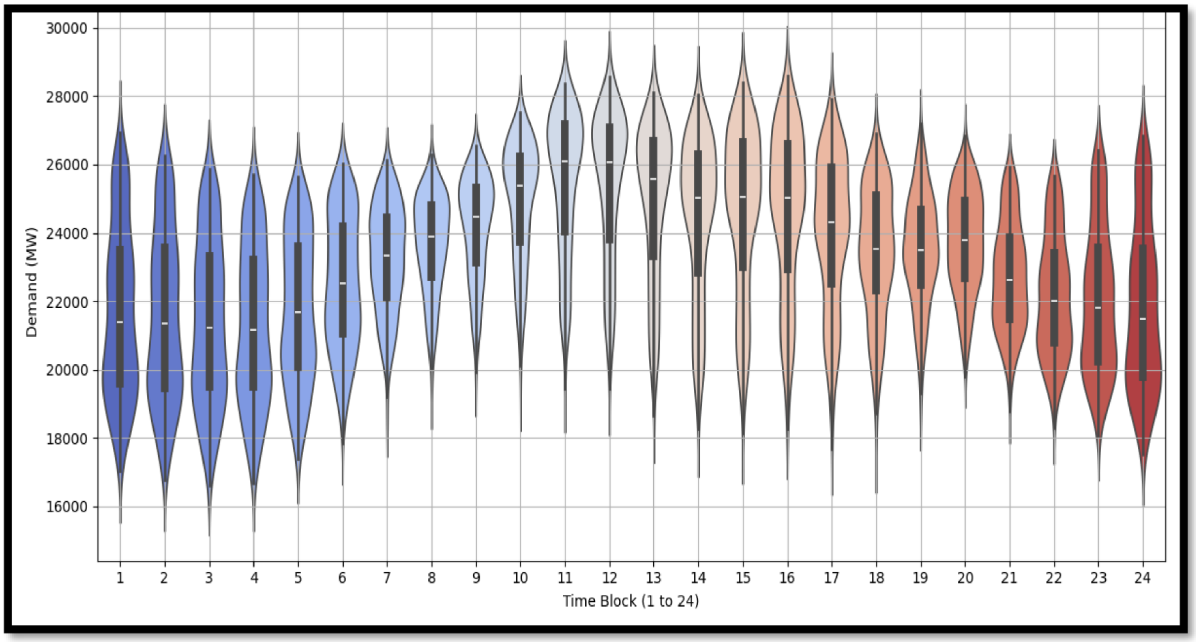

Figure 17: Hourly State Demand Distribution – 2023

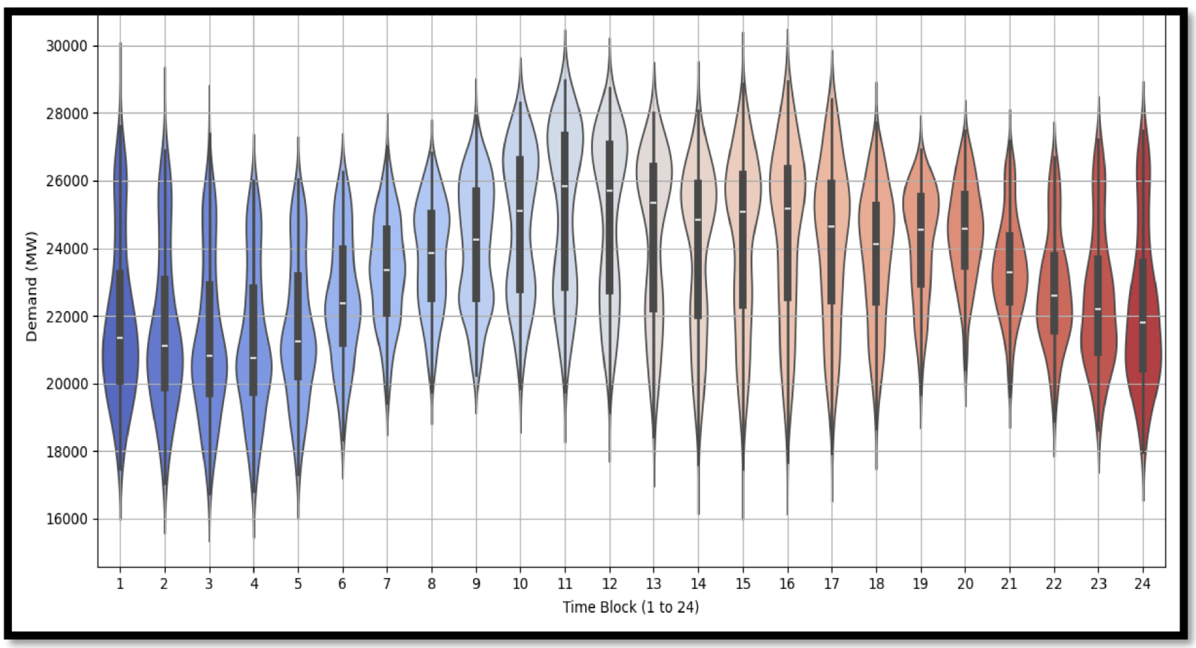

Figure 18: Hourly State Demand Distribution – 2024

2.4 Year-wise State Demand Distribution for a Given Hour (2015–2024)

The Year-wise State Demand distribution has been illustrated from Figure 19 to Figure 42. These plots depict how demand values **of that particular hour** are distributed across all days of a given year and how this distribution changes over the years (2015-2024).

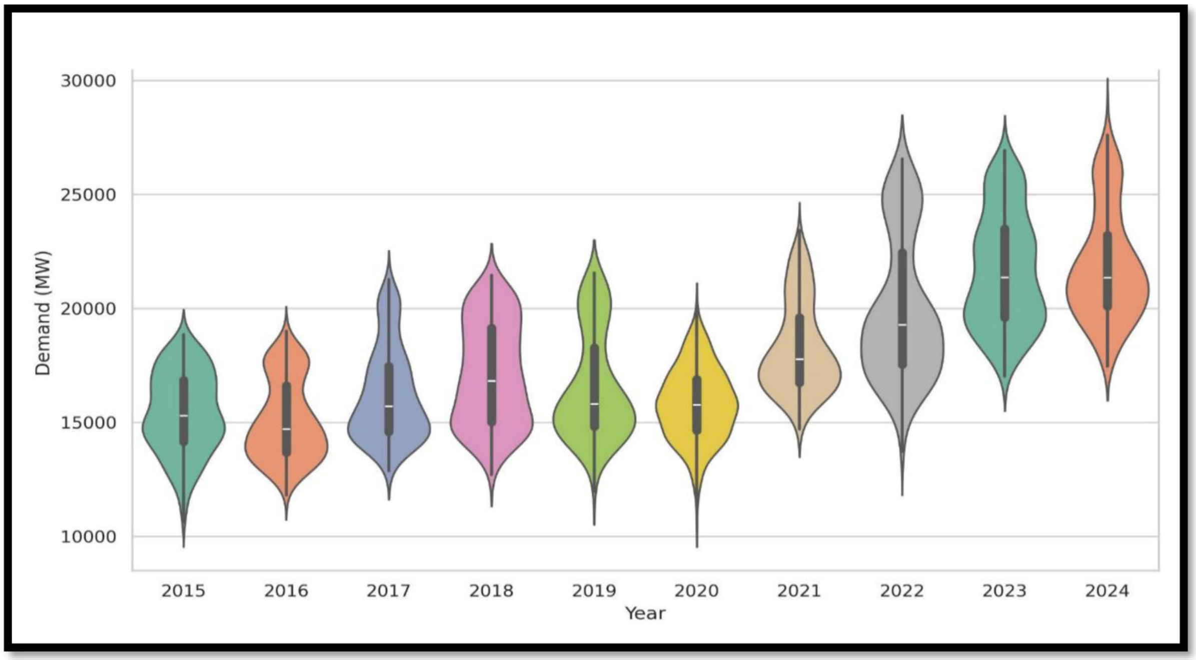

Figure 19: Year-wise State_Demand_Distribution_Hour_1

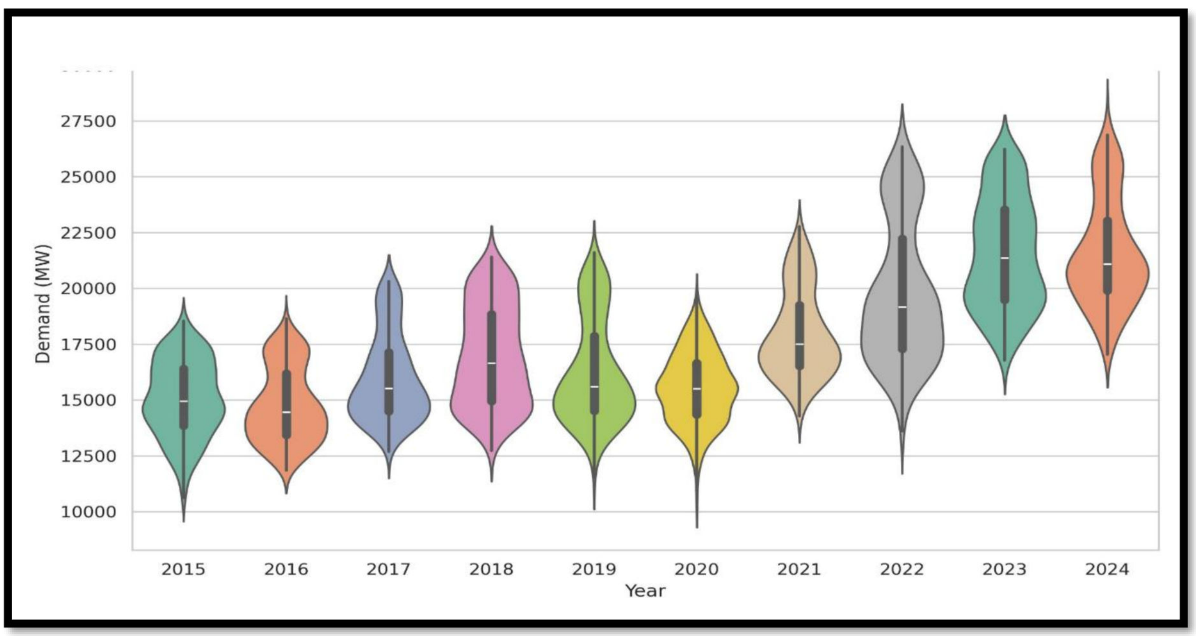

Figure 20: Year-wise State_Demand_Distribution_Hour_2

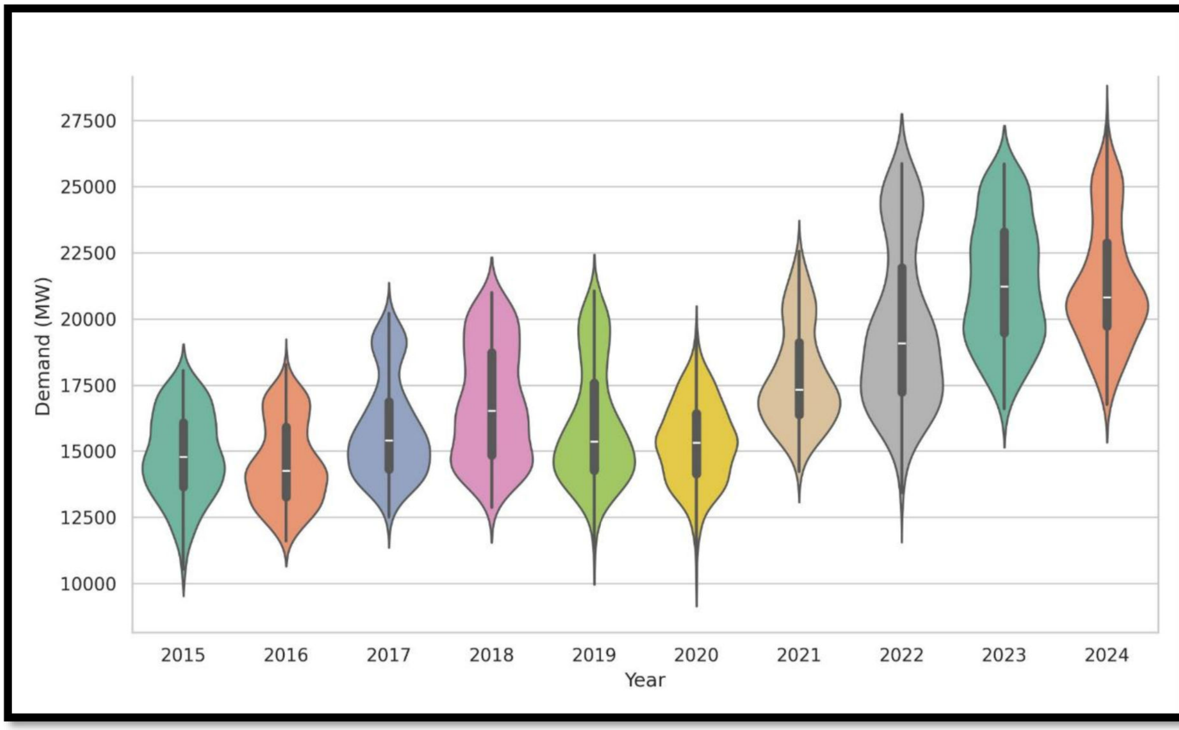

Figure 21: Year-wise State_Demand_Distribution_Hour_3

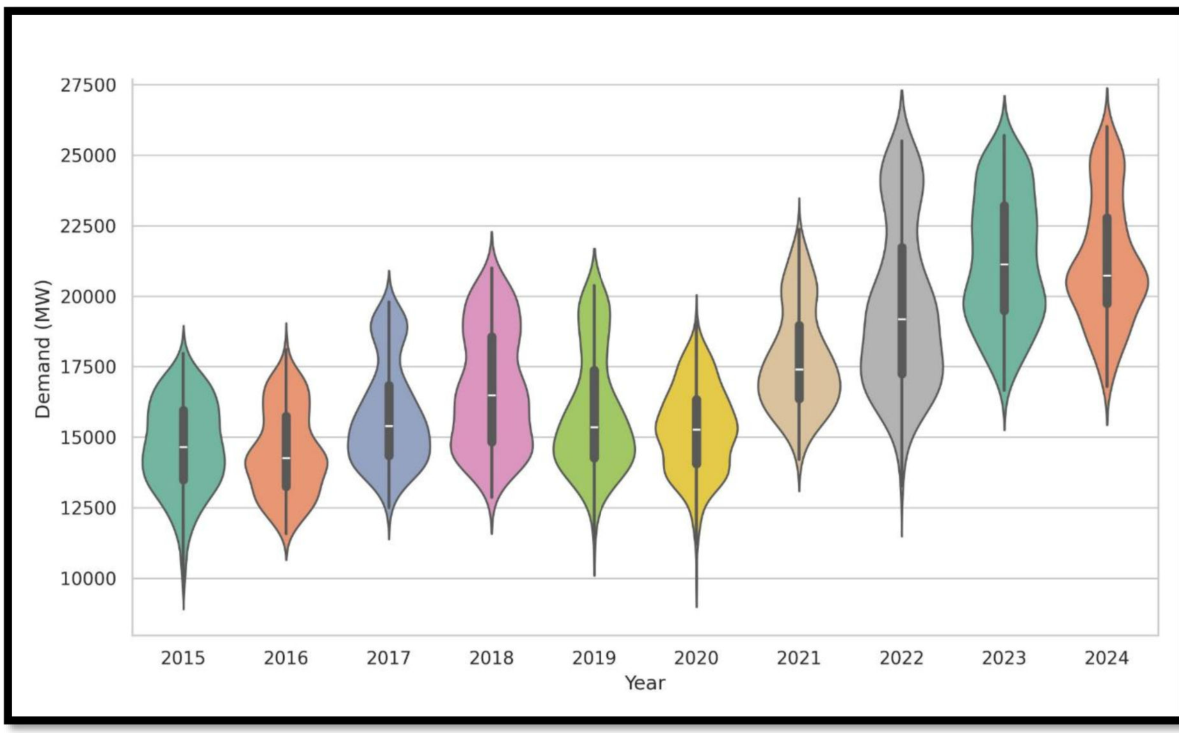

Figure 22: Year-wise State_Demand_Distribution_Hour_4

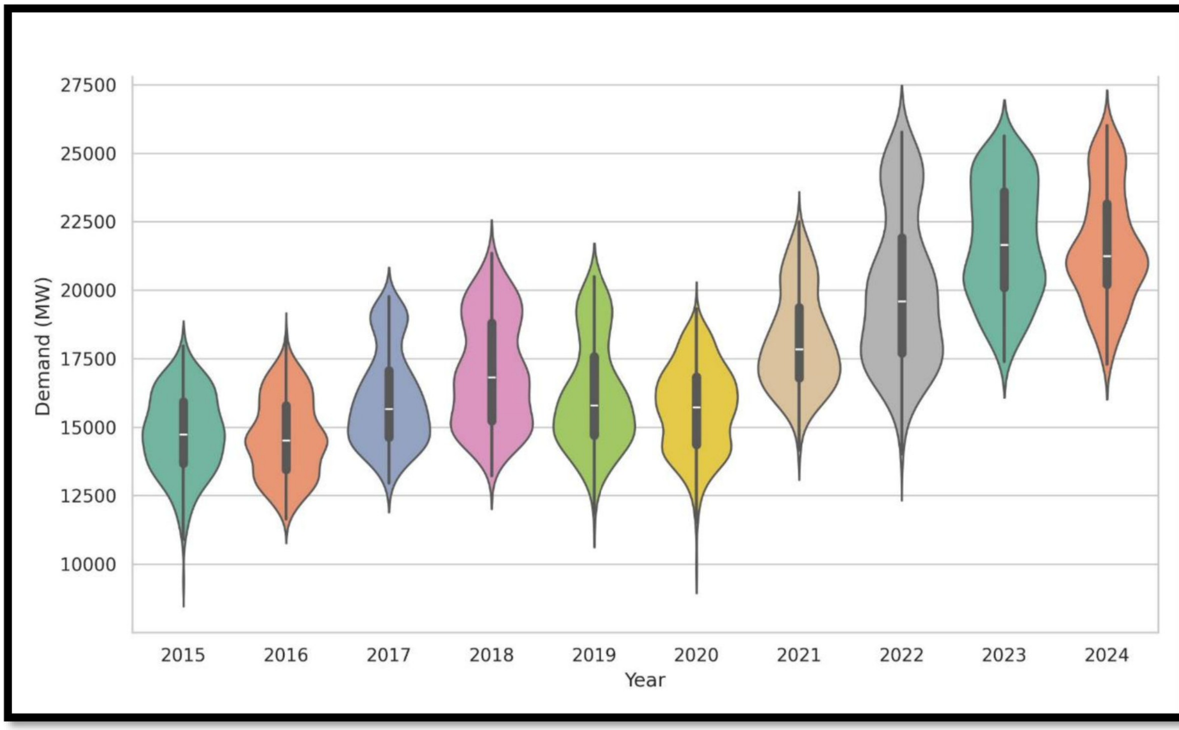

Figure 23: Year-wise State_Demand_Distribution_Hour_5

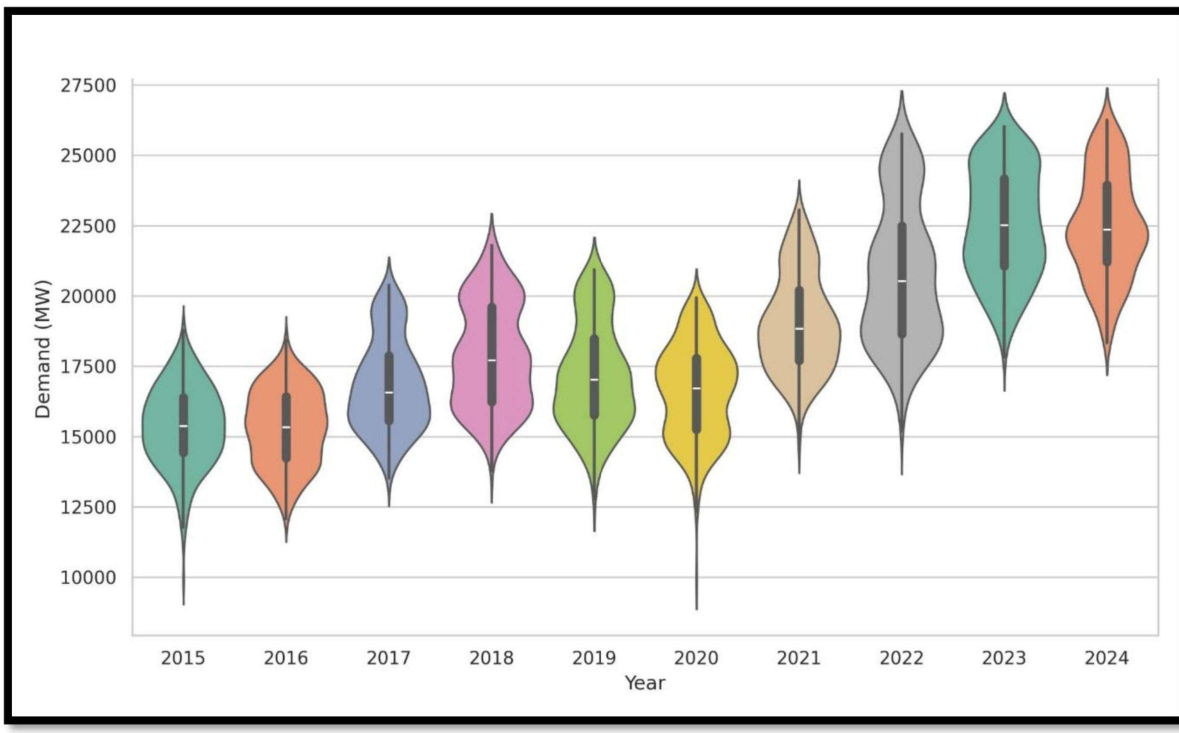

Figure 24: Year-wise State_Demand_Distribution_Hour_6

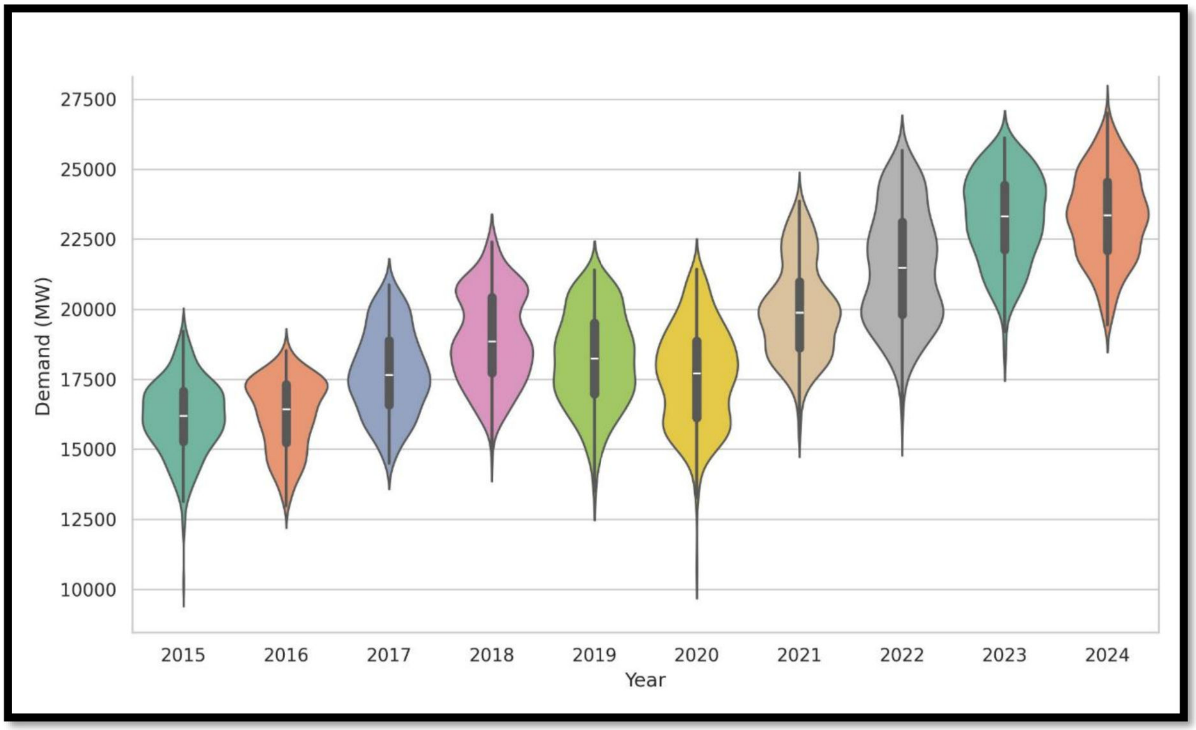

Figure 25: Year-wise State_Demand_Distribution_Hour_7

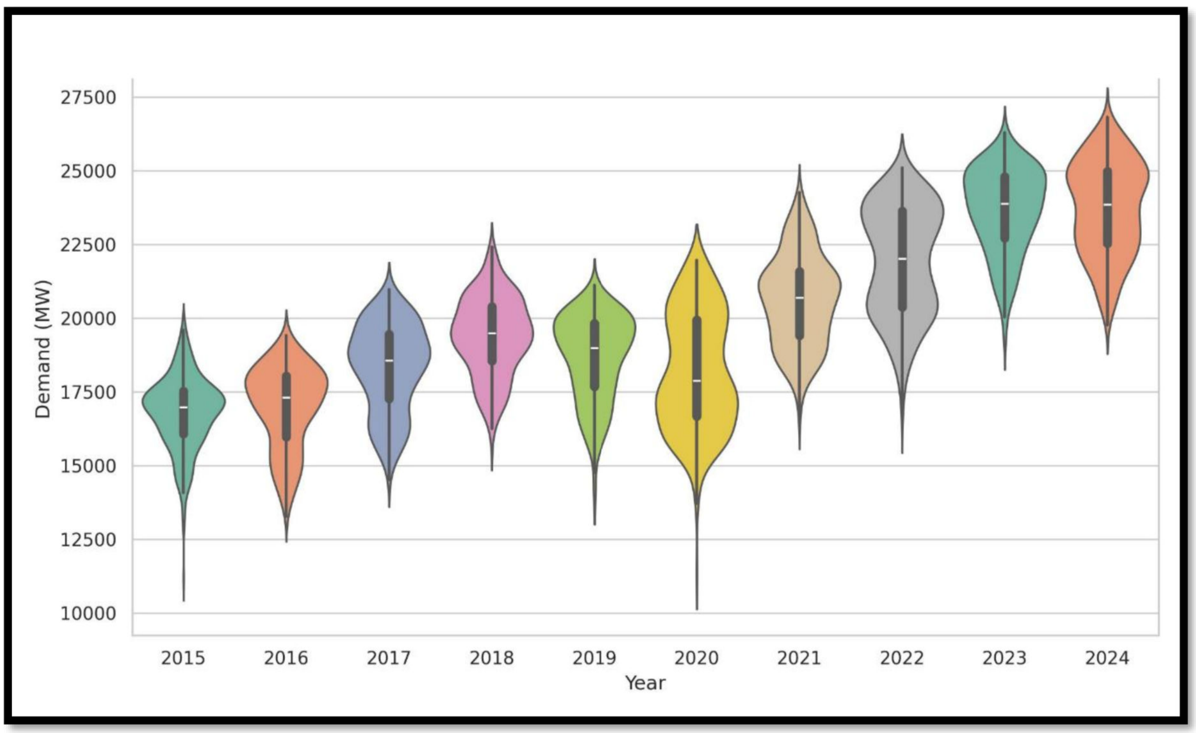

Figure 26: Year-wise State_Demand_Distribution_Hour_8

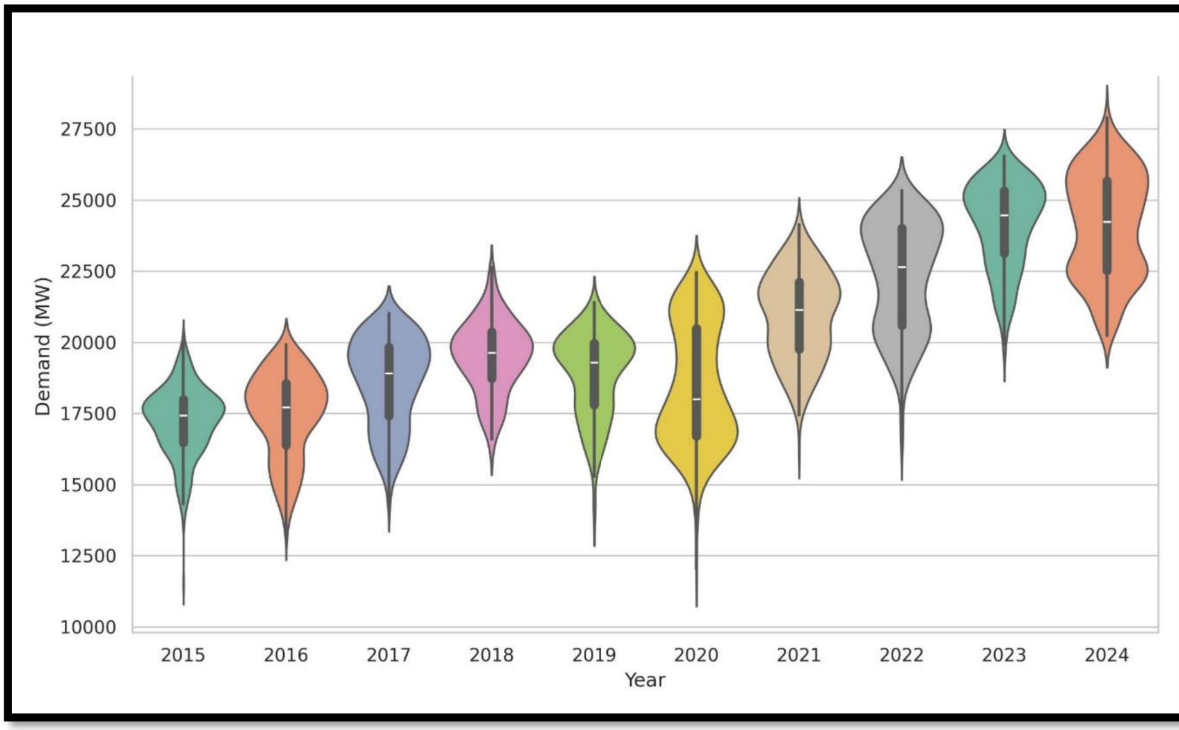

Figure 27: Year-wise State_Demand_Distribution_Hour_9

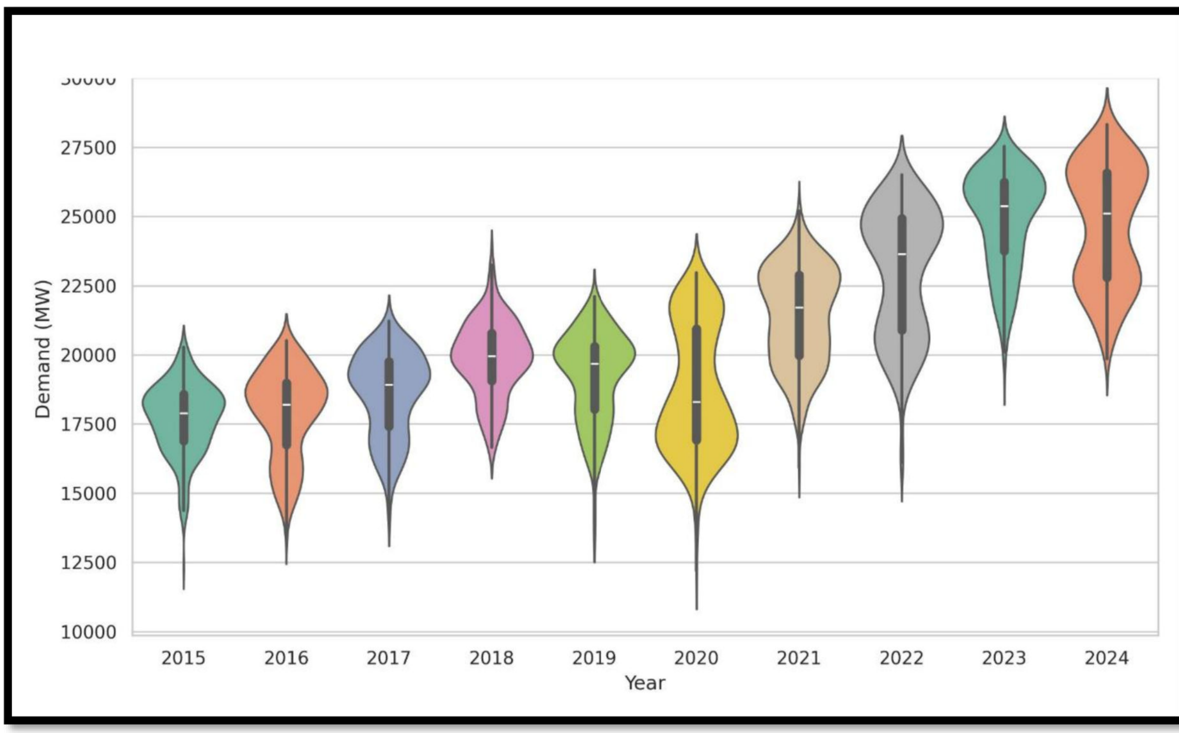

Figure 28: Year-wise State_Demand_Distribution_Hour_10

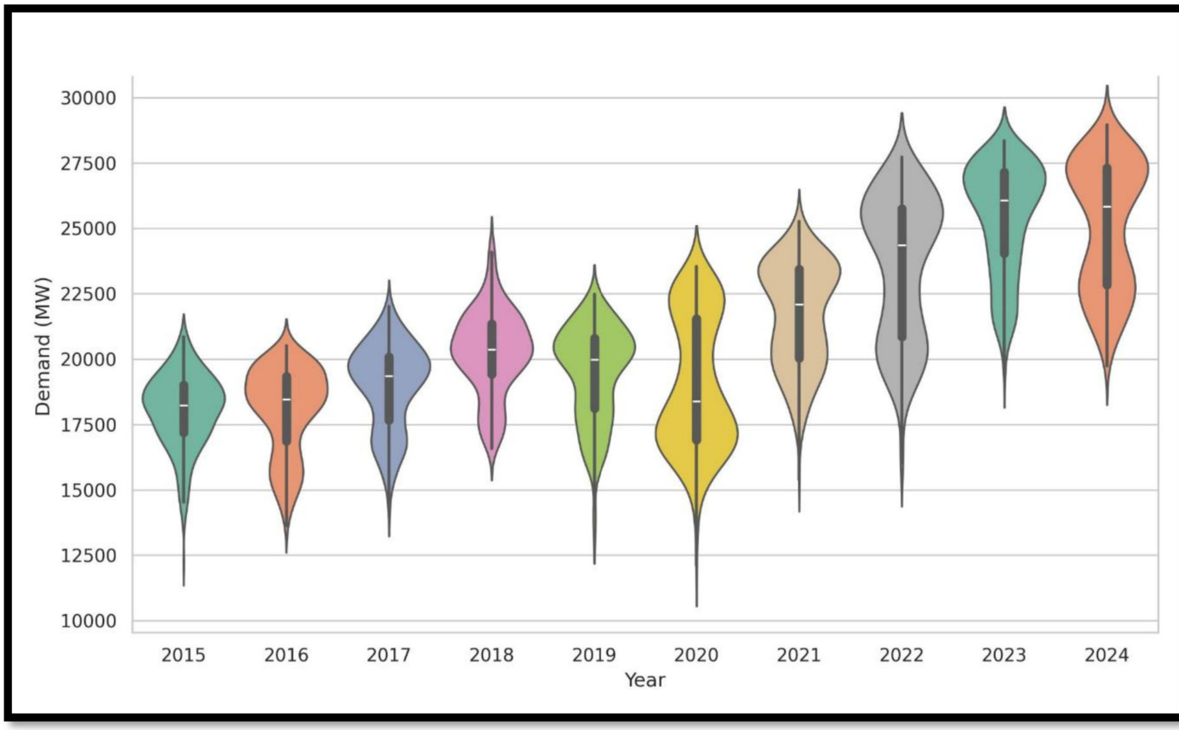

Figure 29: Year-wise State_Demand_Distribution_Hour_11

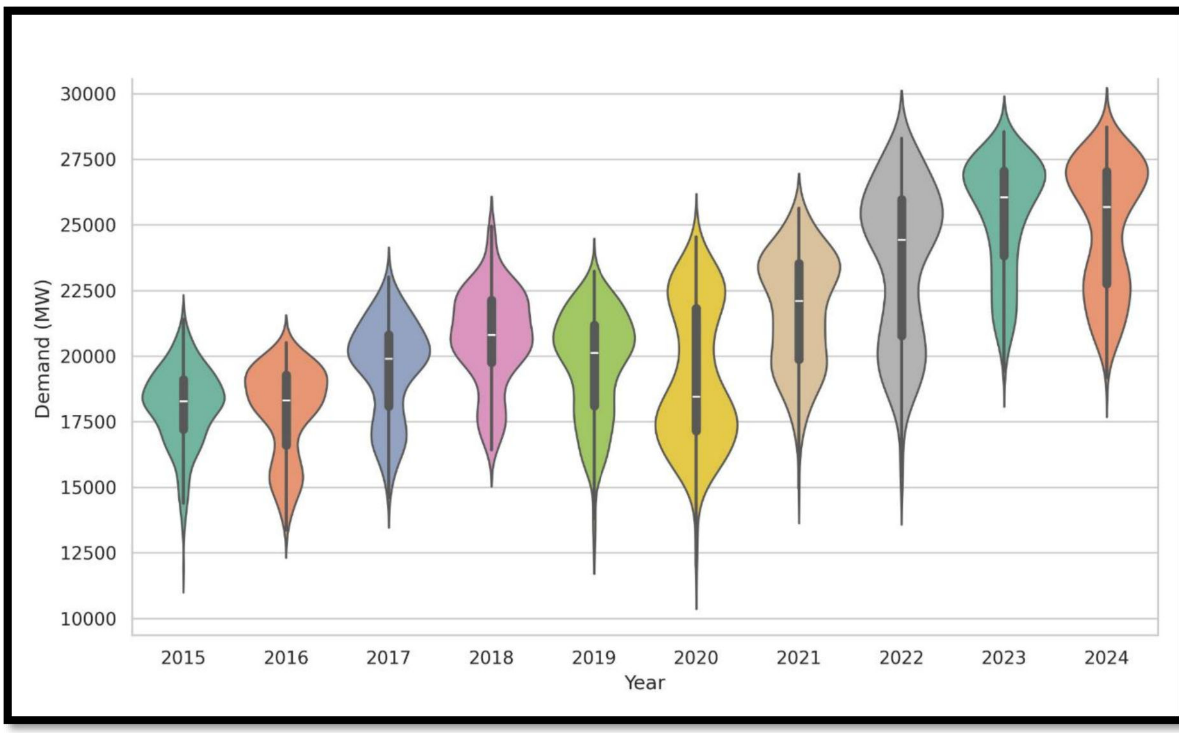

Figure 30: Year-wise State_Demand_Distribution_Hour_12

Figure 31: Year-wise State_Demand_Distribution_Hour_13

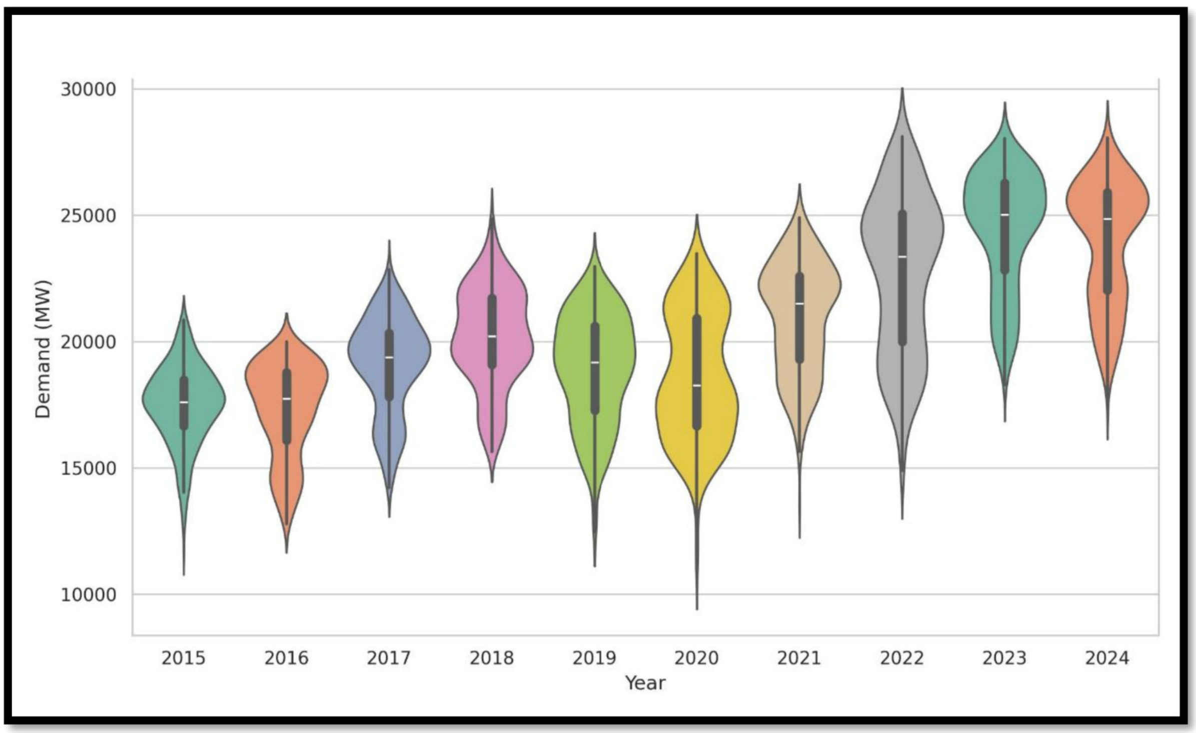

Figure 32: Year-wise State_Demand_Distribution_Hour_14

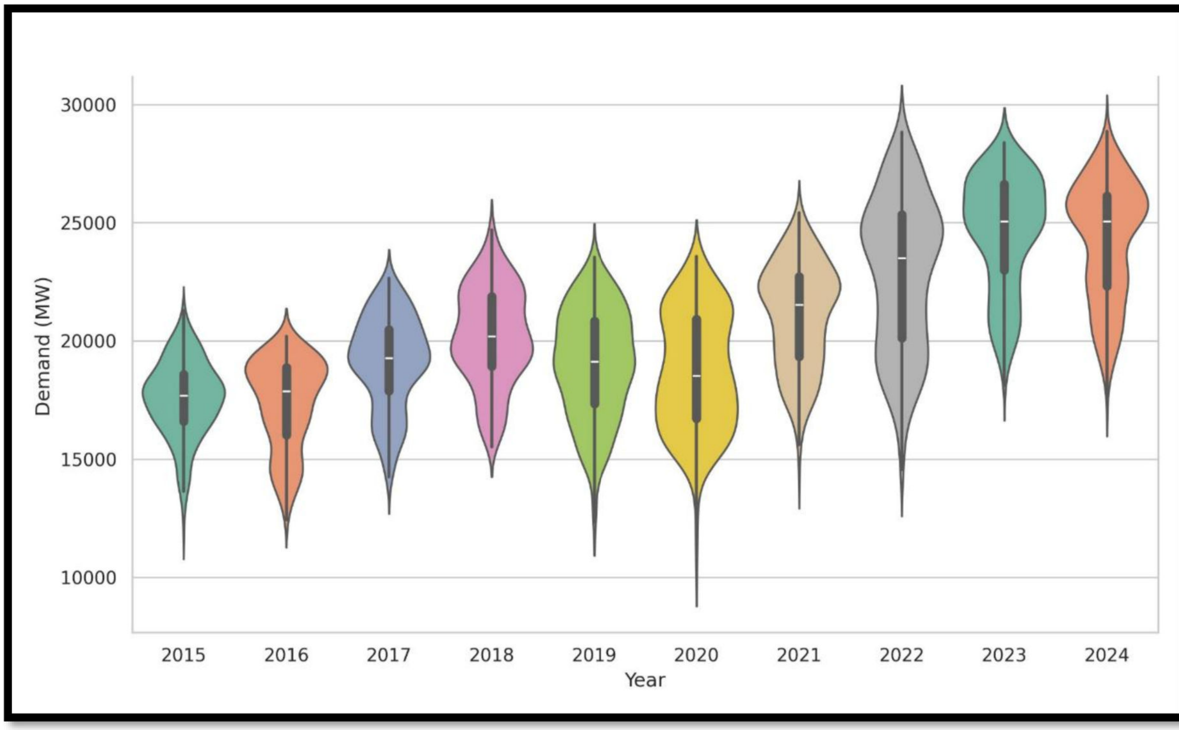

Figure 33: Year-wise State_Demand_Distribution_Hour_15

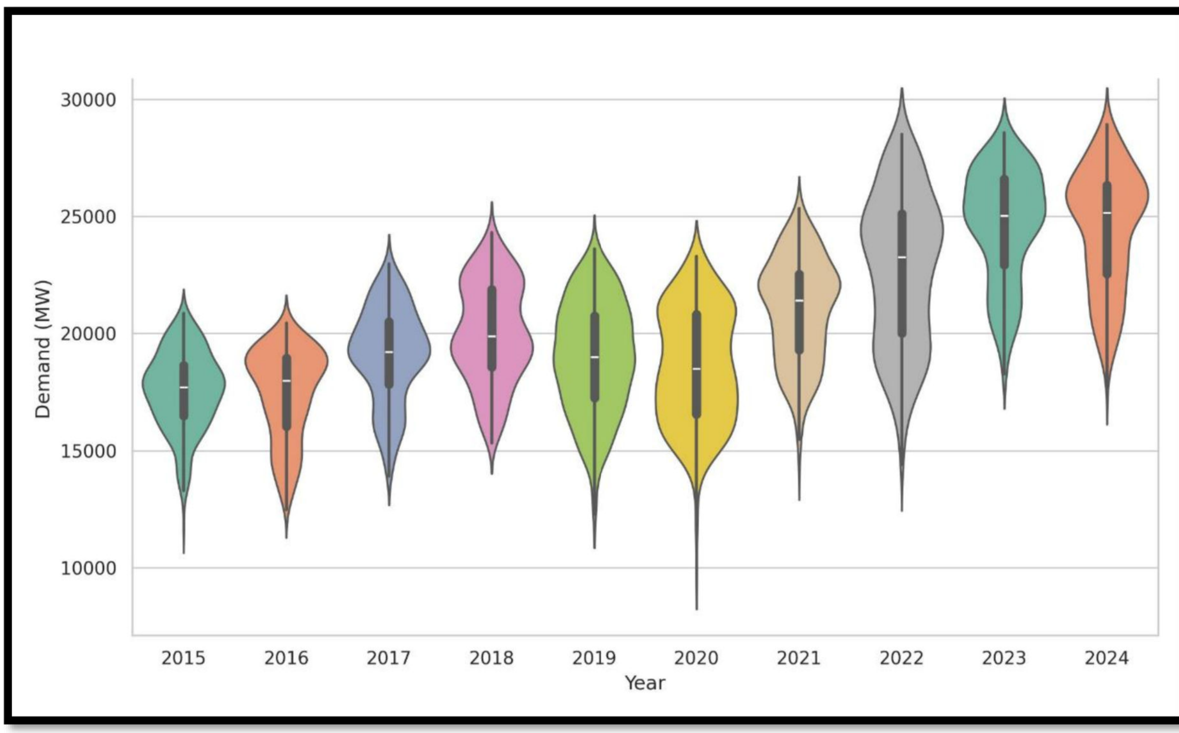

Figure 34: Year-wise State_Demand_Distribution_Hour_16

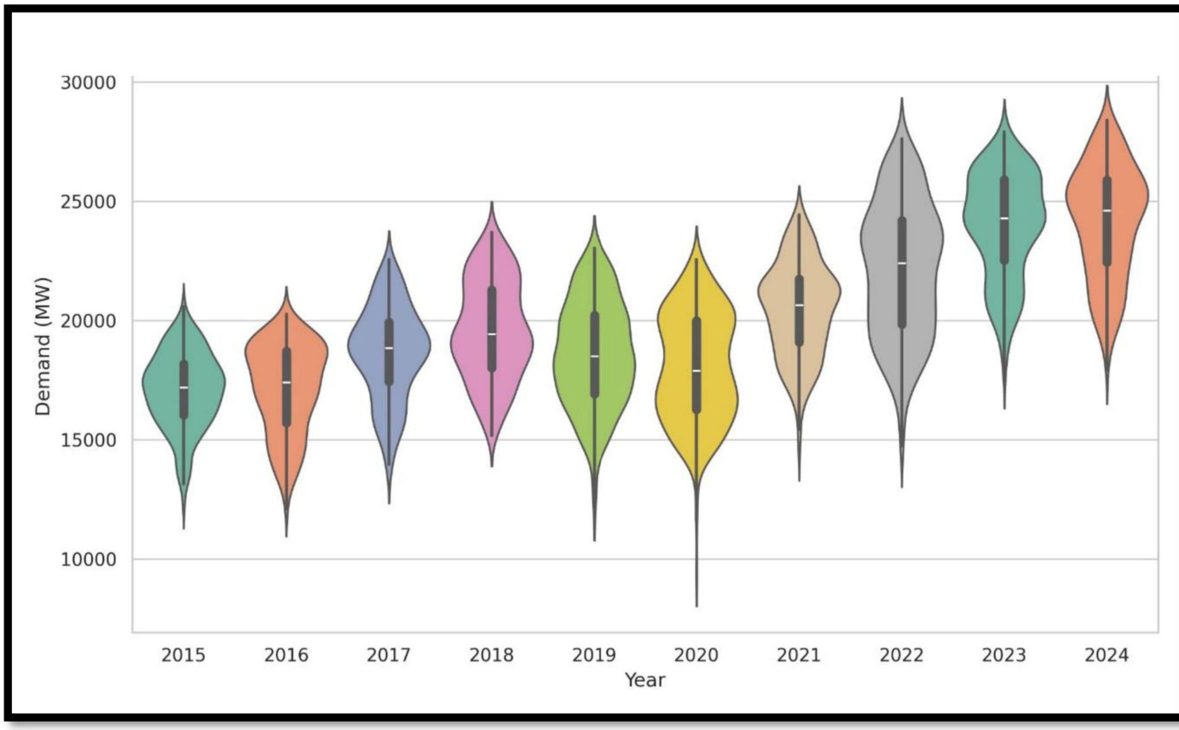

Figure 35: Year-wise State_Demand_Distribution_Hour_17

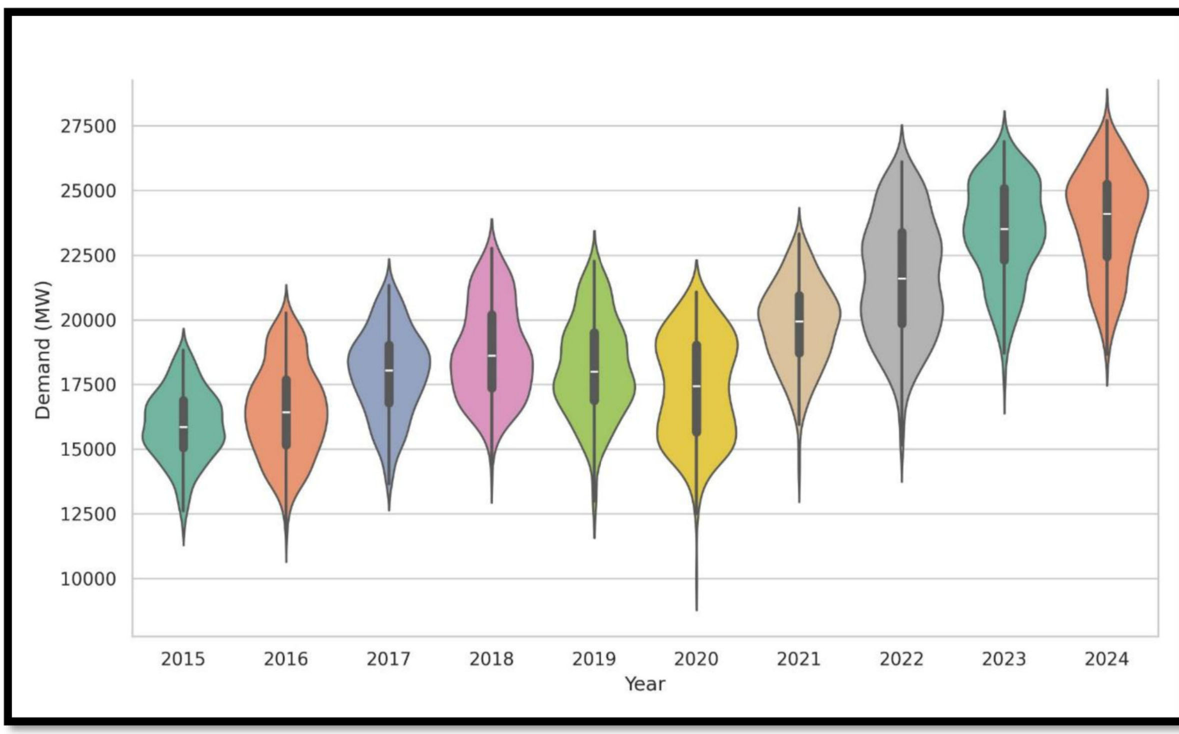

Figure 36: Year-wise State_Demand_Distribution_Hour_18

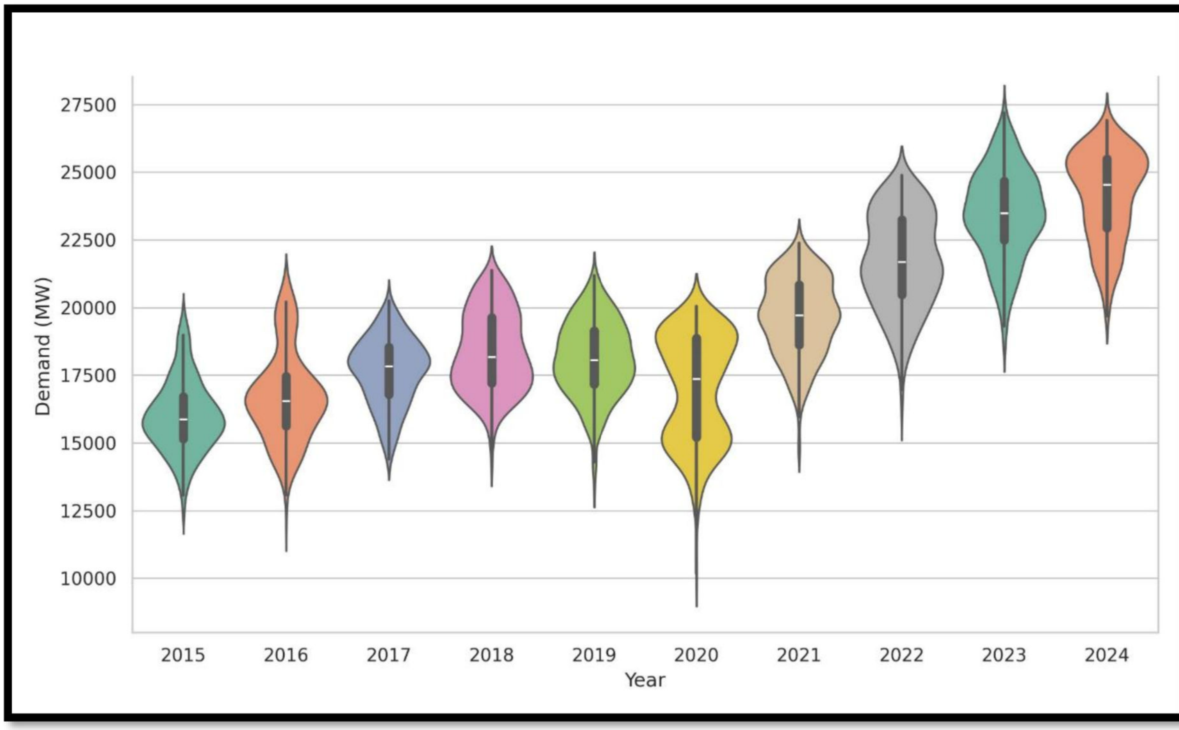

Figure 37: Year-wise State_Demand_Distribution_Hour_19

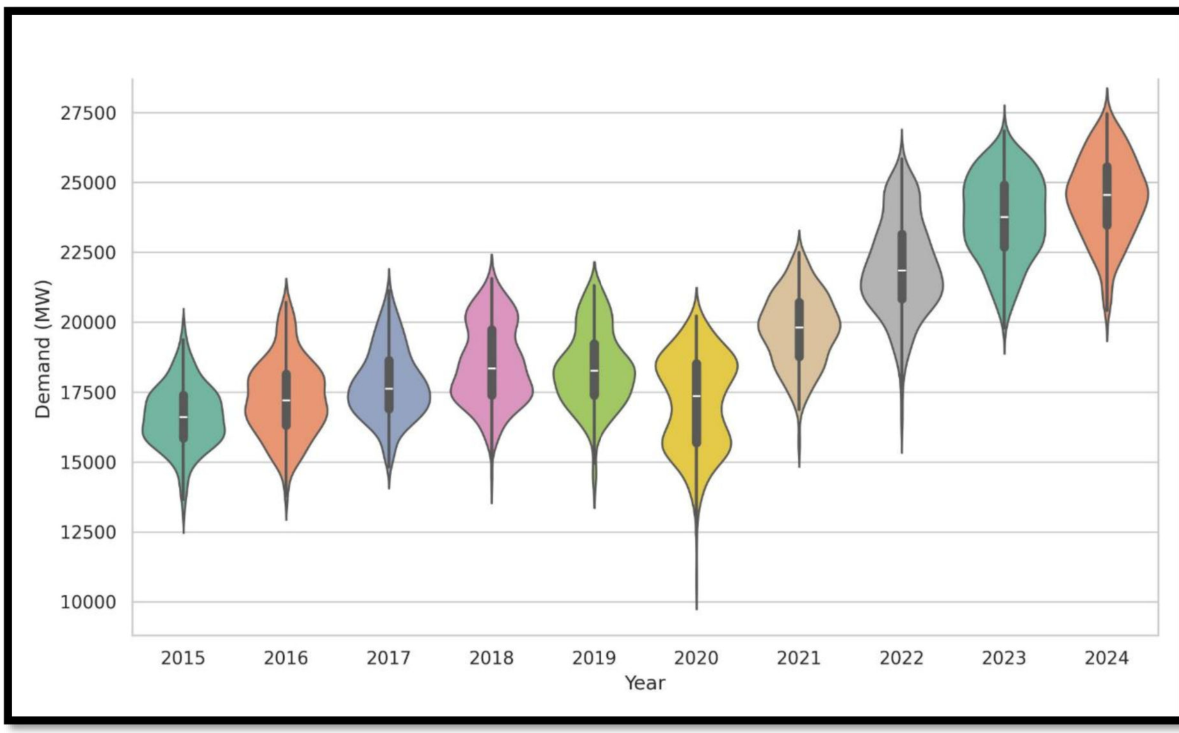

Figure 38: Year-wise State_Demand_Distribution_Hour_20

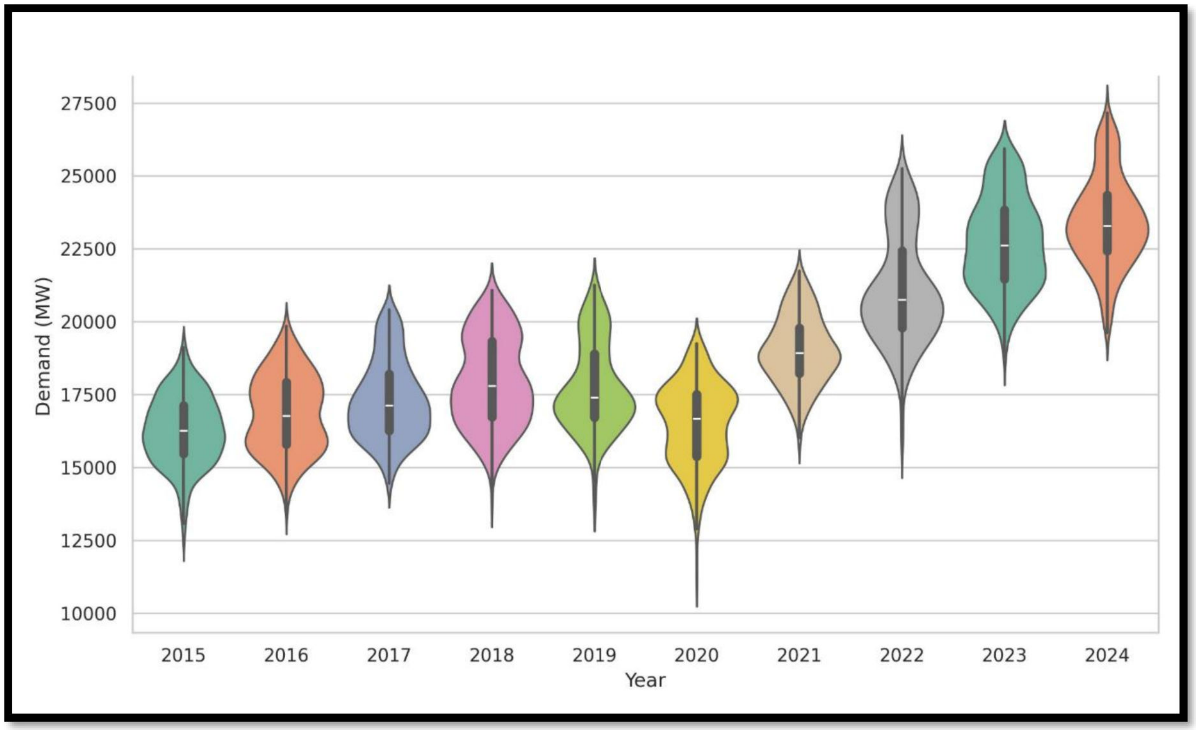

Figure 39: Year-wise State_Demand_Distribution_Hour_21

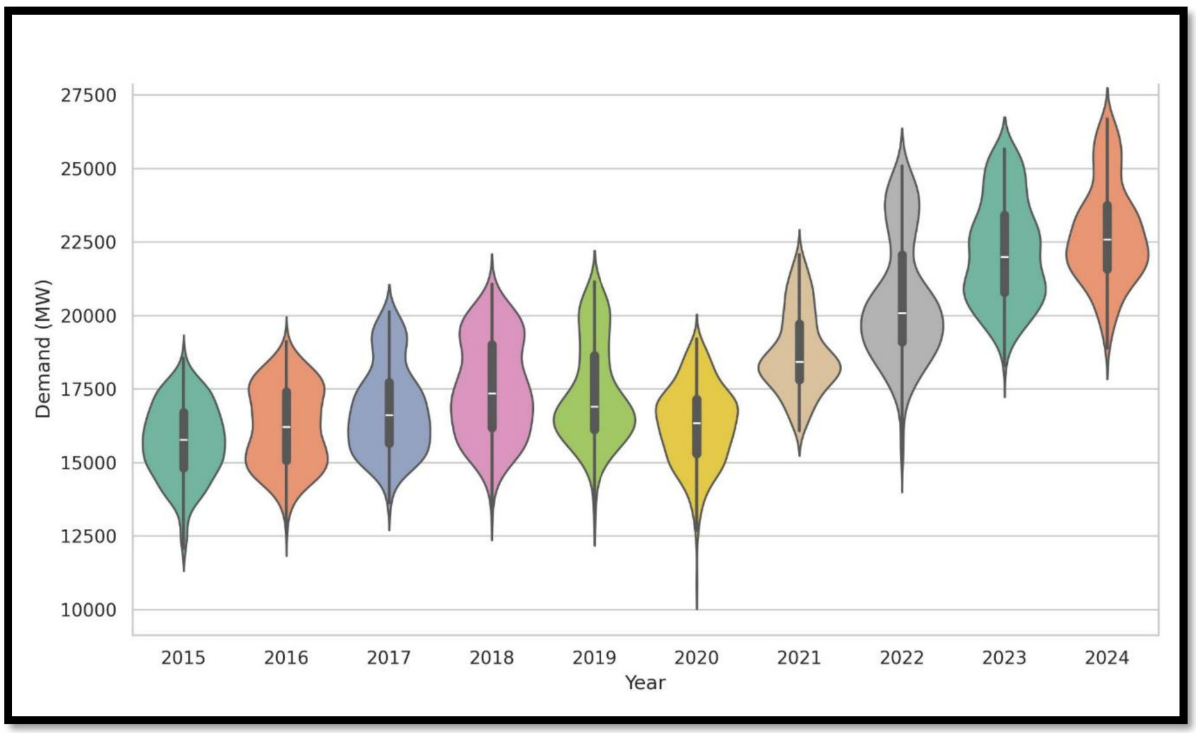

Figure 40: Year-wise State_Demand_Distribution_Hour_22

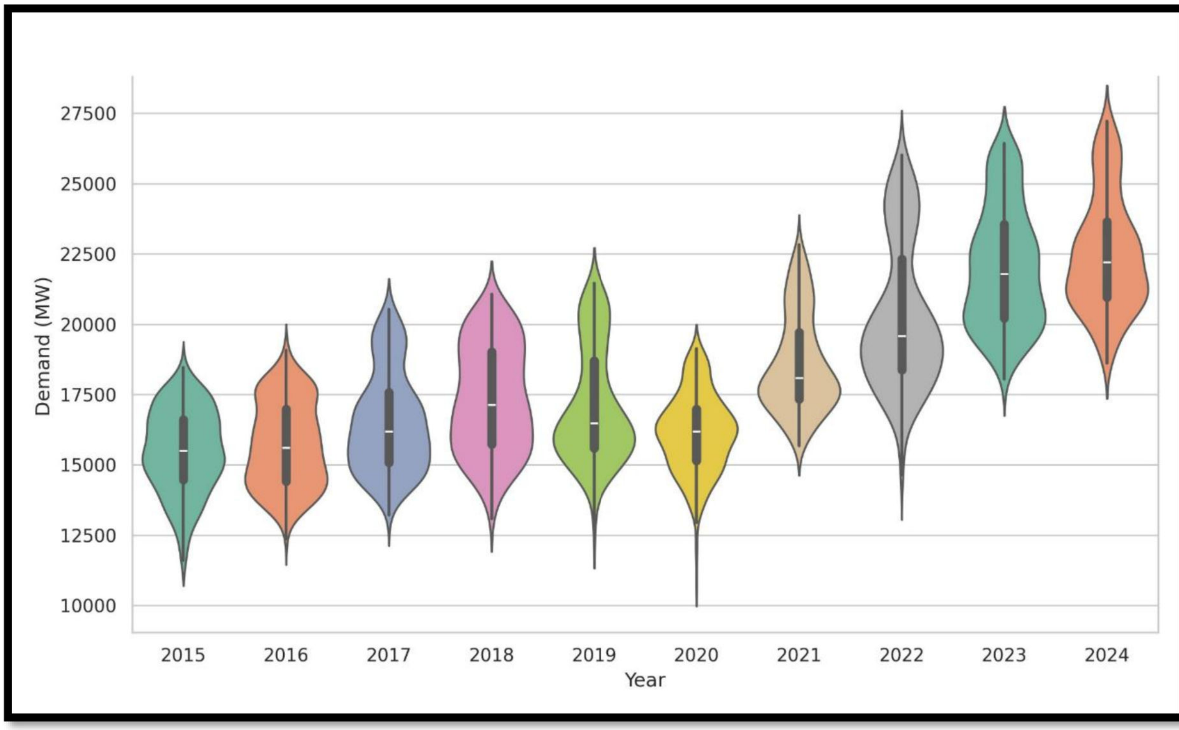

Figure 41: Year-wise State_Demand_Distribution_Hour_23

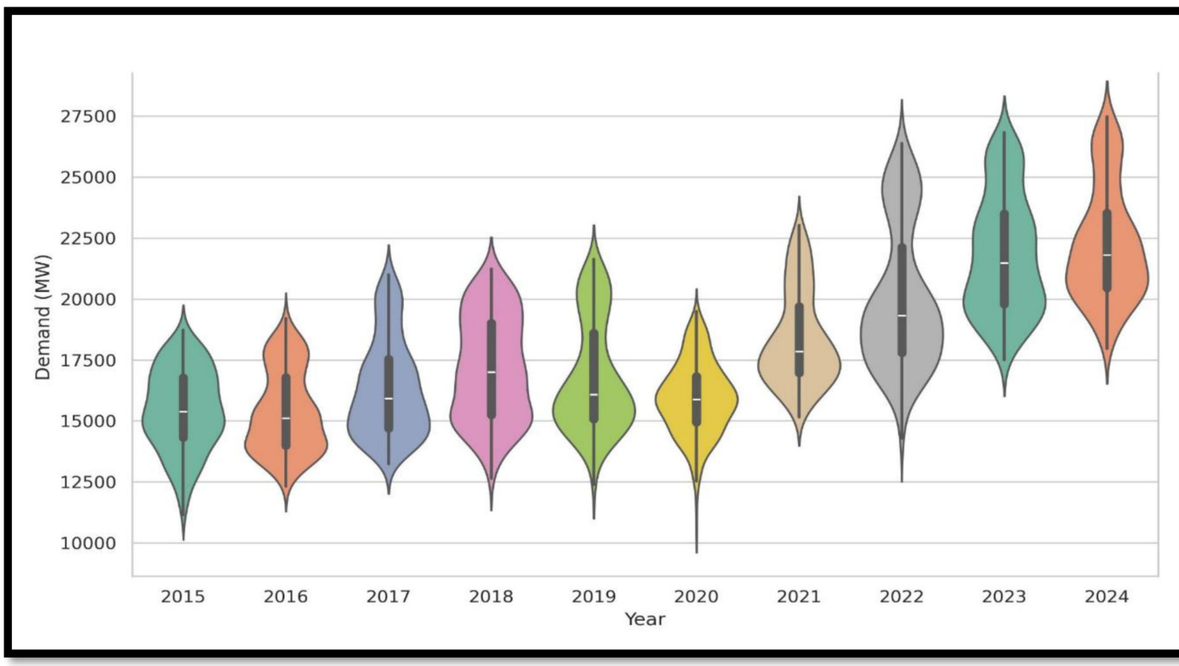

Figure 42: Year-wise State_Demand_Distribution_Hour_24

Table 1: Year-wise Hourly Median of State Demand (2015–2024)

	Median									
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Hours										
1	15316	14724	15728	16842	15826	15786	17784	19290	21378	21354
2	14950	14467	15530	16649	15599	15505	17505	19172	21364	21098
3	14794	14265	15425	16542	15381	15334	17332	19091	21230	20822
4	14664	14272	15408	16504	15367	15278	17404	19198	21142	20747
5	14738	14523	15670	16823	15811	15739	17849	19599	21662	21258
6	15383	15341	16569	17728	17034	16725	18847	20546	22525	22371
7	16204	16440	17657	18865	18244	17712	19890	21492	23325	23370
8	16990	17309	18569	19499	18999	17888	20700	22023	23889	23863
9	17434	17720	18913	19633	19301	18006	21149	22653	24472	24245
10	17902	18216	18925	19957	19686	18308	21712	23642	25375	25106
11	18248	18459	19360	20368	19992	18390	22103	24363	26087	25836
12	18292	18322	19904	20820	20131	18467	22115	24444	26069	25692
13	17959	18014	19717	20552	19645	18352	21797	23930	25574	25344
14	17611	17741	19375	20218	19175	18267	21513	23361	25035	24852
15	17694	17880	19279	20200	19127	18545	21536	23526	25064	25070
16	17713	17996	19220	19891	19012	18506	21428	23272	25036	25164
17	17215	17426	18857	19446	18518	17923	20660	22427	24302	24634
18	15859	16434	18052	18620	18008	17440	19955	21610	23524	24106
19	15877	16558	17832	18182	18073	17380	19719	21693	23493	24544
20	16609	17210	17630	18363	18275	17373	19824	21860	23775	24565
21	16266	16780	17143	17810	17405	16692	18933	20763	22627	23298
22	15782	16214	16609	17356	16909	16352	18435	20082	21997	22599
23	15500	15609	16202	17142	16485	16194	18096	19598	21797	22207
24	15398	15124	15926	17013	16086	15884	17862	19336	21493	21815

Table 2: Year-wise Hourly Interquartile Range (IQR) of State Demand (2015–2024)

	IQR									
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Hours										
1	2712	2957	2897	4138	3470	2258	2885	4931	3905	3133
2	2566	2769	2662	3924	3388	2320	2744	4950	4067	3157
3	2421	2636	2545	3875	3300	2271	2726	4699	3807	3151
4	2470	2485	2481	3741	3099	2277	2600	4487	3713	3046
5	2245	2328	2422	3565	2868	2469	2582	4203	3504	2940

	IQR									
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Hours										
6	1950	2189	2305	3371	2719	2537	2494	3833	3111	2730
7	1794	2077	2288	2703	2526	2745	2363	3297	2309	2446
8	1438	2061	2183	1843	2152	3265	2175	3260	2085	2457
9	1524	2167	2399	1624	2161	3779	2350	3405	2196	3156
10	1685	2231	2350	1709	2260	4020	2904	4028	2475	3782
11	1809	2481	2413	1920	2677	4641	3401	4885	3108	4460
12	1887	2664	2730	2385	3079	4675	3650	5190	3223	4277
13	1785	2681	2693	2549	3204	4495	3451	4966	3335	4149
14	1828	2679	2517	2640	3343	4267	3297	5066	3444	3871
15	1976	2855	2595	2943	3492	4197	3372	5199	3627	3821
16	2152	2914	2668	3324	3498	4272	3230	5104	3648	3783
17	2140	3009	2490	3256	3298	3721	2648	4336	3380	3443
18	1822	2516	2231	2824	2629	3363	2225	3526	2773	2809
19	1555	1833	1736	2415	1963	3650	2210	2773	2171	2546
20	1531	1833	1728	2337	1832	2841	1942	2323	2222	2096
21	1654	2129	1940	2601	2176	2122	1544	2635	2365	1904
22	1875	2338	2073	2831	2513	1854	1899	2966	2626	2161
23	2135	2569	2491	3275	3101	1826	2375	3930	3327	2688
24	2460	2807	2847	3776	3537	1899	2742	4347	3725	3085

The Table-1 shows the year-wise Hourly Median of State Demand (2015–2024). For a given year , the median represents the central demand level of all daily demand values corresponding only to that specific hour.

The Table-2 shows the year-wise Interquartile Range (IQR) of State Demand (2015–2024). For a given year, the interquartile range represents the spread of the middle 50% of daily demand values corresponding only to that specific hour.

3. Year-wise State Demand 3D plots (2015-2024)

3.1 Introduction

This chapter presents a year-wise visual assessment of system demand using **3D plots** prepared from hourly demand data. It illustrates how demand varies simultaneously across **time of day** and **calendar period** within each year.

In all plots, the X-axis represents the progression of dates within the year, the Y-axis represents system demand, and the Z-axis represents hourly blocks (Hours 1 to 24).

3.2 Year-wise State Demand 3D plots (2015-2024)

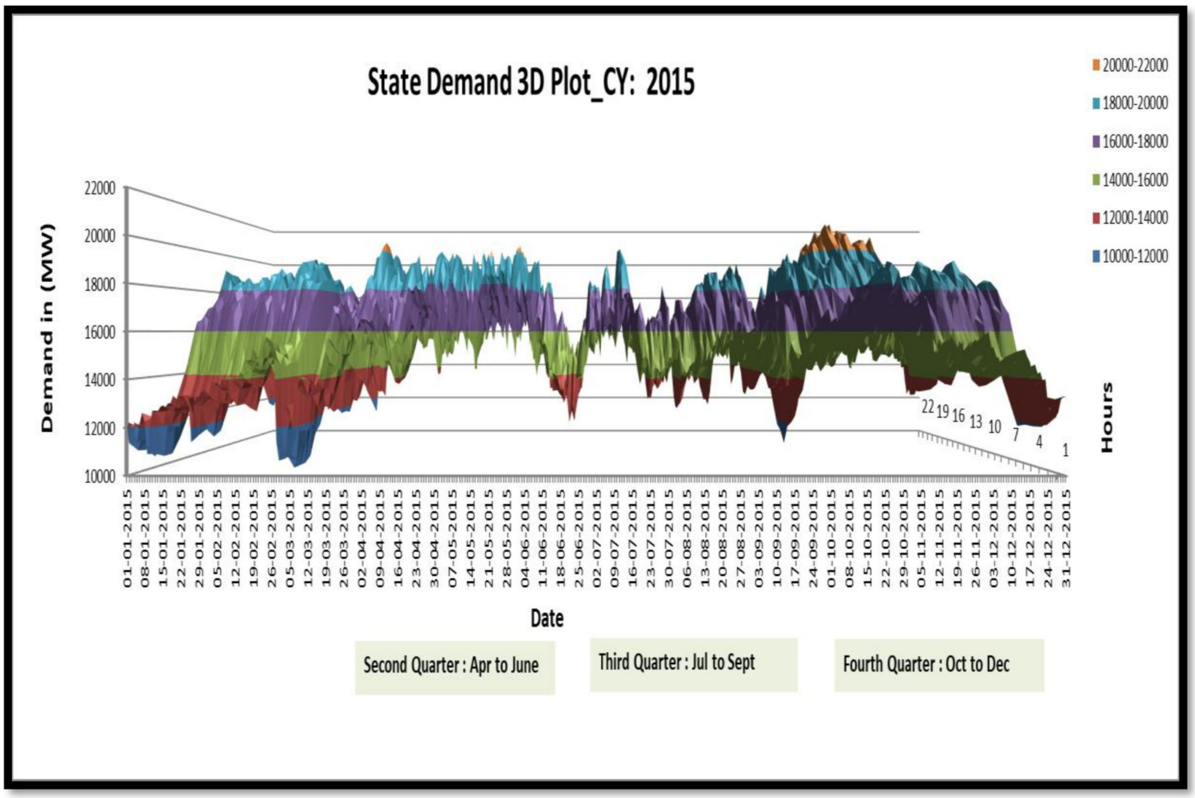

Figure 43: State Demand 3D Plot CY: 2015

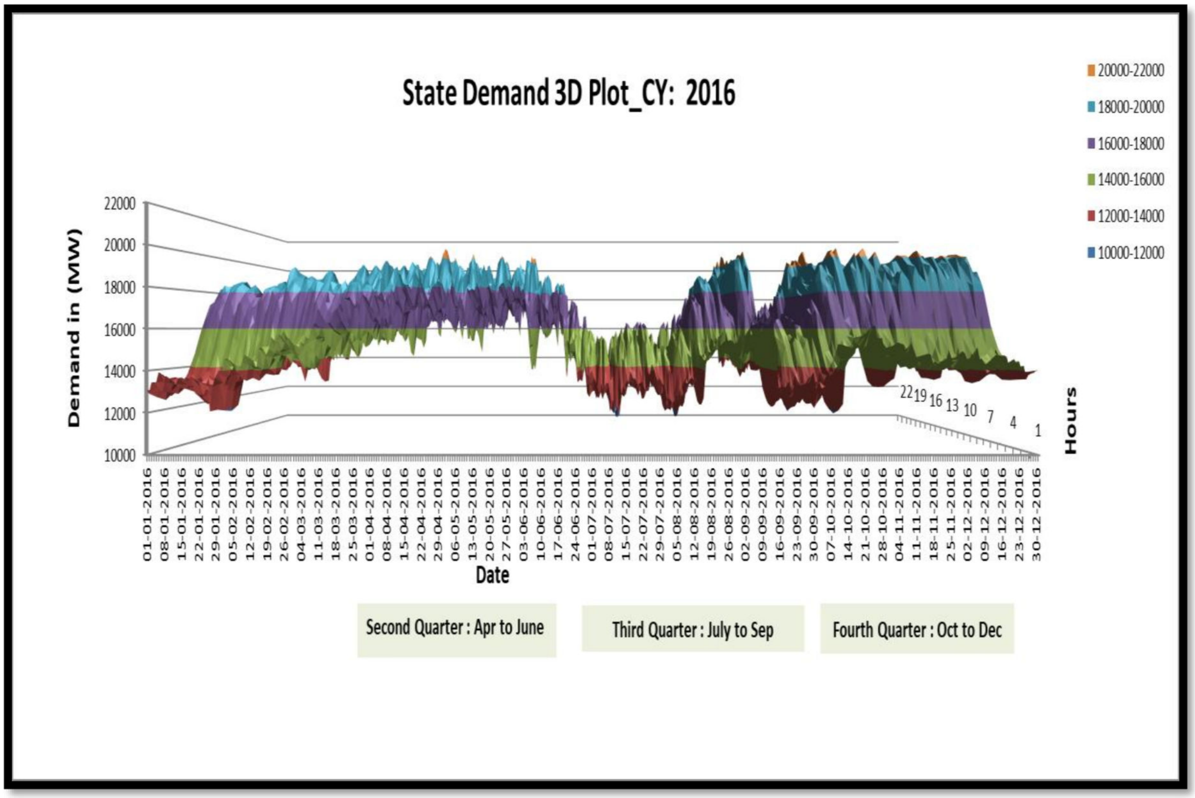

Figure 44: State Demand 3D Plot CY: 2016

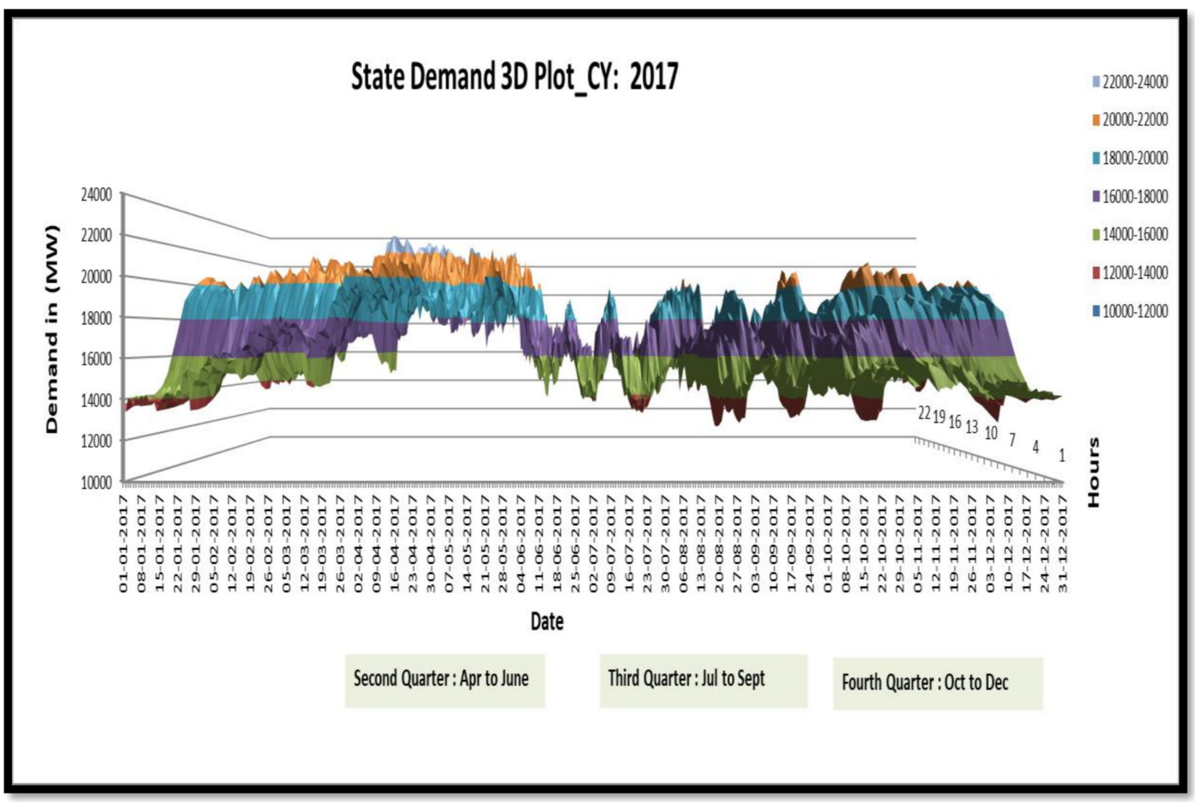

Figure 45: State Demand 3D Plot CY: 2017

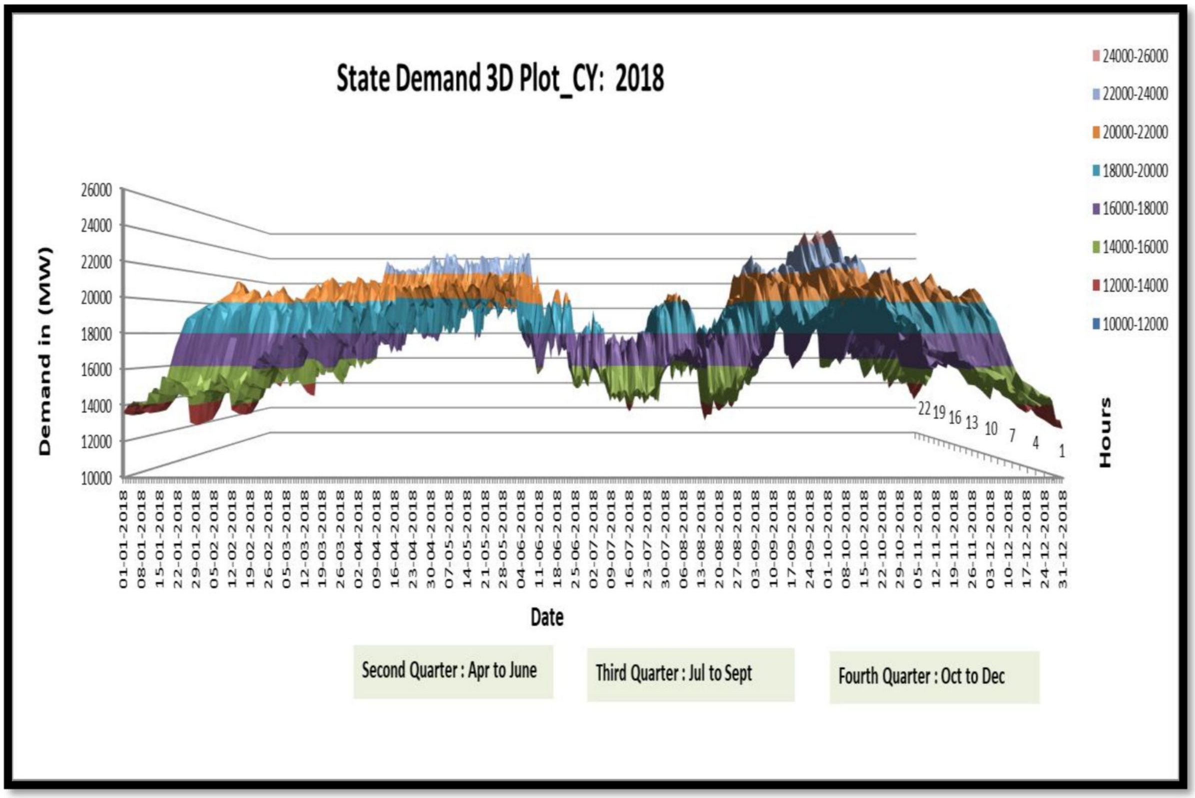

Figure 46: State Demand 3D Plot CY: 2018

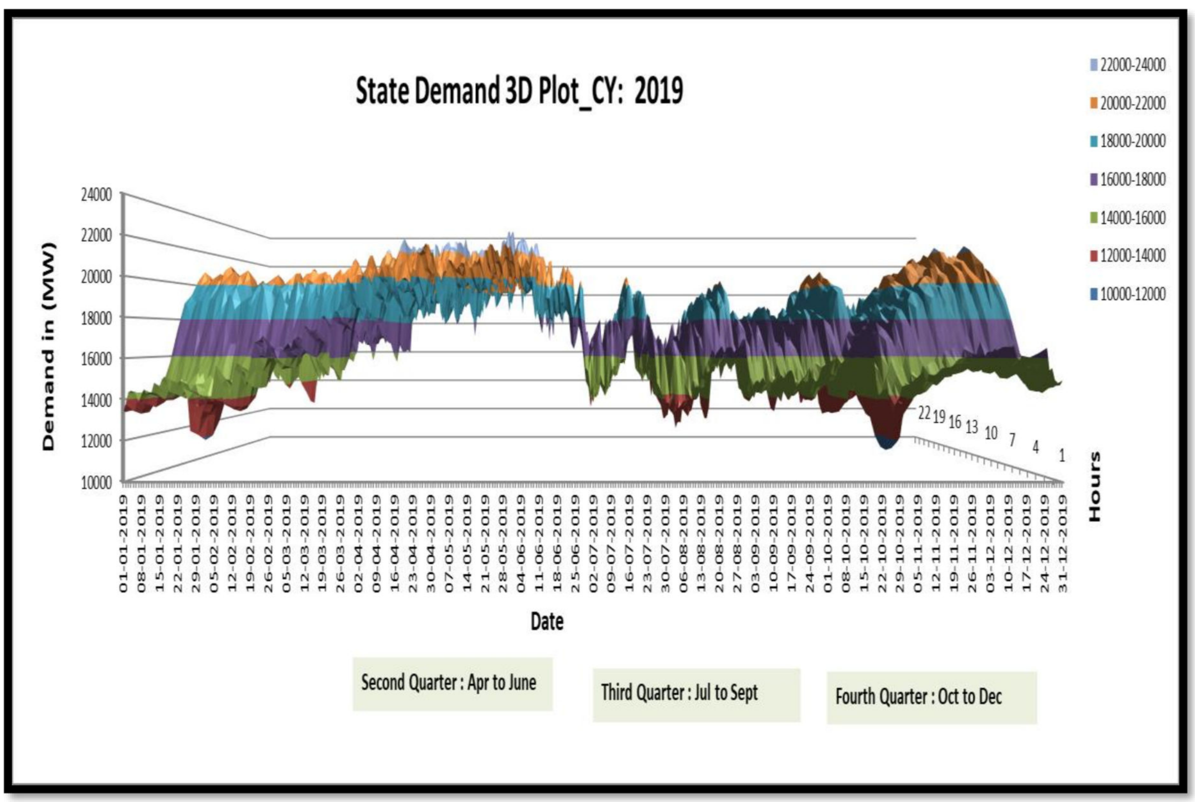

Figure 47: State Demand 3D Plot CY: 2019

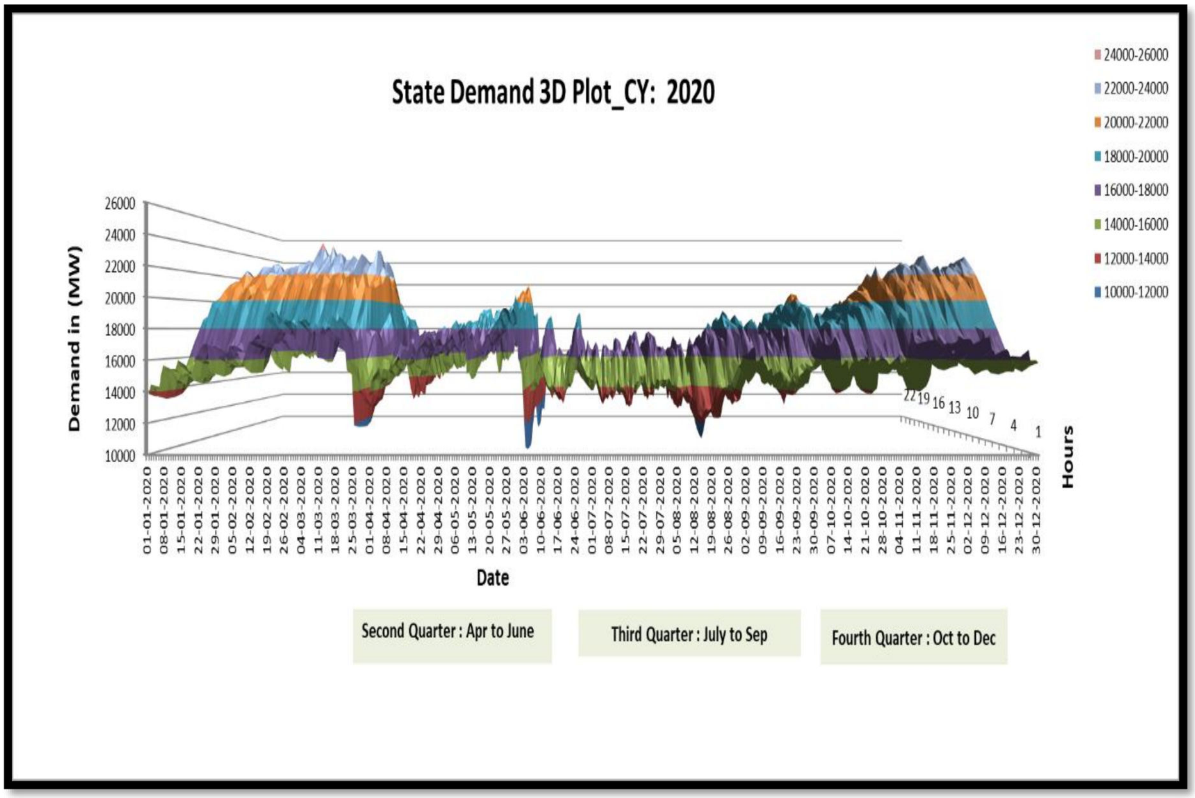

Figure 48: State Demand 3D Plot CY: 2020

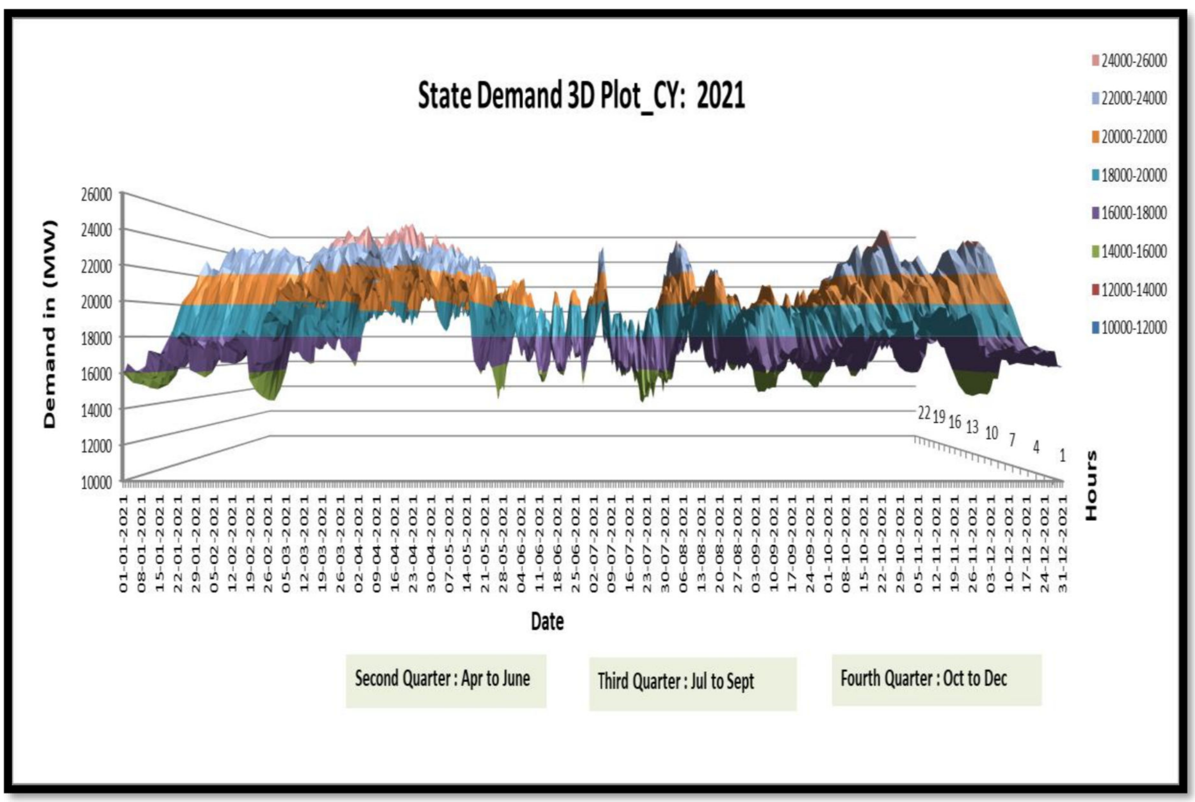

Figure 49: State Demand 3D Plot CY: 2021

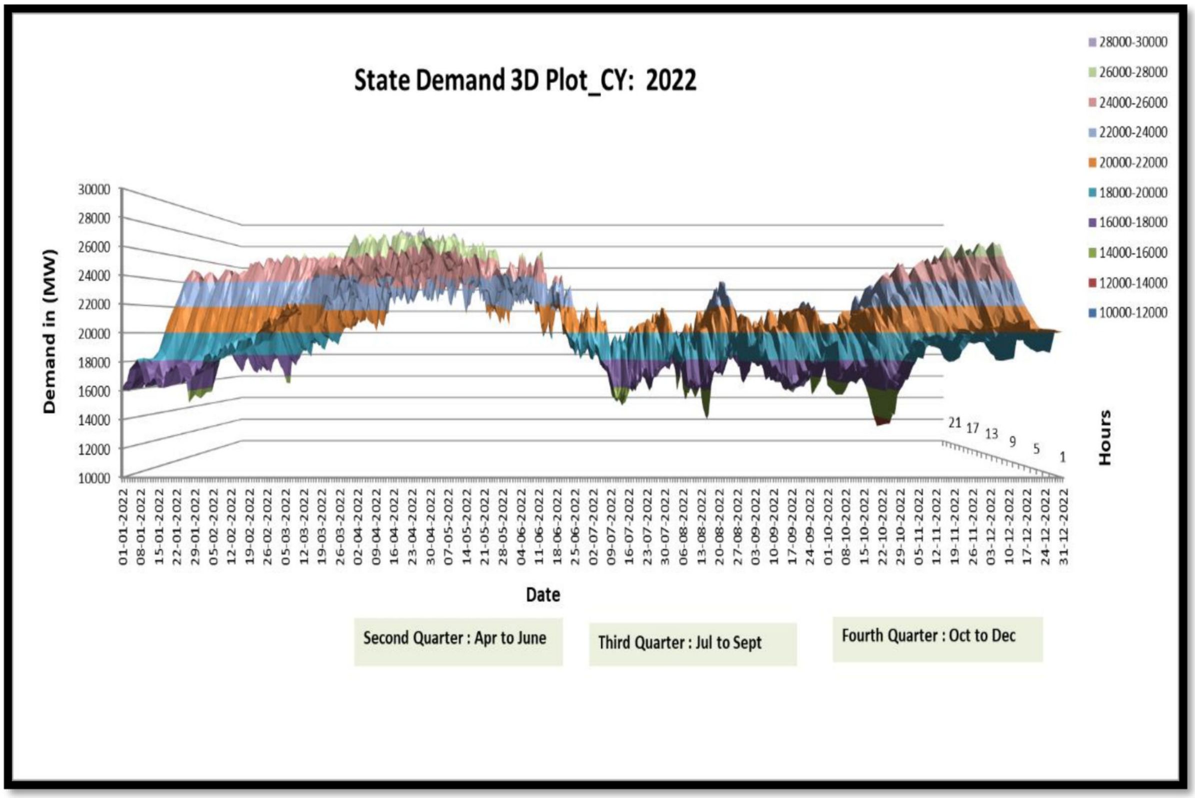

Figure 50: State Demand 3D Plot CY: 2022

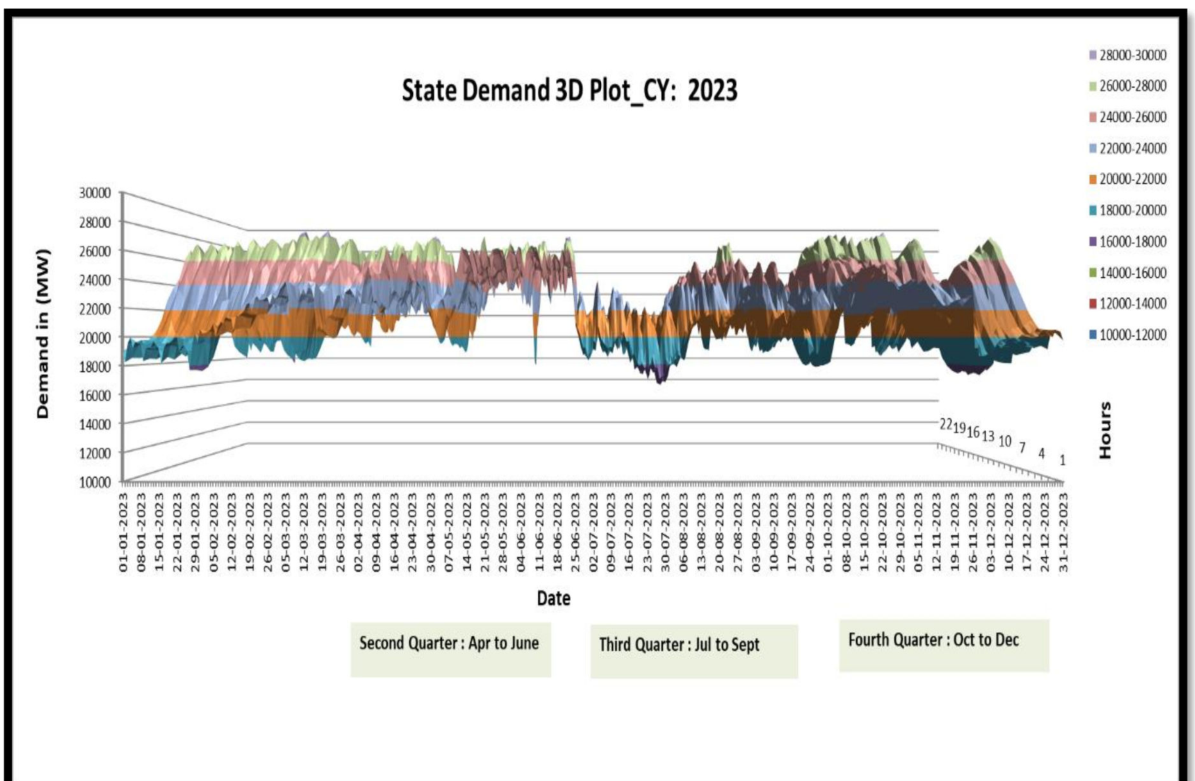

Figure 51: State Demand 3D Plot CY: 2023

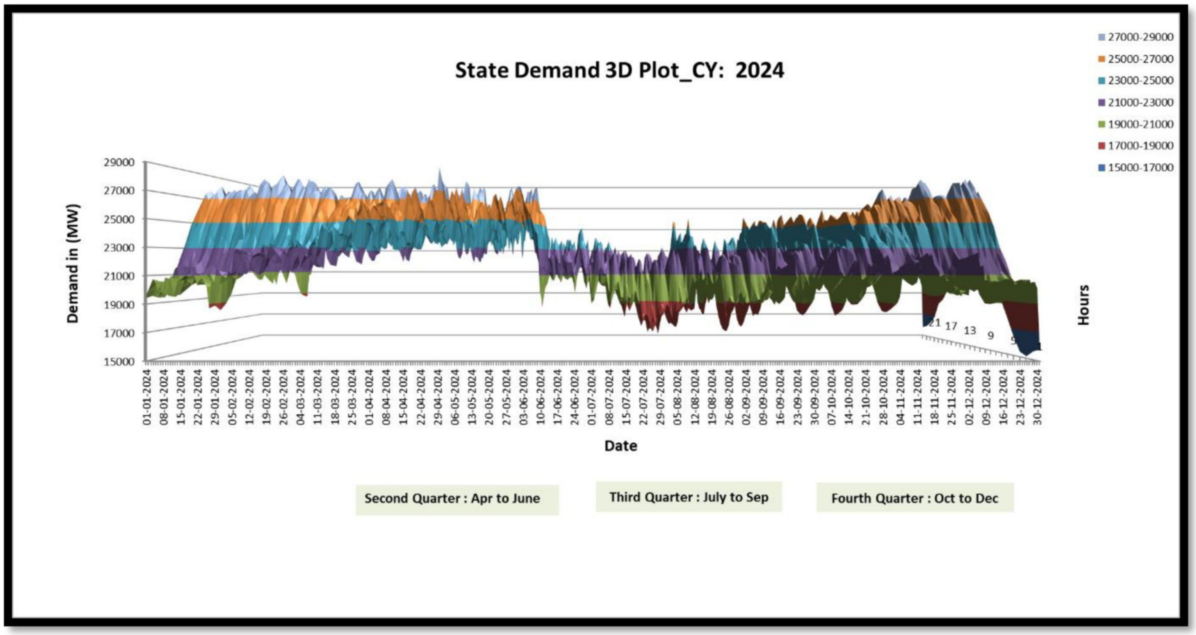

Figure 52: State Demand 3D Plot CY: 2024

A seasonal variation is evident within each year with higher demand concentrations in summer months and comparatively lower demand during monsoon/winter periods.

4. State Demand behaviour on National Holidays Relative to Adjacent Days

4.1 Introduction:

This chapter examines deviations in state demand on holidays by comparing the hourly demand profile of each holiday with that of the immediately preceding and succeeding days. The comparison highlights differences in demand levels and hourly patterns observed on holidays relative to adjacent non-holiday days over the study period.

In this chapter, **Δ1 and Δ2 are plotted throughout**, where **Δ1** represents the difference between the demand on a holiday and that of the preceding day, and **Δ2** represents the difference between the demand on a holiday and that of the succeeding day, both calculated on an hourly basis. A positive Δ1 indicates that the demand on the holiday is higher than the previous day, whereas a negative Δ1 implies a lower demand on the holiday. A positive Δ2 indicates that the demand on the holiday is higher than the succeeding day, whereas a negative Δ2 implies a lower demand on the holiday.

4.2 State Demand on Diwali relative to adjacent days

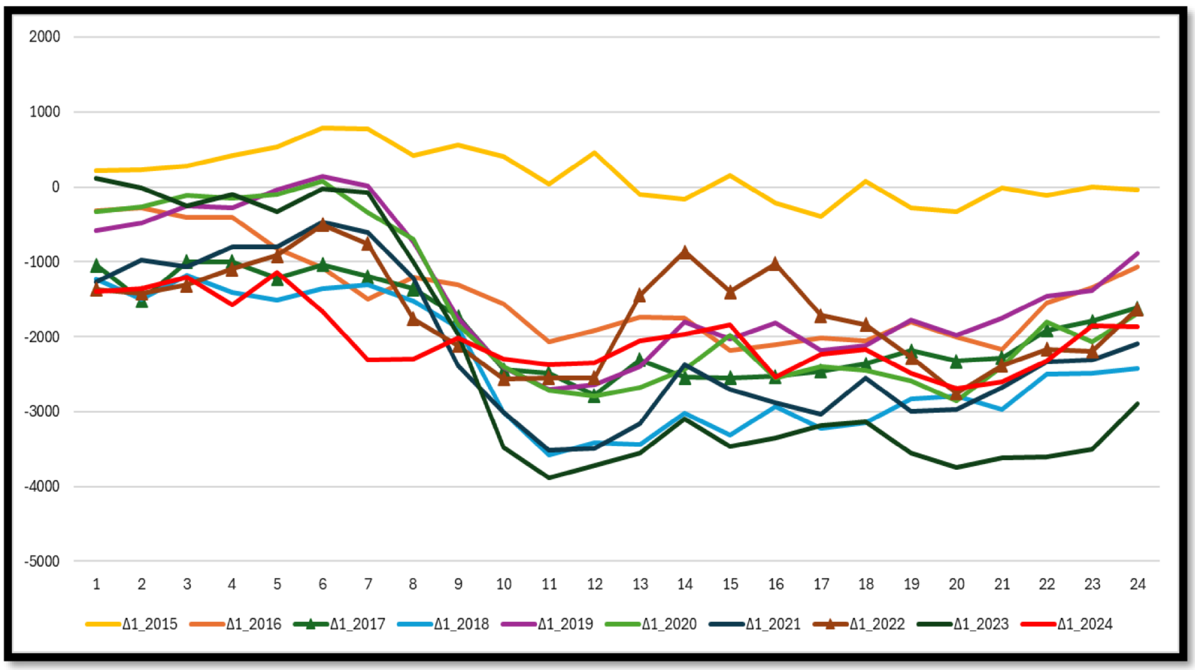

Figure 53: State Demand on Diwali relative to preceding day from 2015 to 2024

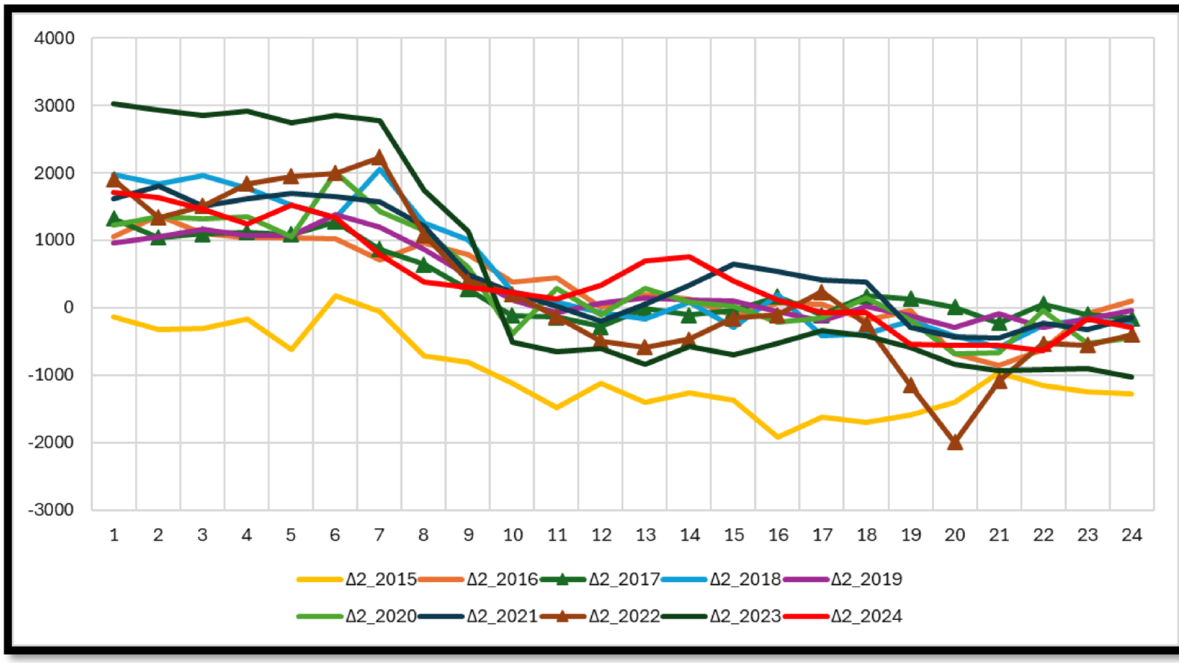

Figure 54: State Demand on Diwali relative to succeeding day from 2015 to 2024

The plotted Δ1 values on an hourly basis (Figure-53) show that **Diwali** day demand remains lower than the demand of the preceding day across all hours. The year 2015 is the only exception and does not follow this pattern.

For 2015, Δ2 remains negative throughout the day, with demand on Diwali lower than that of the succeeding day across all hourly blocks. From 2016 to 2024, Diwali demand remains higher during the initial 42% to 50% of the day (up to the 10th–12th hourly block), after which it remains lower than the demand of the succeeding day during the later hours.

4.3 State Demand on Christmas relative to adjacent days

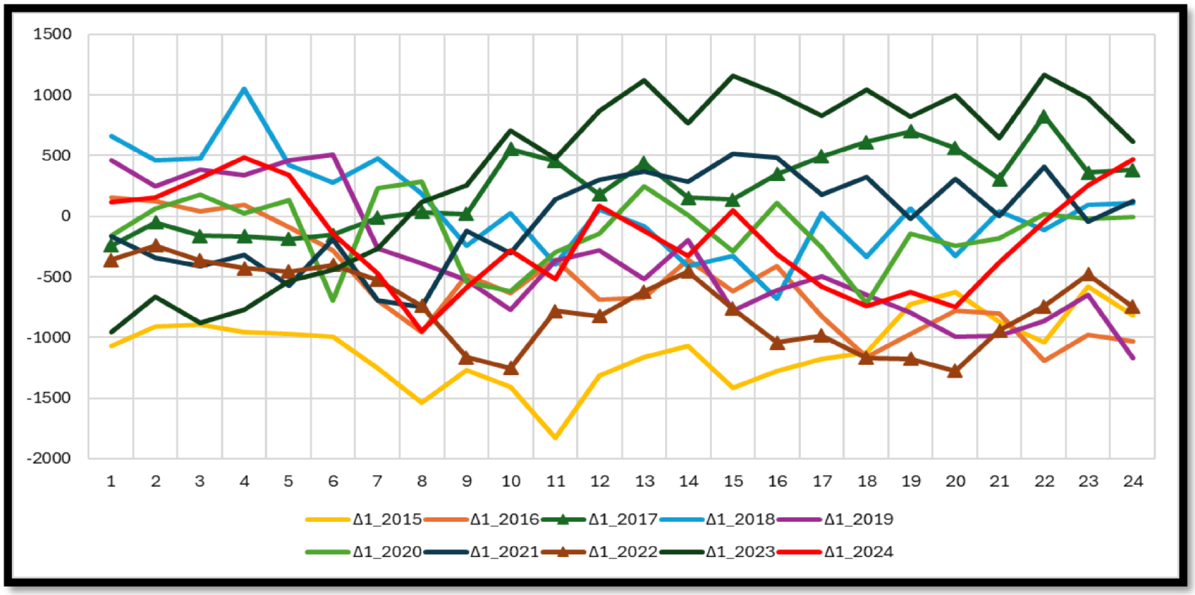

Figure 55: State Demand on Christmas relative to preceding day from 2015 to 2024

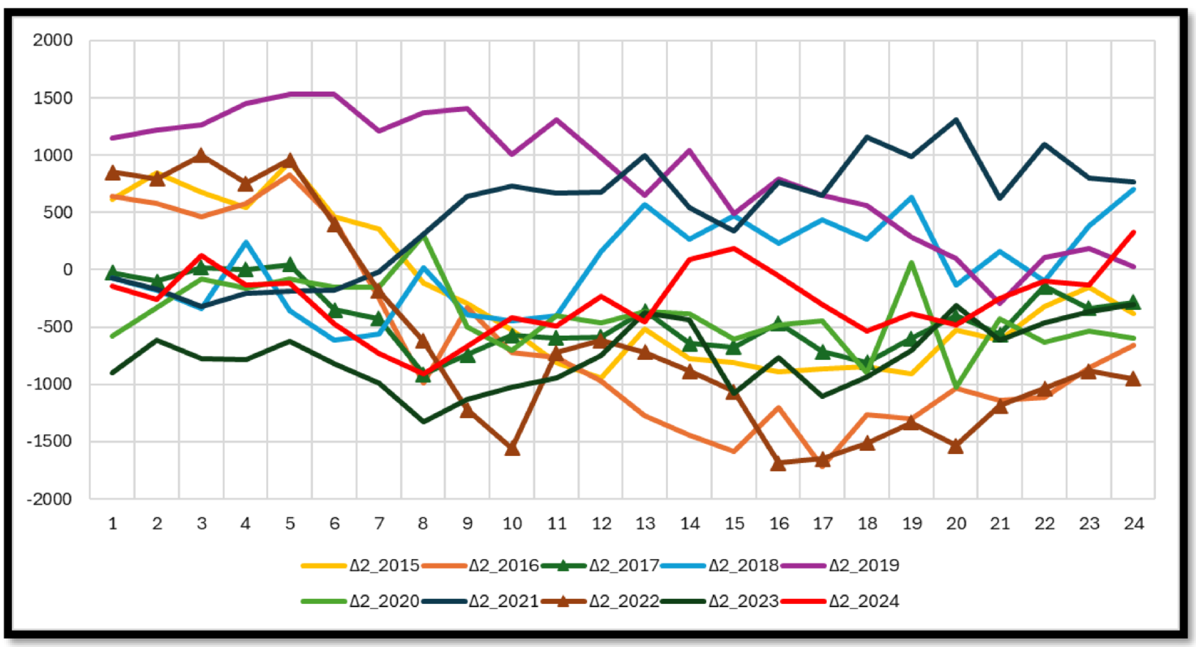

Figure 56: State Demand on Christmas relative to succeeding day from 2015 to 2024

For the years 2015 and 2022, Δ1 remains consistently negative with demand on **Christmas** Day is lower than that of the preceding day. For the remaining years, no clear or consistent pattern is observed in Δ1. Across the years, Δ2 does not exhibit a consistent pattern, indicating variability in post-Christmas demand behaviour, except in 2023, wherein Δ2 remains entirely negative across all hourly blocks with demand on the succeeding day consistently exceeded that of Christmas Day.

4.4 State Demand on Dussehra relative to adjacent days

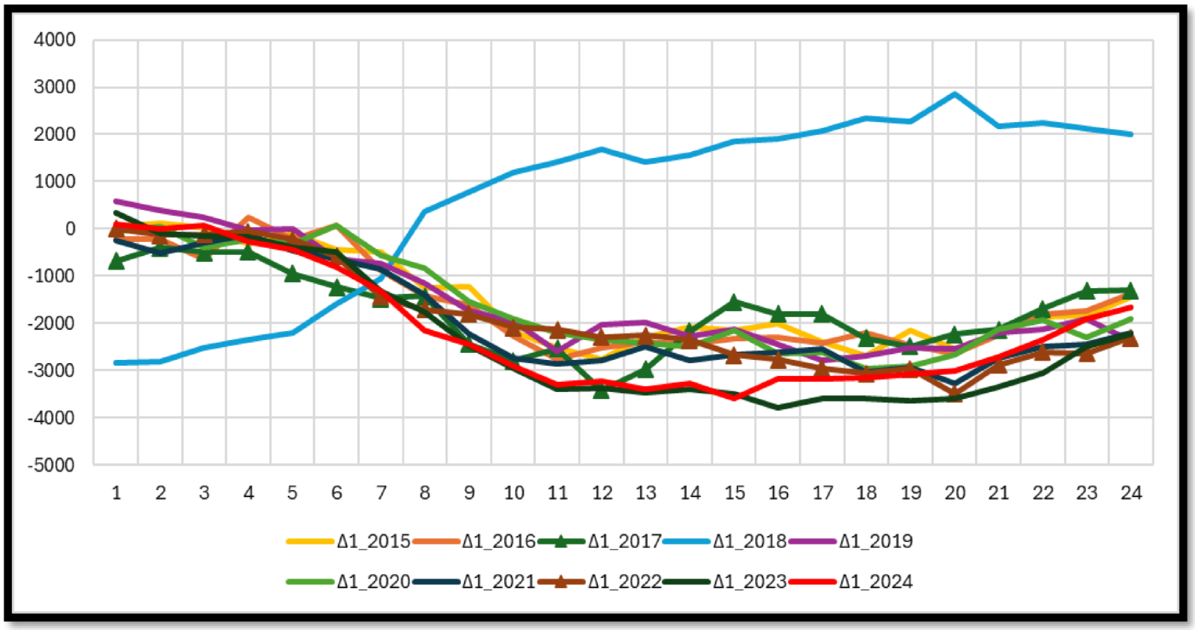

Figure 57: State Demand on Dusshera relative to preceding day from 2015 to 2024

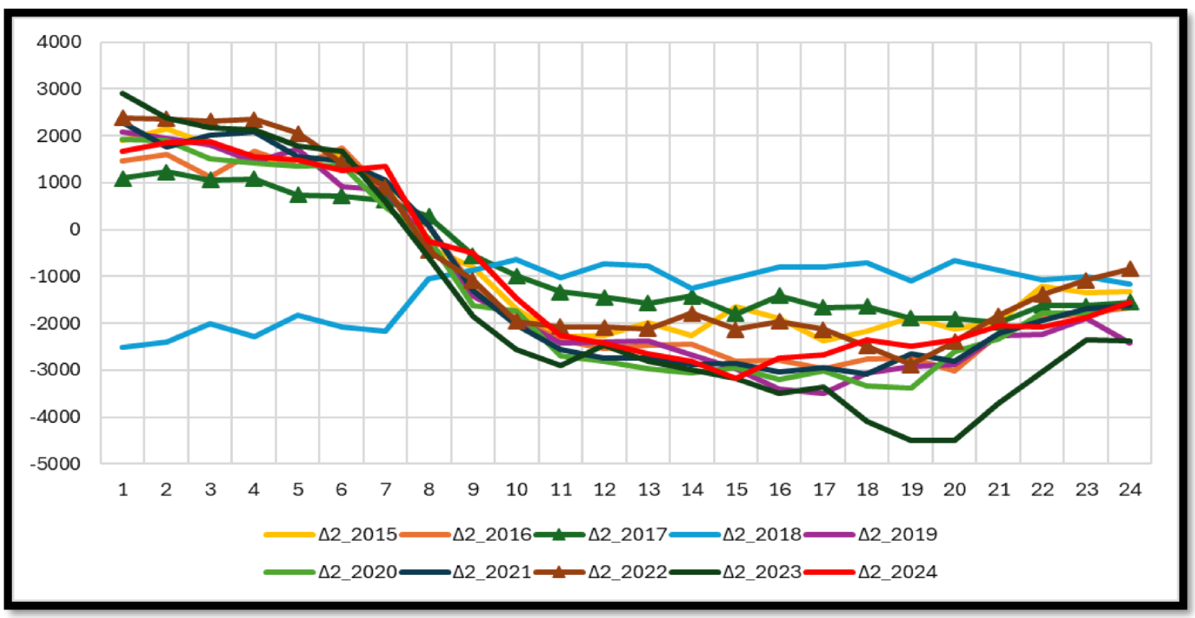

Figure 58: State Demand on Dusshera relative to succeeding day from 2015 to 2024

Figure-57 shows a common pattern where Δ1 remains positive during the initial hourly blocks (up to the 5th or 6th hour), with demand on **Dussehra** higher than that of the preceding day during early hours. In the subsequent hours, Δ1 turns negative, with demand on Dussehra falling below that of the preceding day. The year 2018 deviates from this pattern, with a different hourly behaviour compared to other years. As shown in Figure-58, Δ2 remains positive up to the 7th or 8th hourly block, with demand on Dussehra higher than that of the succeeding day during early hours. Beyond these hours, Δ2 turns negative, with demand on the succeeding day exceeding that of Dussehra during later hours. In 2018, Δ2 remains negative across all hourly blocks, with demand on Dussehra lower than that of the succeeding day throughout the day, unlike the pattern observed in other years.

4.5 State Demand on Holi relative to adjacent days

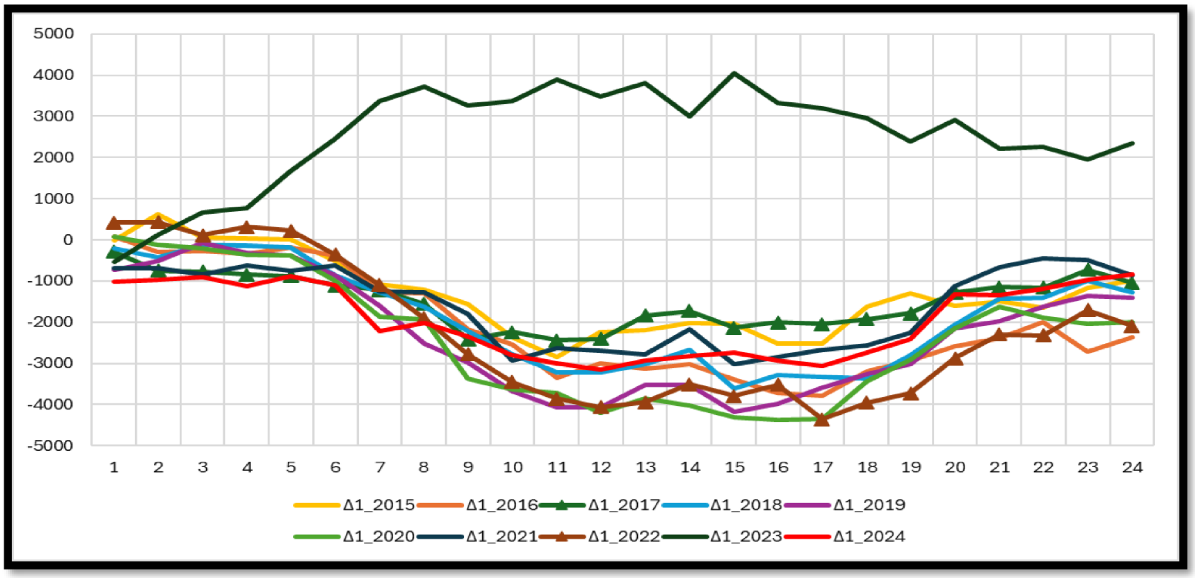

Figure 59: State Demand on Holi relative to preceding day from 2015 to 2024

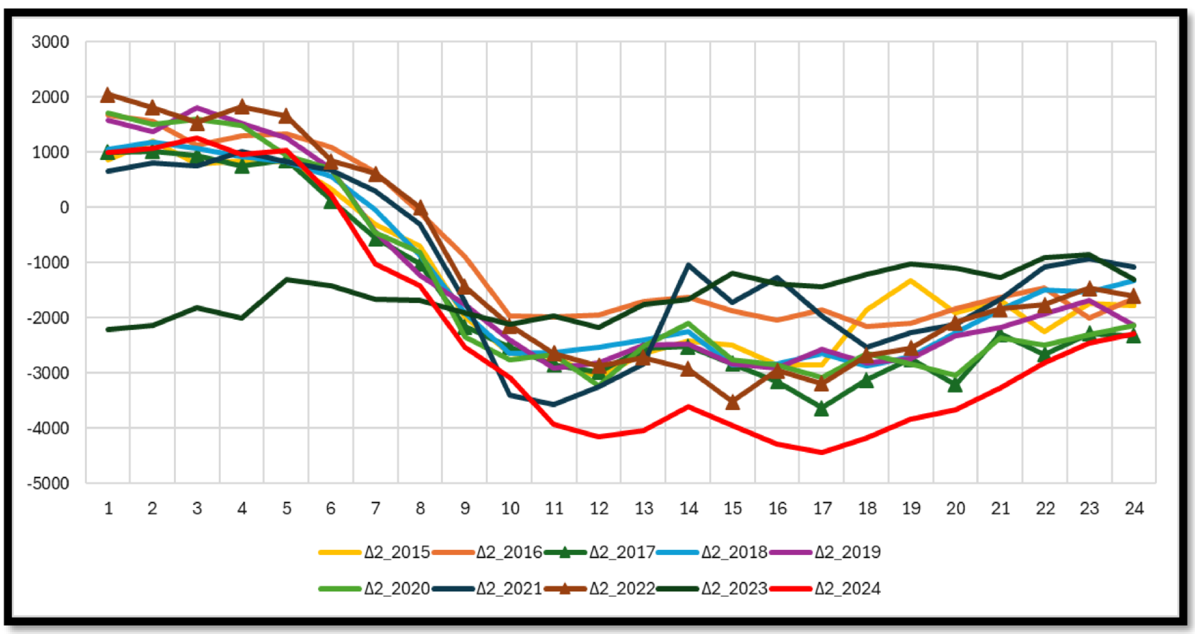

Figure 60: State Demand on Holi relative to succeeding day from 2015 to 2024

A consistently negative Δ1 trend is observed for most years—from 2016 to 2021 and in 2024—with demand on **Holi** remaining lower than that of the preceding day across all hourly blocks. In contrast, 2015 and 2022 show a mixed profile, with Δ1 positive up to the 5th hourly block and negative thereafter. The year 2023 deviates from this behaviour, with Δ1 remaining positive across all hourly blocks, with demand on Holi higher than that of the preceding day throughout the day.

As shown in Figure-60, Δ2 remains positive up to the 6th or 7th hourly block and turns negative thereafter, with demand on the succeeding day exceeding that of Holi during the later hours. The year 2023 again deviates from this pattern, with Δ2 remaining negative across all hourly blocks, with demand on Holi lower than that of the succeeding day throughout the day.

4.6 State Demand on Independence Day relative to adjacent days

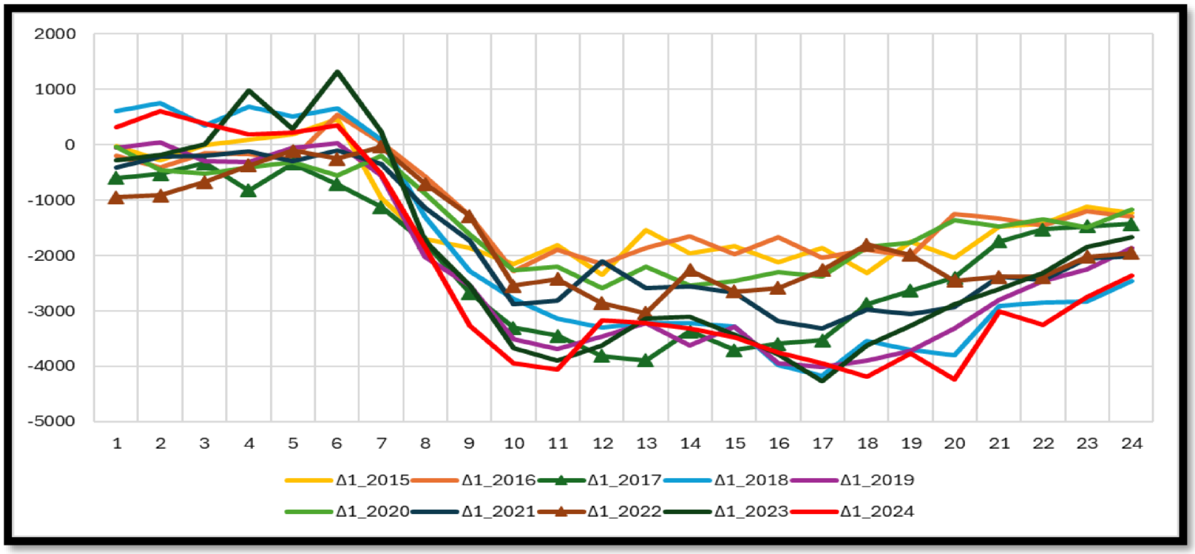

Figure 61: State Demand on Independence Day relative to preceding day from 2015 to 2024

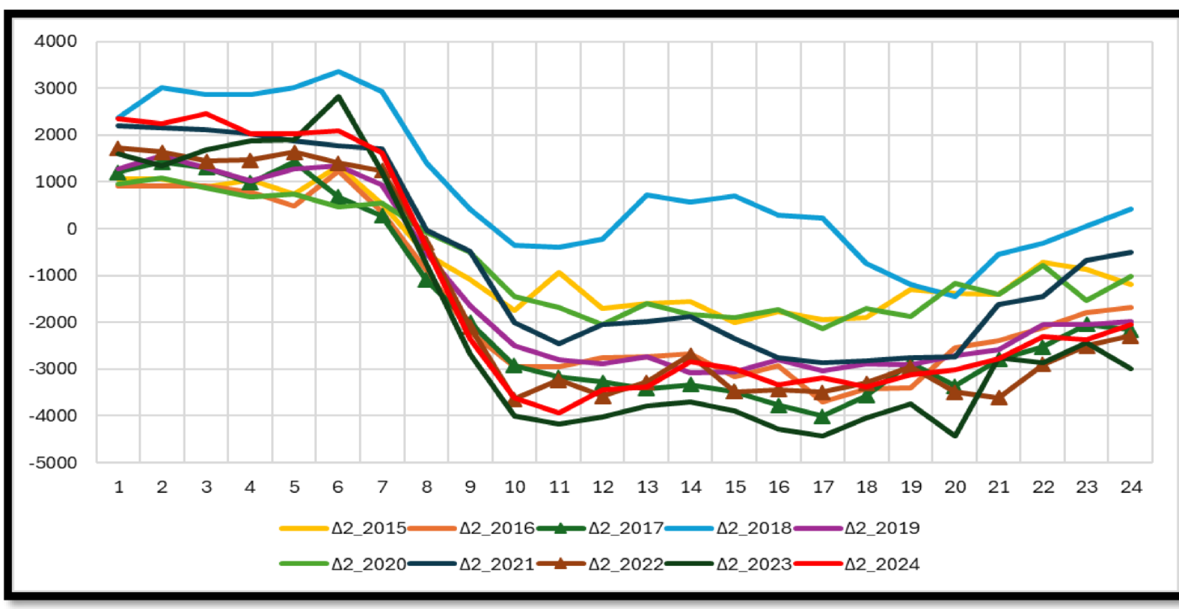

Figure 62: State Demand on Independence Day relative to succeeding day from 2015 to 2024

Figure-61 shows that Δ1 turns negative after the 7th or 8th hourly block, with demand on **Independence Day** remaining lower than that of the preceding day during the later hours. In 2017, 2020, 2021, and 2022, the Δ1 profile remains negative across all hourly blocks, with demand on Independence Day lower throughout the day compared to the preceding day.

Figure-62 shows that Δ2 turns negative after the 8th hourly block, with demand on the succeeding day exceeding that of Independence Day during the later hours. The year 2018 deviates from this pattern, exhibiting a mixed profile with both positive and negative values across the day.

4.7 State Demand on Maharashtra Day relative to adjacent days

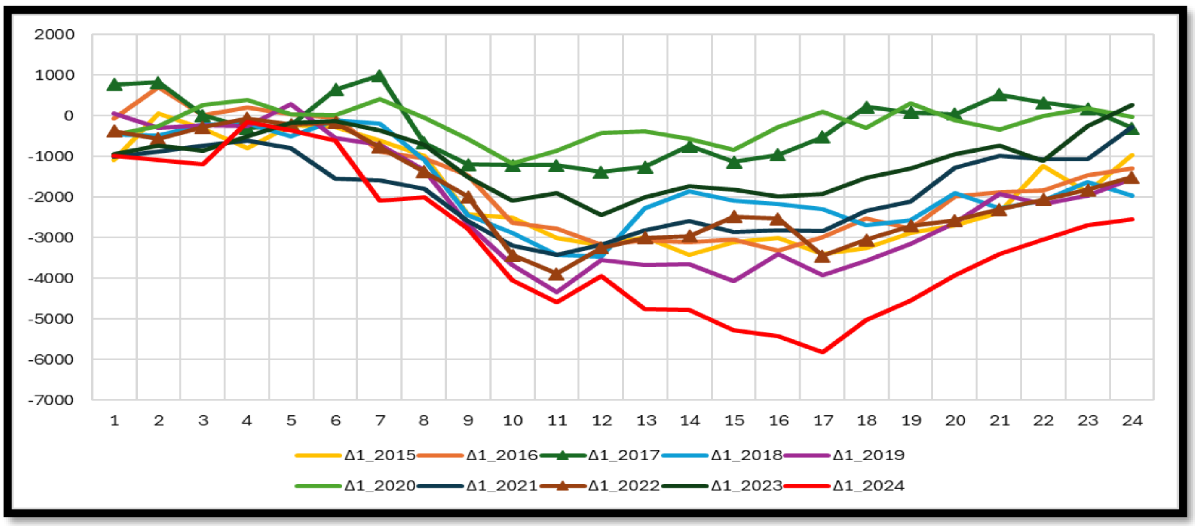

Figure 63: State Demand on Maharashtra Day relative to preceding day from 2015 to 2024

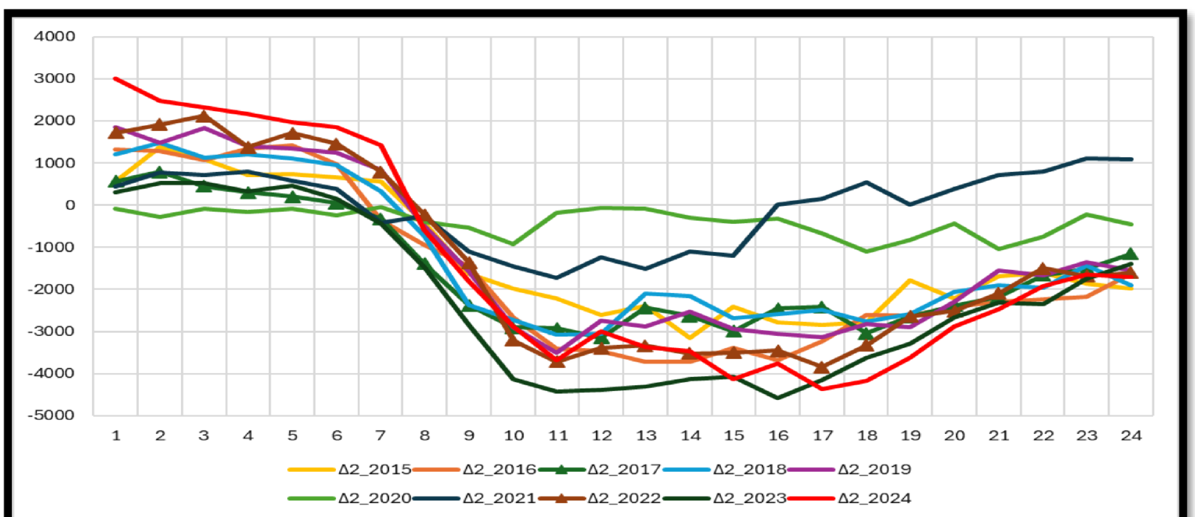

Figure 64: State Demand on Maharashtra day relative to succeeding day from 2015 to 2024

Δ1 shows a consistently negative trend for most years, with demand on **Maharashtra Day** remaining lower than that of the preceding day. The years 2017 and 2020 deviate from this pattern, with Δ1 values alternating between positive and negative across the day.

Δ2 shows a clear and consistent pattern in most years, remaining positive up to the 7th or 8th hourly block and turning negative thereafter, with demand on the succeeding day exceeding that of Maharashtra Day during the later hours. The years 2020 and 2021 deviate from this pattern: in 2020, Δ2 remains negative throughout the day, while in 2021, the Δ2 profile alternates between positive and negative values without any pattern.

4.8 State Demand on Republic Day relative to adjacent days

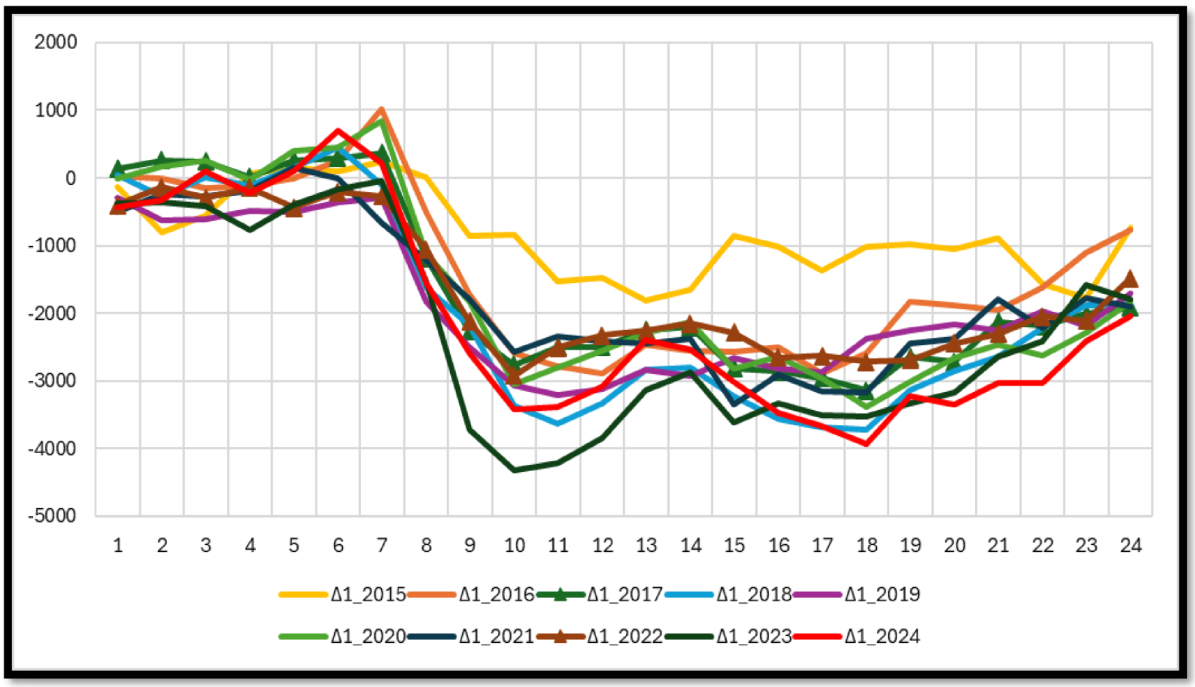

Figure 65: State Demand on Republic Day relative to preceding day from 2015 to 2024

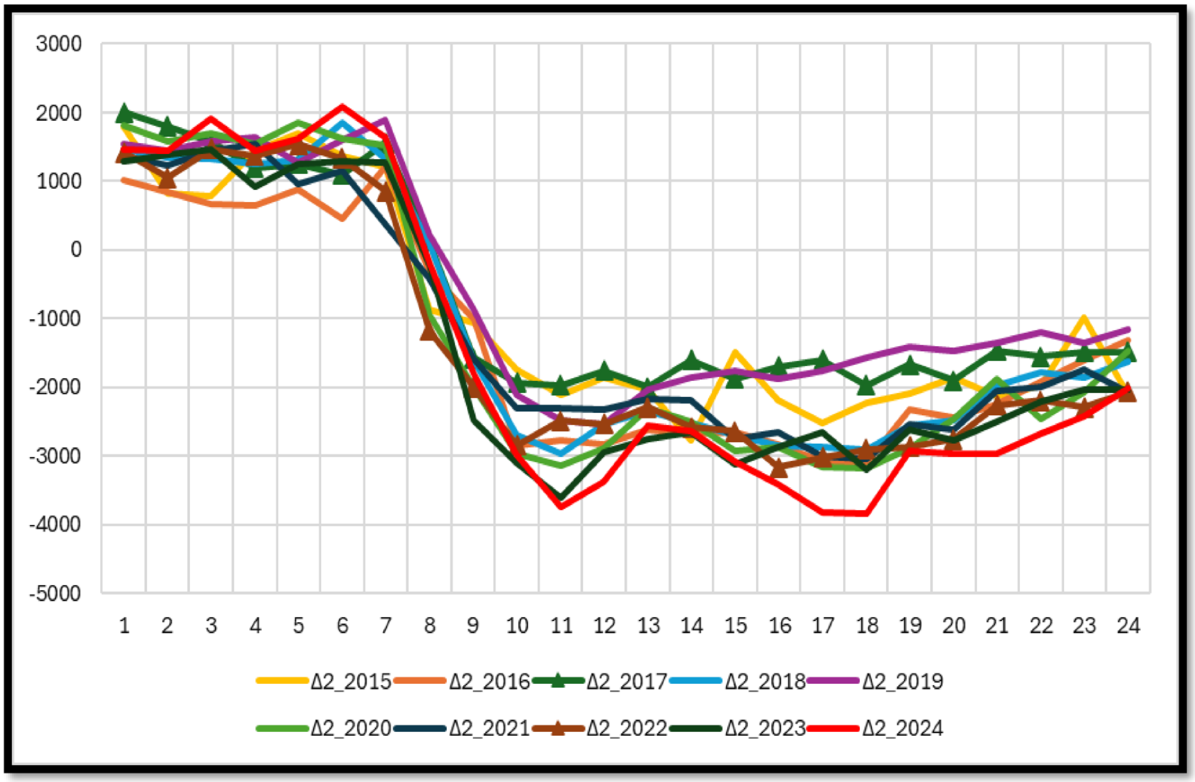

Figure 66: State Demand on Republic Day relative to succeeding day from 2015 to 2024

The Figure-65 & 66 illustrates that, Δ1 remains positive up to the 7th or 8th hourly block, showing higher demand on **Republic Day** during the early part of the day. Beyond these blocks, the trend shifts to negative, with demand on the preceding day exceeding that of Republic Day in the later hours. Δ2 remains positive up to the 8th or 9th hourly block, showing higher demand on Republic Day during the early hours. After this point, the trend turns negative, with demand on the day following Republic Day exceeding that of Republic Day in the later part of the day.

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5. State Demand Profile on Maximum/ Minimum Demand Day

5.1 Introduction

This chapter presents the hourly state demand profiles for each year from 2015 to 2024, corresponding to the day of maximum recorded demand and the day of minimum recorded demand for the respective year. The profiles capture the intra-day variation of demand on these extreme days.

5.2 Maximum demand day and minimum demand profile

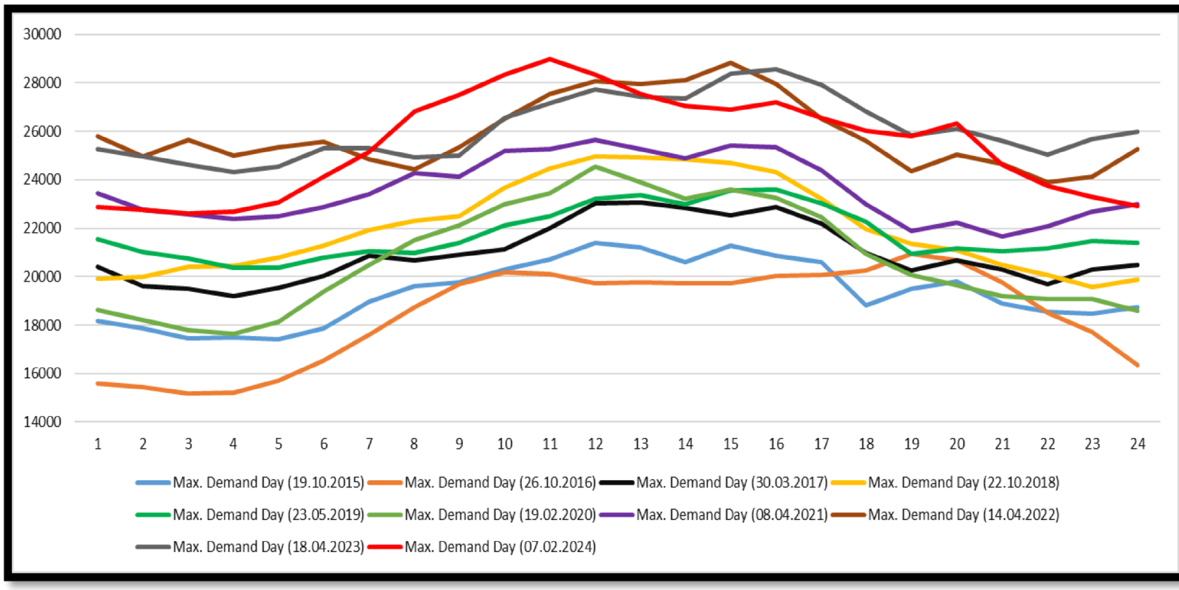

Figure 67: Maximum Demand Day Profiles from 2015 to 2024

The maximum demand day profiles over the period 2015–2024 (in Figure 67) show an increase in peak demand, with the peak corresponding to the day on which the maximum demand was recorded in each year, rising from 21,414 MW in 2015 to 28,969 MW in 2024, representing an overall increase of approximately 35.3%.

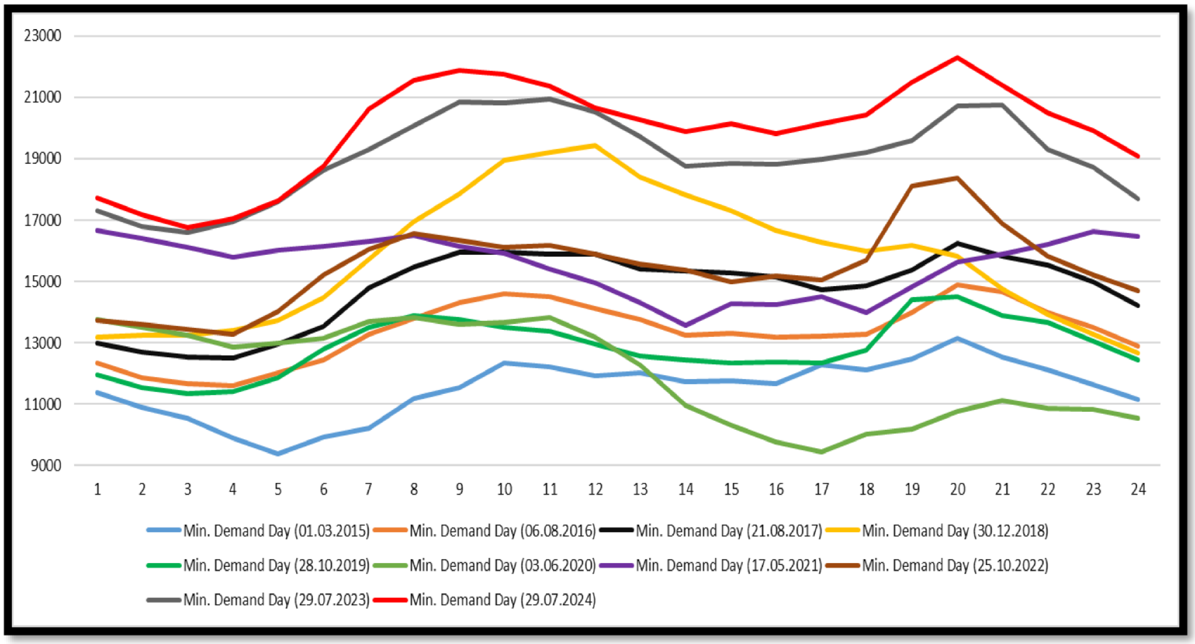

Figure 68: Minimum Demand Day Profiles from 2015 to 2024

Figure 68 illustrates the minimum demand day profiles for each year from 2015 to 2024, with the minimum demand corresponding to the day on which the lowest demand was recorded in each year, increasing from 13,161 MW in 2015 to 22,298 MW in 2024, representing an increase of approximately 69.5%.

Table 3: Year-wise Maximum State Demand Day with Load Shedding Quantum

Year	Max Demand Day (Date)	Peak Demand on the Day (MW)	Lowest Demand on the Day (MW)	*Load Shedding Quantum (MUs)
2015	19.10.2015	21414	17421	4.46
2016	26.10.2016	20951	15168	0
2017	30.03.2017	23055	19209	1.75
2018	22.10.2018	24962	19574	15.16
2019	23.05.2019	23613	20357	0
2020	19.02.2020	24550	17632	0
2021	08.04.2021	25644	21662	0
2022	14.04.2022	28845	23882	20.48
2023	18.04.2023	28584	24315	1.02
2024	07.02.2024	28969	22615	0.53

**Demand value includes load shedding quantum. Load Shedding includes Tx. Constraints & planned component.*

Table 4: Year-wise Minimum State Demand Day with Load Shedding Quantum

Year	Min Demand Day (Date)	Peak Demand on the Day (MW)	Lowest Demand on the Day (MW)	Load Shedding Quantum (MUs)
2015	01.03.2015	13161	9377	1.55
2016	06.08.2016	14896	11598	0
2017	21.08.2017	16255	12509	0
2018	30.12.2018	19438	12651	0
2019	28.10.2019	14502	11342	0
2020	03.06.2020	13834	9423	0
2021	17.05.2021	16668	13572	0
2022	25.10.2022	18375	13281	0
2023	29.07.2023	20963	16605	0
2024	29.07.2024	22298	16766	0.30

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6. State Demand Behaviour on Peak Weekday

6.1 Introduction

This chapter analyses the peak electricity demand trends across weekdays—Monday to Sunday—over a 10-year period from 2015 to 2024. For each year, the analysis identifies the day with the highest state demand out of all 52 instances of that weekday and plots its hourly demand profile.

6.2 State Demand on Peak Monday Across Years (2015–2024)

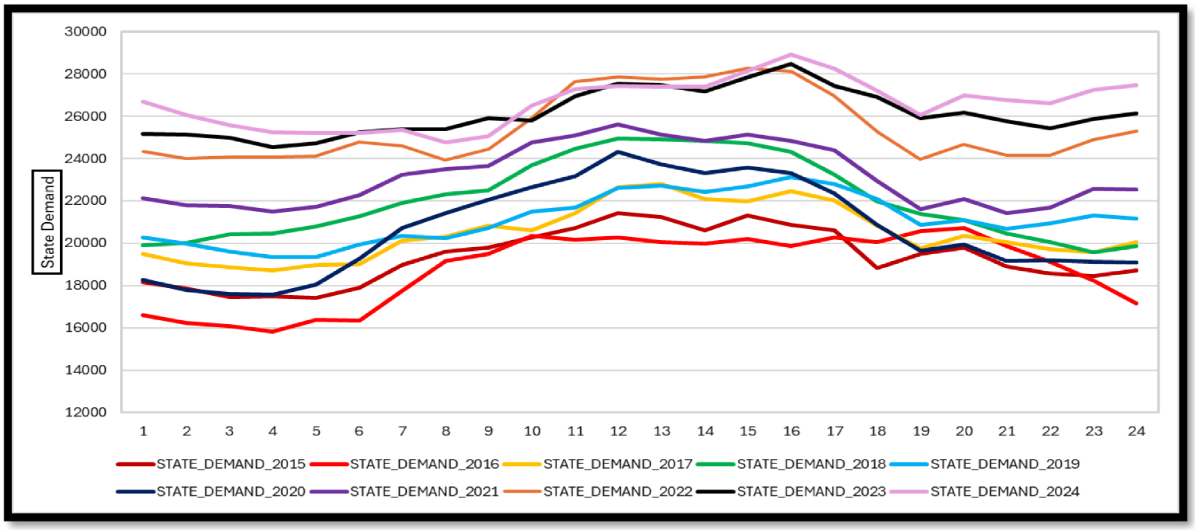

Figure 69: State Demand on Peak Monday Across Years (2015–2024)

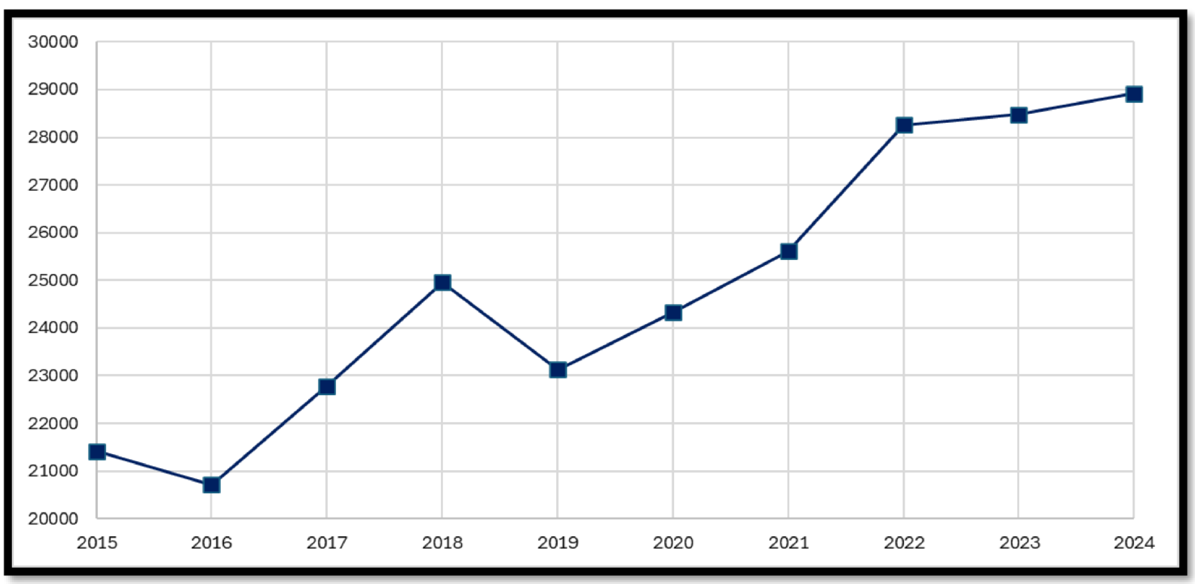

Figure 70: Yearly Maximum Demand on Monday (considering all Mondays)

The peak demand on Mondays has shown an increase from 2015 (21,414 MW) to 2024 (28,924 MW) with percentage increase of 35.09 %.

Table 5: Year-wise Peak Monday Demand in Maharashtra (2015–2024)

Date	Time Block	Peak Demand (MW)	Year	Day
19-10-2015	12	21414	2015	Monday
12-09-2016	20	20713.81	2016	
27-03-2017	13	22784.41	2017	
22-10-2018	12	24962.27	2018	
20-05-2019	16	23132	2019	
24-02-2020	12	24322.5	2020	
05-04-2021	12	25614	2021	
04-04-2022	15	28259	2022	
19-06-2023	16	28474	2023	
29-04-2024	16	28924	2024	

6.3 State Demand on Peak Tuesday Across Years (2015–2024)

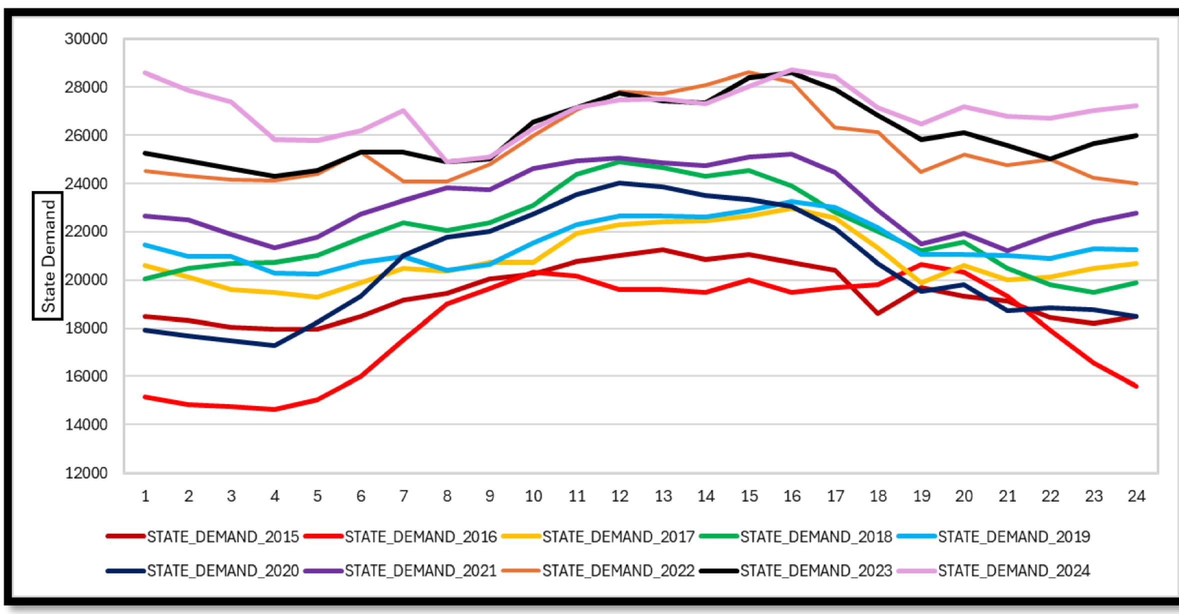

Figure 71: State Demand on Peak Tuesday Across Years (2015–2024)

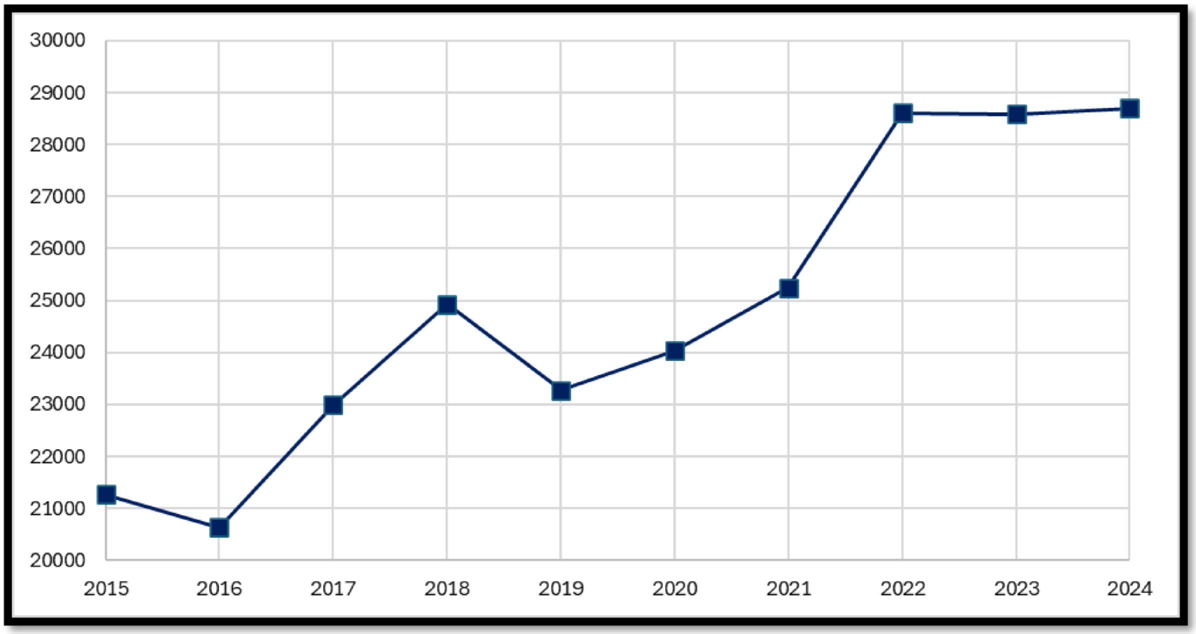

Figure 72: Yearly Maximum Demand on Tuesday (considering all Tuesdays)

The peak demand on Tuesdays has shown increasing trend from 2015 (21267 MW) to 2024 (28702 MW) with percentage increase of 34.97%.

Table 6: Year-wise Peak Tuesday Demand in Maharashtra (2015–2024)

Date	Time Block	Peak Demand (MW)	Year	Day
20-10-2015	13	21267	2015	Tuesday
08-11-2016	19	20638.55	2016	
11-04-2017	16	22994	2017	
16-10-2018	12	24922.424	2018	
28-05-2019	16	23276	2019	
18-02-2020	12	24031	2020	
06-04-2021	16	25241	2021	
12-04-2022	15	28611	2022	
18-04-2023	16	28584	2023	
30-04-2024	16	28702.84	2024	

6.4 State Demand on Peak Wednesday Across Years (2015–2024)

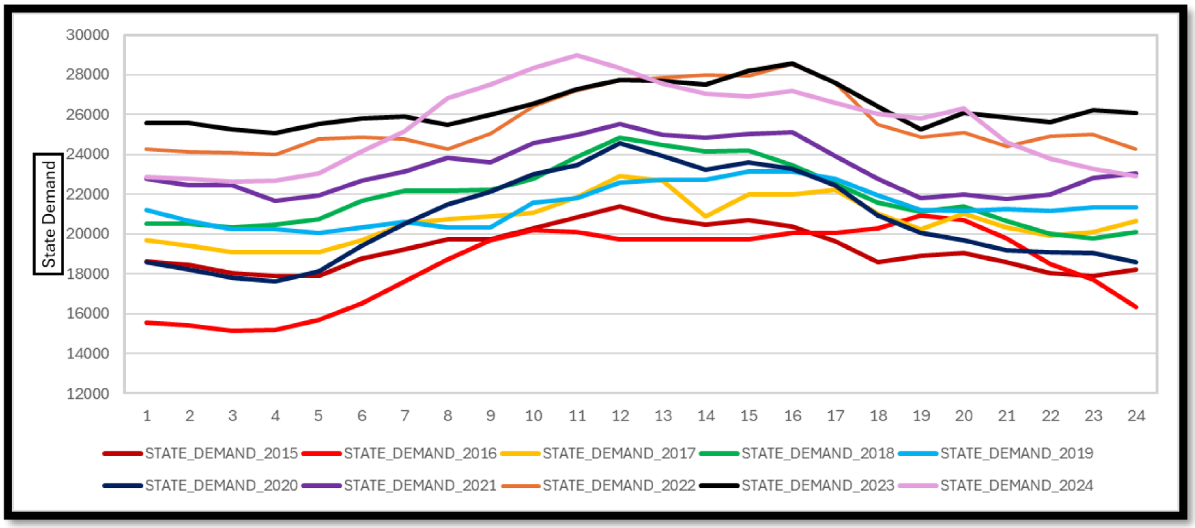

Figure 73: State Demand on Peak Wednesday Across Years (2015–2024)

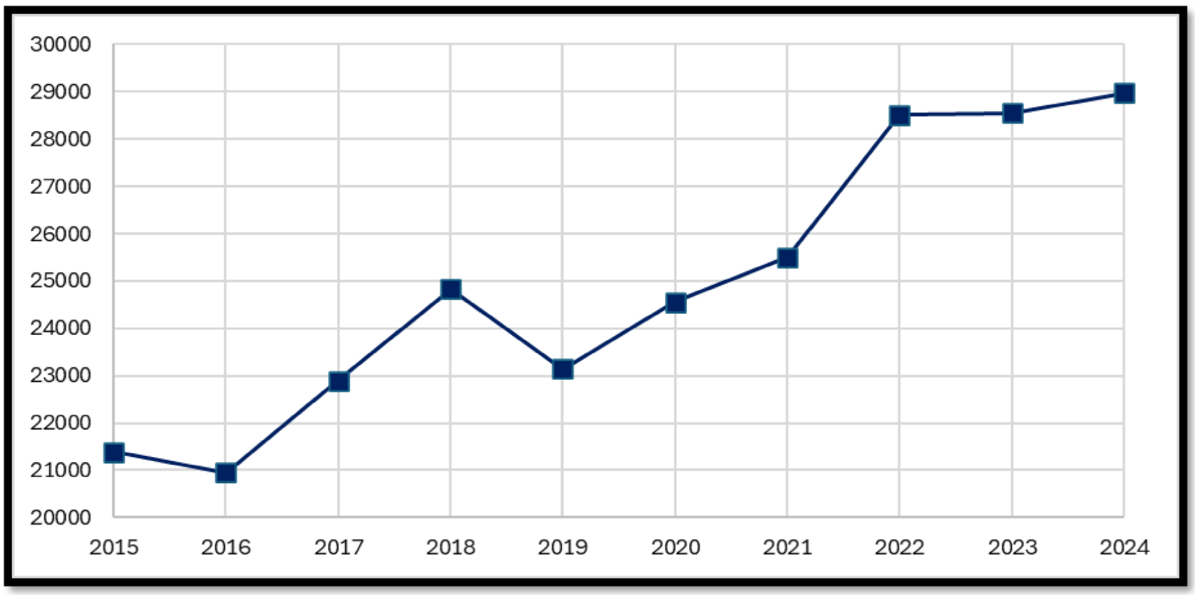

Figure 74: Yearly Maximum Demand on Wednesday (considering all Wednesdays)

The peak demand on Tuesdays has shown an increasing trend from 2015 (21388 MW) to 2024 (28969 MW), with a percentage increase of approximately 35.38%.

Table 7: Year-wise Peak Wednesday Demand in Maharashtra (2015–2024)

Date	Time Block	Peak Demand	Year	Day
21-10-2015	12	21388	2015	Wednesday
26-10-2016	19	20950.9	2016	
29-03-2017	12	22892.92	2017	
10-10-2018	12	24826.44	2018	
22-05-2019	15	23139	2019	
19-02-2020	12	24550	2020	
07-04-2021	12	25506	2021	
13-04-2022	16	28514	2022	
21-06-2023	16	28546	2023	
07-02-2024	11	28969	2024	

6.5 State Demand on Peak Thursday Across Years (2015–2024)

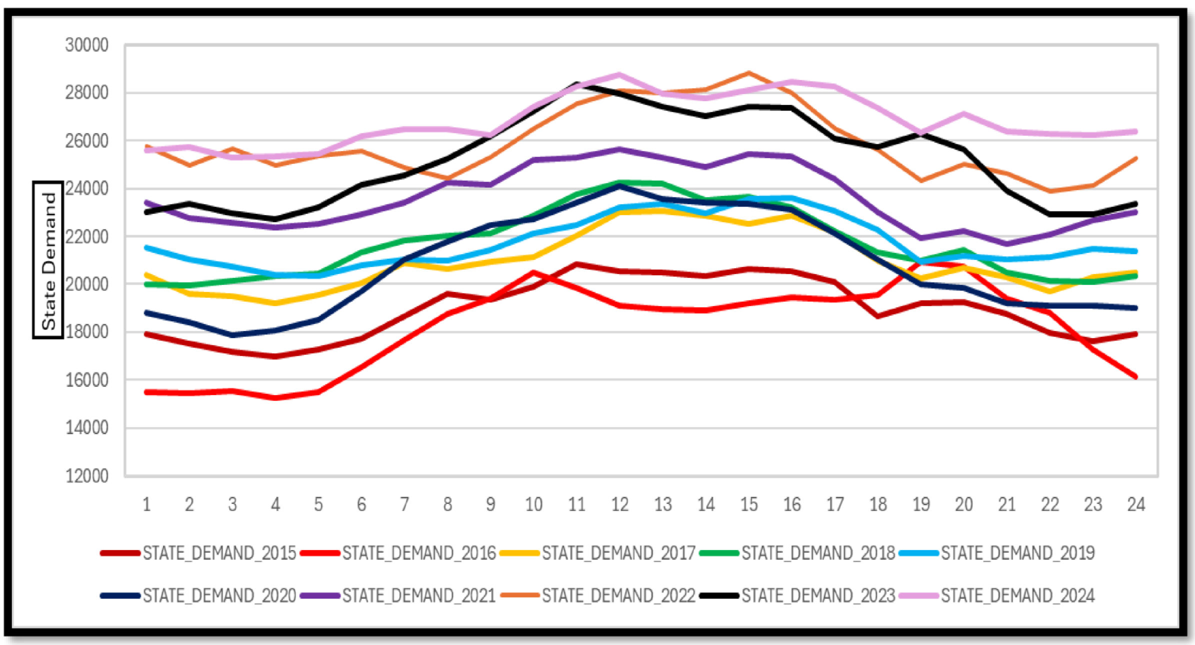

Figure 75: State Demand on Peak Thursday Across Years (2015–2024)

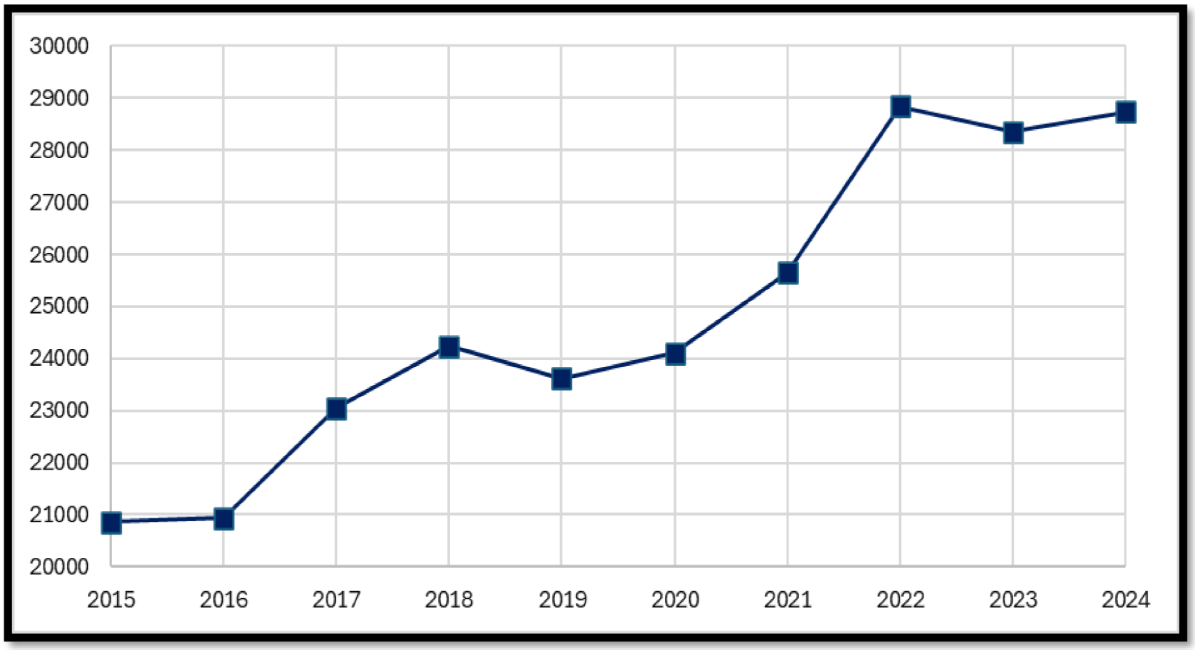

Figure 76: Yearly Maximum Demand on Thursday (considering all Thursdays)

The peak demand on Tuesdays has shown an increasing trend from 2015 (20857 MW) to 2024 (28735 MW), with a percentage increase of approximately 37.77%.

Table 8: Year-wise Peak Thursday Demand in Maharashtra (2015–2024)

Date	Time Block	Peak Demand	Year	Day
15-10-2015	11	20857	2015	Thursday
27-10-2016	19	20938.91	2016	
30-03-2017	13	23055.456	2017	
11-10-2018	12	24239.308	2018	
23-05-2019	16	23613	2019	
20-02-2020	12	24110	2020	
08-04-2021	12	25644	2021	
14-04-2022	15	28845	2022	
09-11-2023	11	28356	2023	
28-03-2024	12	28735	2024	

6.6 State Demand on Peak Friday Across Years (2015–2024)

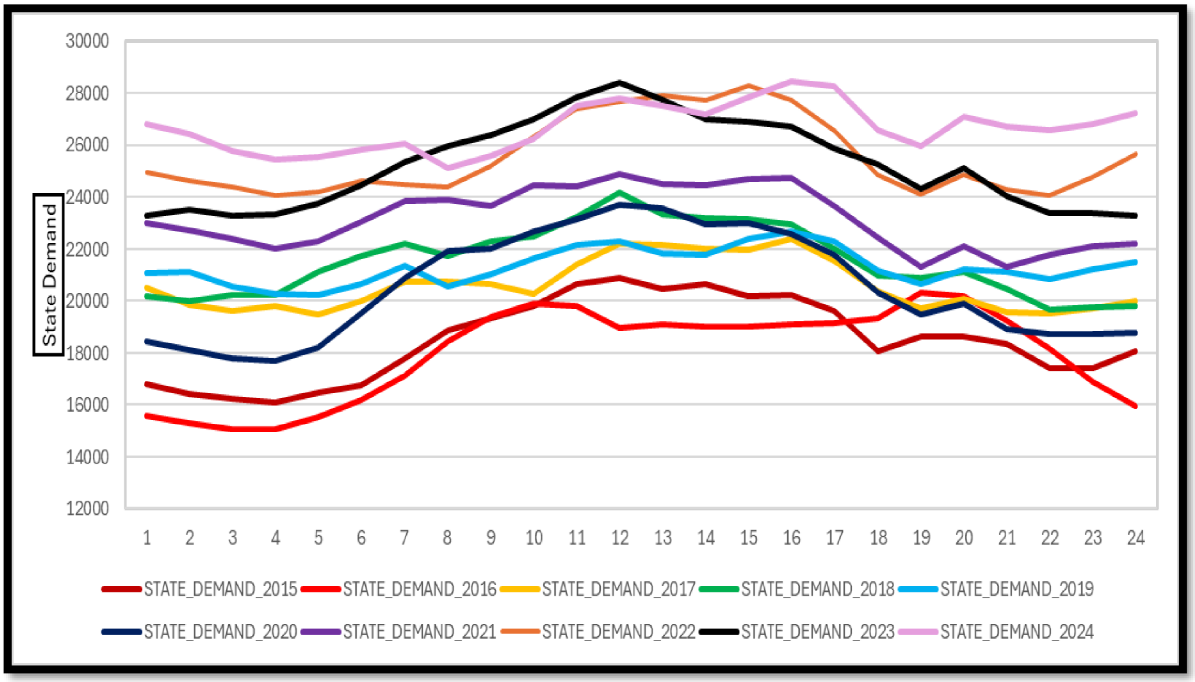

Figure 77: State Demand on Peak Friday Across Years (2015–2024)

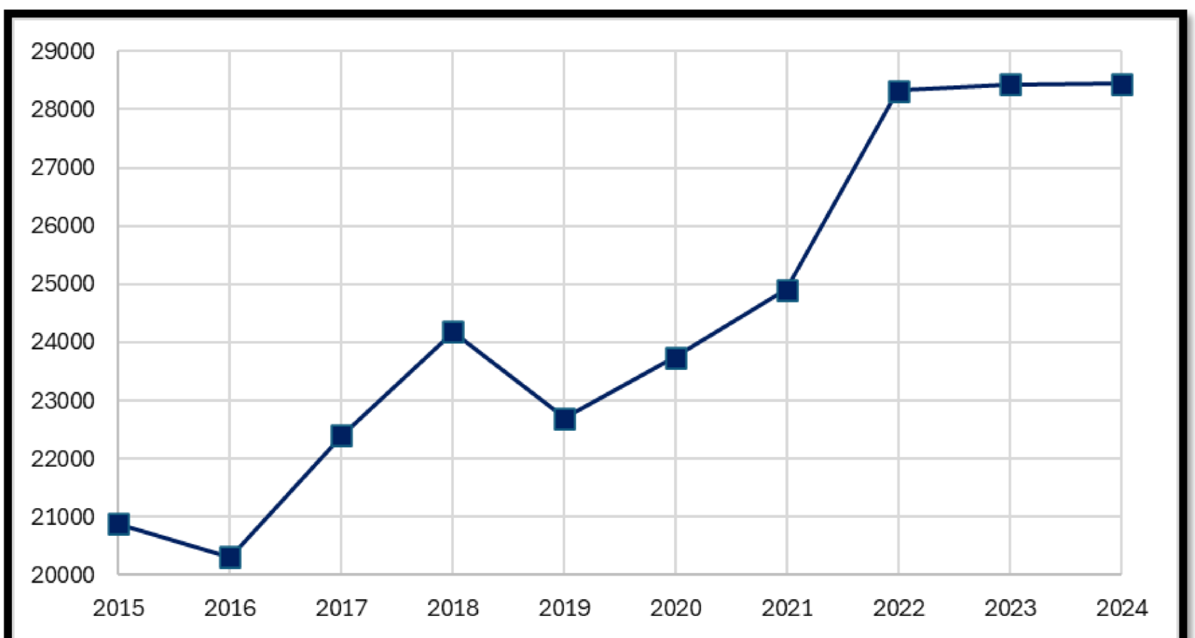

Figure 78: Yearly Maximum Demand on Friday (considering all Fridays)

The peak demand on Tuesdays has shown an increasing trend from 2015 (20882 MW) to 2024 (28446 MW), with a percentage increase of approximately 36.23%.

Table 9: Year-wise Peak Friday Demand in Maharashtra (2015–2024)

Date	Time Block	Peak Demand	Year	Day
23-10-2015	12	20882	2015	Friday
28-10-2016	19	20305.824	2016	
31-03-2017	16	22397.456	2017	
12-10-2018	12	24183.172	2018	
26-04-2019	16	22697	2019	
28-02-2020	12	23737	2020	
09-04-2021	12	24908	2021	
08-04-2022	15	28324	2022	
03-03-2023	12	28430.5	2023	
19-04-2024	16	28445.516	2024	

6.7 State Demand on Peak Saturday Across Years (2015–2024)

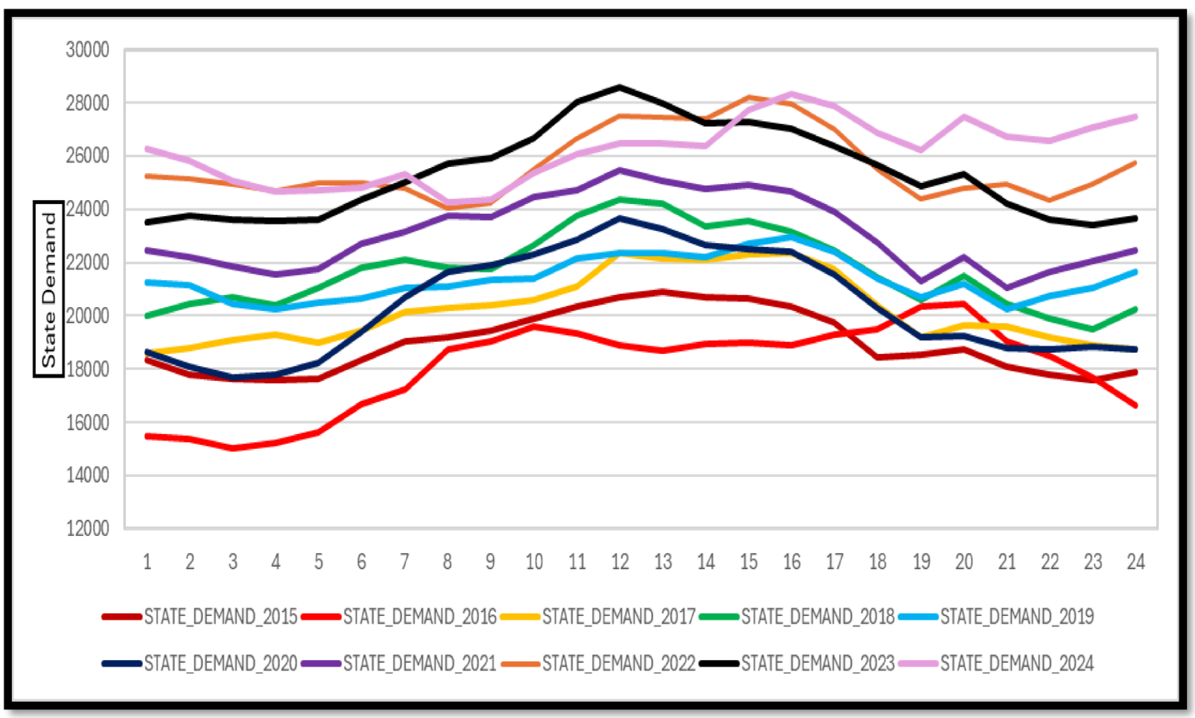

Figure 79:State Demand on Peak Saturday Across Years (2015–2024)

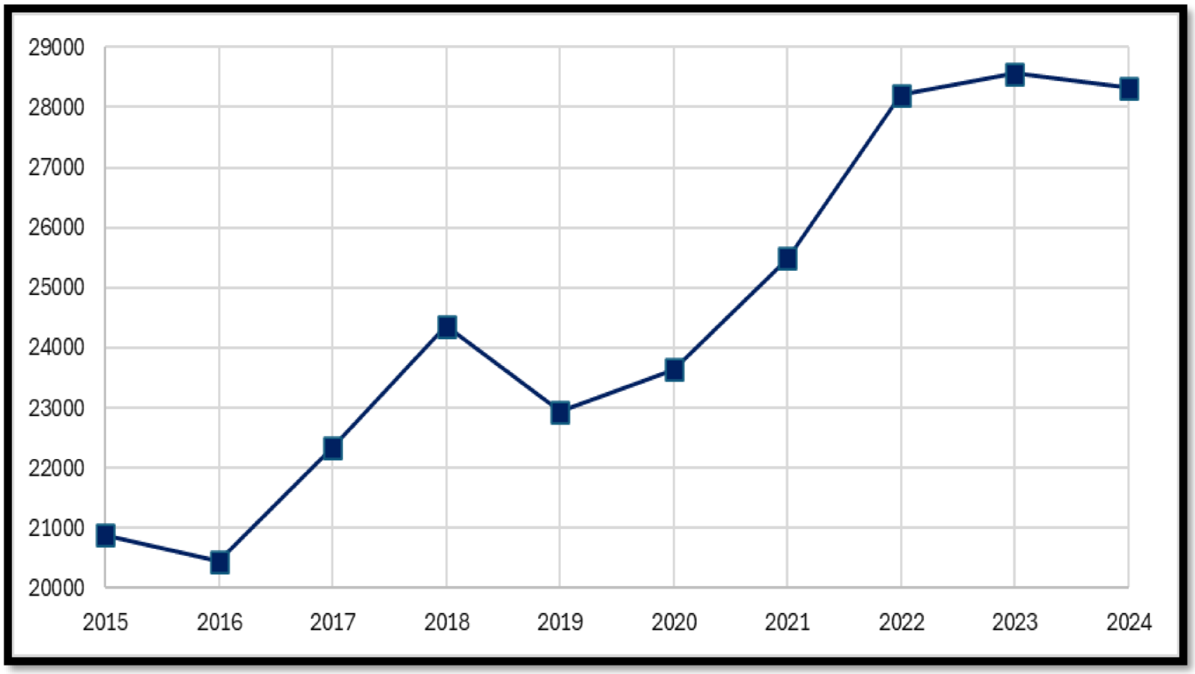

Figure 80: Yearly Maximum Demand on Saturday (considering all Saturdays)

The peak demand on Tuesdays has shown an increasing trend from 2015 (20885 MW) to 2024 (28331 MW), with a percentage increase of approximately 35.64%.

Table 10: Year-wise Peak Saturday Demand in Maharashtra (2015–2024)

Date	Time Block	Peak Demand	Year	Day
24-10-2015	13	20885	2015	Saturday
22-10-2016	20	20441.848	2016	
06-05-2017	16	22345.872	2017	
13-10-2018	12	24358.5	2018	
27-04-2019	16	22933	2019	
22-02-2020	12	23636.5	2020	
03-04-2021	12	25490.5	2021	
23-04-2022	15	28209.997	2022	
04-03-2023	12	28566.14	2023	
27-04-2024	16	28331	2024	

6.8 State Demand on Peak Sunday Across Years (2015–2024)

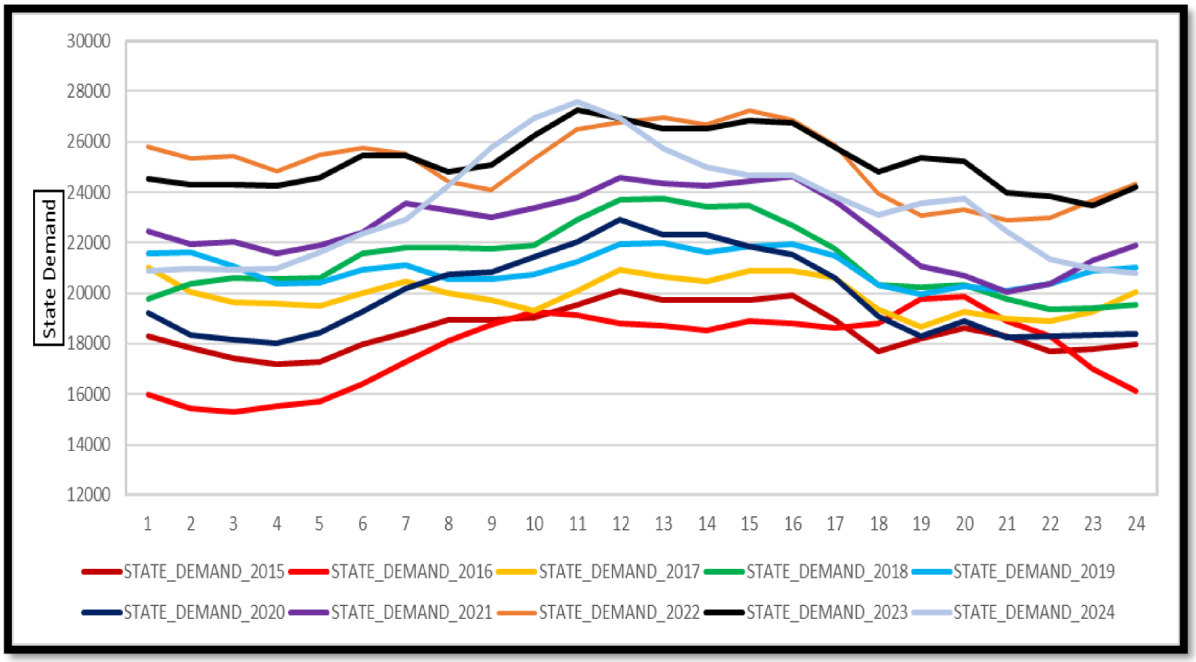

Figure 81: State Demand on Peak Sunday Across Years (2015–2024)

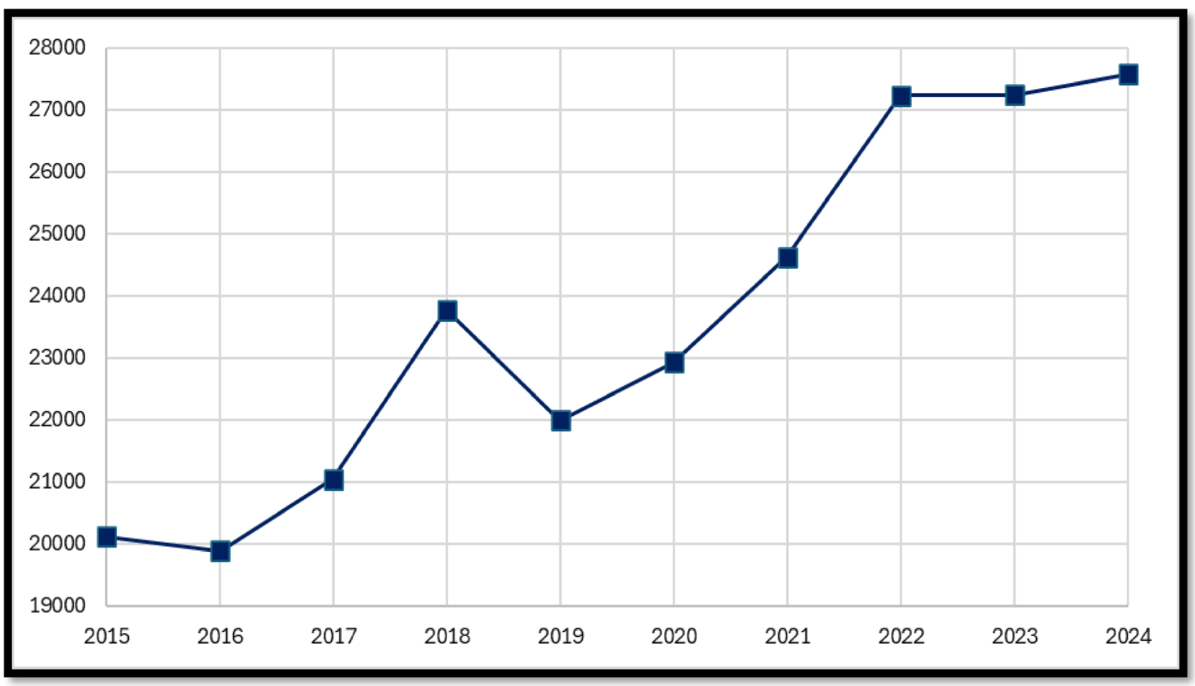

Figure 82: Yearly Maximum Demand on Sunday (considering all Sundays)

The peak demand on Tuesdays has shown an increasing trend from 2015 (20115 MW) to 2024 (27568 MW), with a **percentage increase of approximately 37.07%**.

Table 11: Year-wise Peak Sunday Demand in Maharashtra (2015–2024)

Date	Time Block	Peak Demand	Year	Day
18-10-2015	12	20115	2015	Sunday
23-10-2016	20	19878.848	2016	
16-04-2017	1	21037.544	2017	
21-10-2018	13	23766.272	2018	
28-04-2019	13	21987	2019	
23-02-2020	12	22928	2020	
28-03-2021	16	24622.25	2021	
10-04-2022	15	27224	2022	
22-10-2023	11	27235.15	2023	
28-01-2024	11	27568	2024	

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7. Morning & Evening Demand Scenario from CY 2020 – CY 2024

7.1 Introduction

This chapter presents the State Demand and Net Demand (*State Demand excluding Wind and Solar*) during the **morning period (07:00–13:00 hrs)** and **evening period (18:00–22:00 hrs)** for CY 2020 to CY 2024.Hourly demand profiles of both State Demand and Net Demand are plotted for each year during the specified morning and evening periods.

7.2 Morning Peak period (From 7:00 Hrs - 13:00 Hrs) scenario for State Demand Vs Net Demand in CY 2020-2024

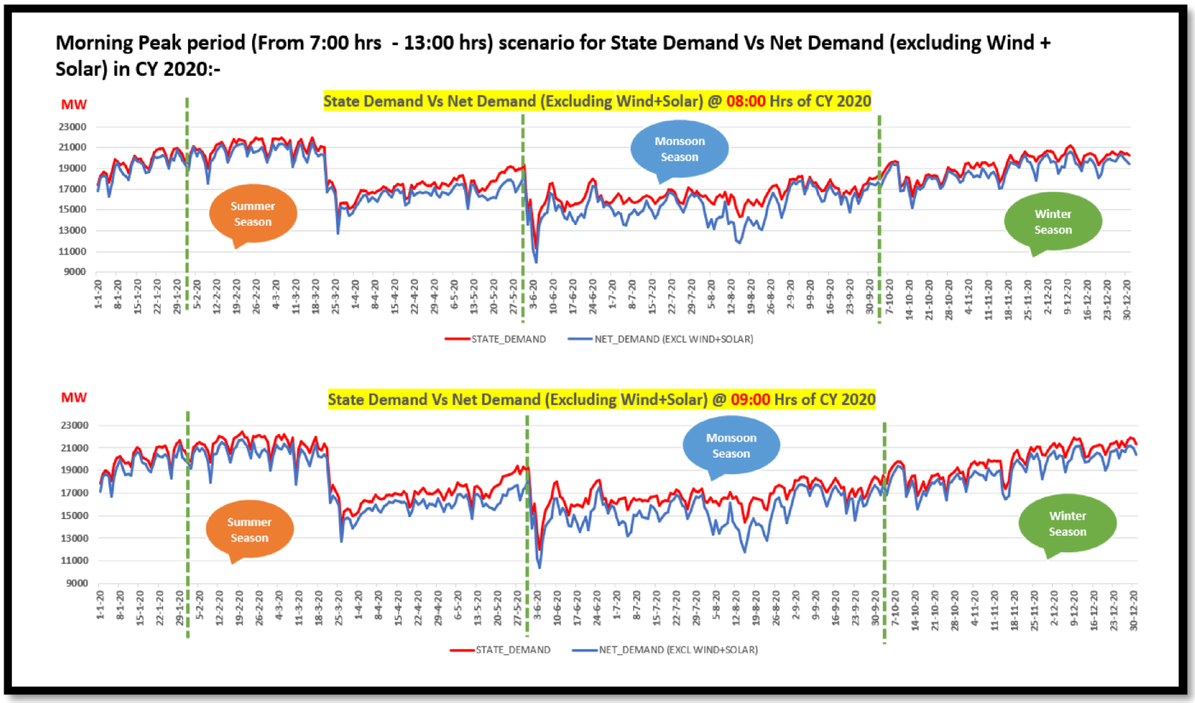
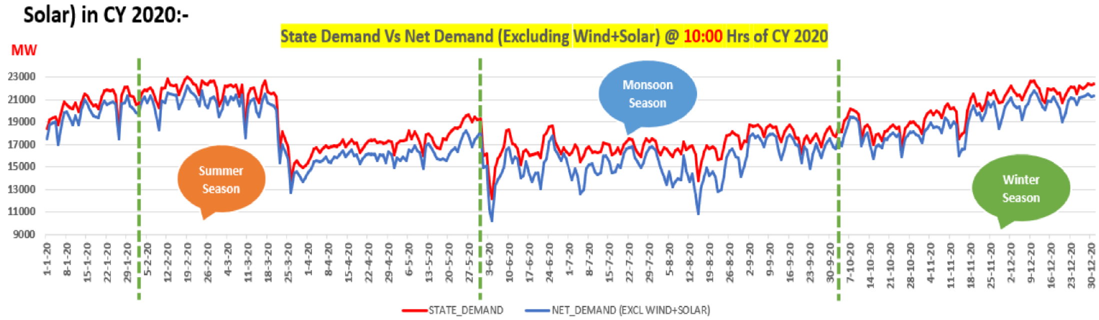


Figure 83: State Demand Vs Net Demand @ 08:00 Hrs and 09:00 Hrs in CY 2020

Morning Peak period (From 7:00 hrs - 13:00 hrs) scenario for State Demand Vs Net Demand (excluding Wind + Solar) in CY 2020:-



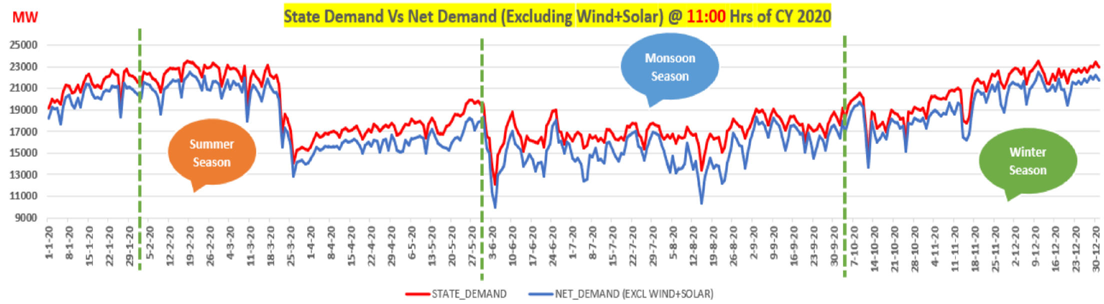
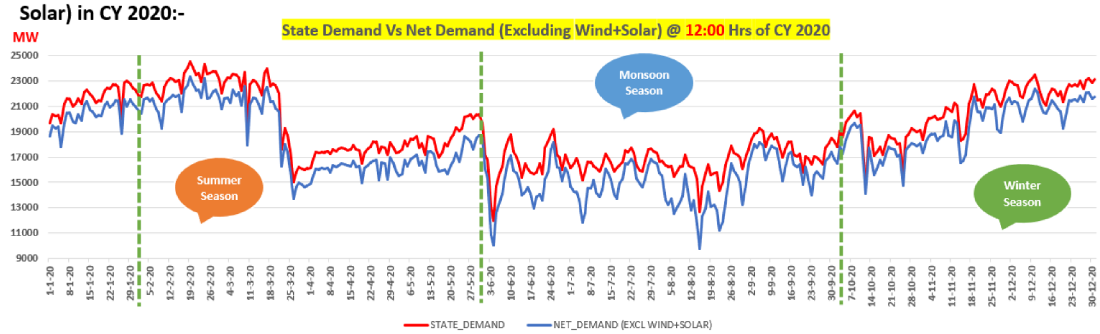


Figure 84: State Demand Vs Net Demand @ 10:00 Hrs and 11:00 Hrs in CY 2020

Morning Peak period (From 7:00 hrs - 13:00 hrs) scenario for State Demand Vs Net Demand (excluding Wind + Solar) in CY 2020:-



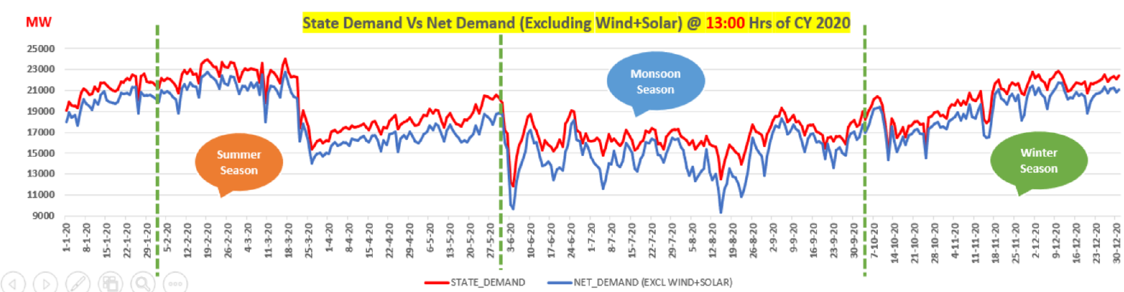


Figure 85: State Demand Vs Net Demand @ 12:00 Hrs and 13:00 Hrs in CY 2020

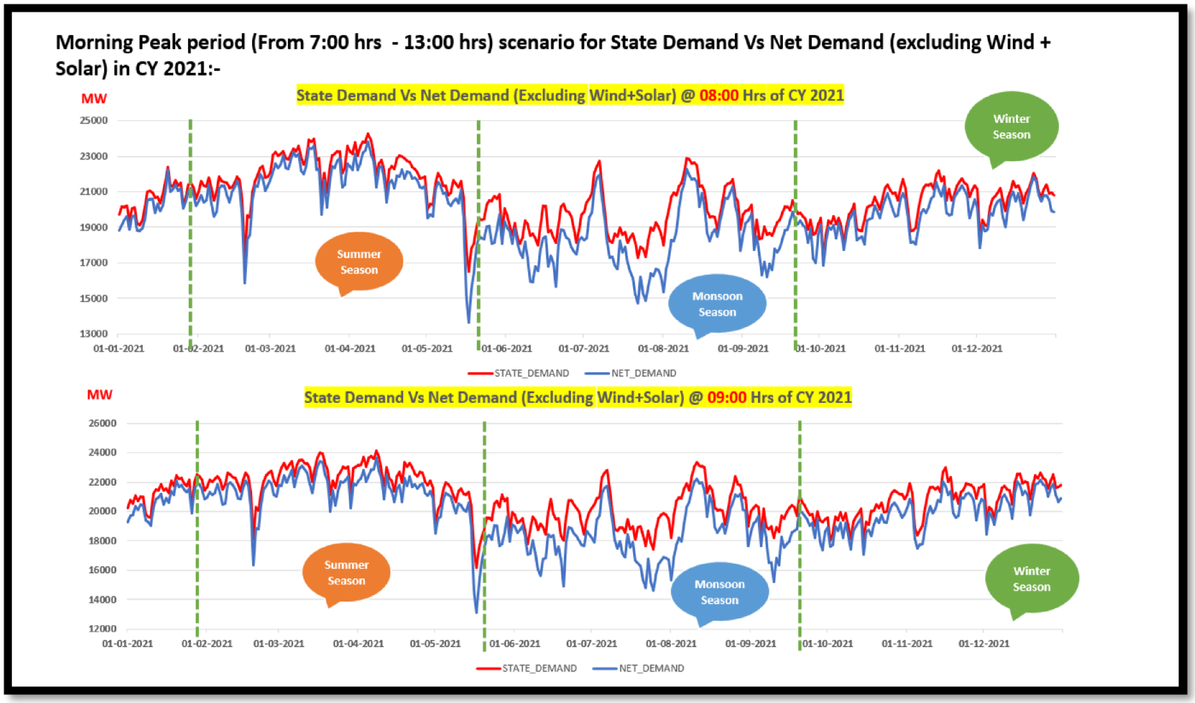


Figure 86: State Demand Vs Net Demand @ 08:00 Hrs and 09:00 Hrs in CY 2021

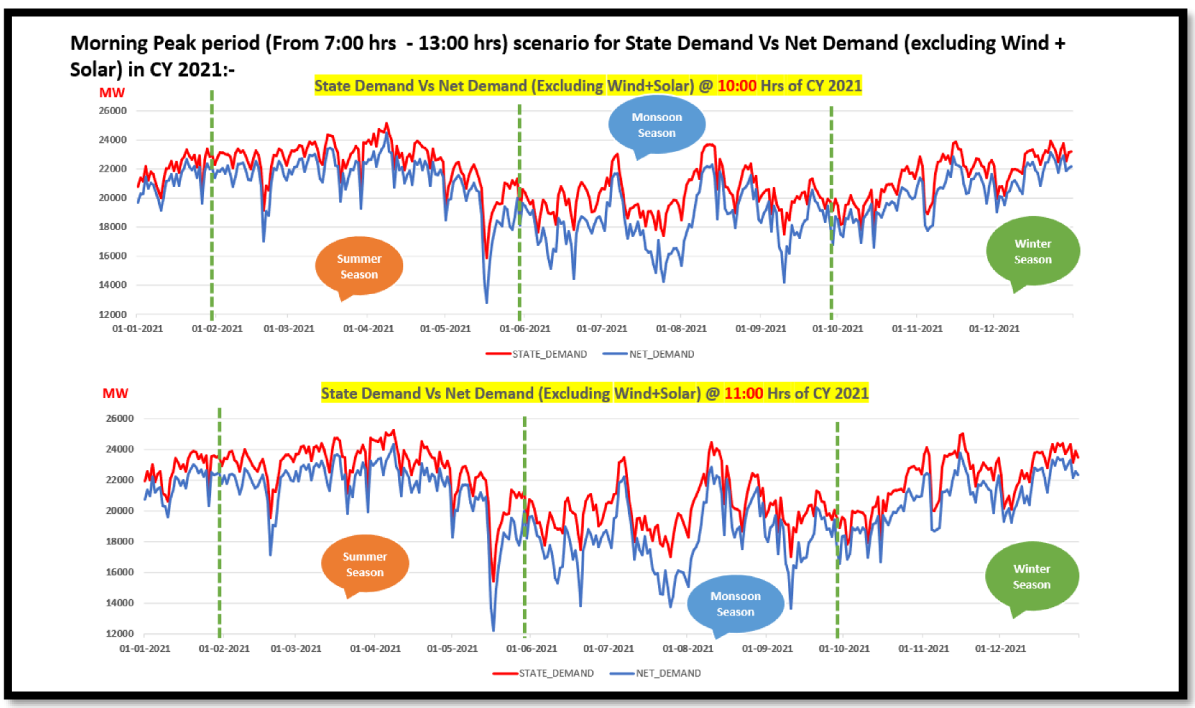


Figure 87: State Demand Vs Net Demand @ 10:00 Hrs and 11:00 Hrs in CY 2021

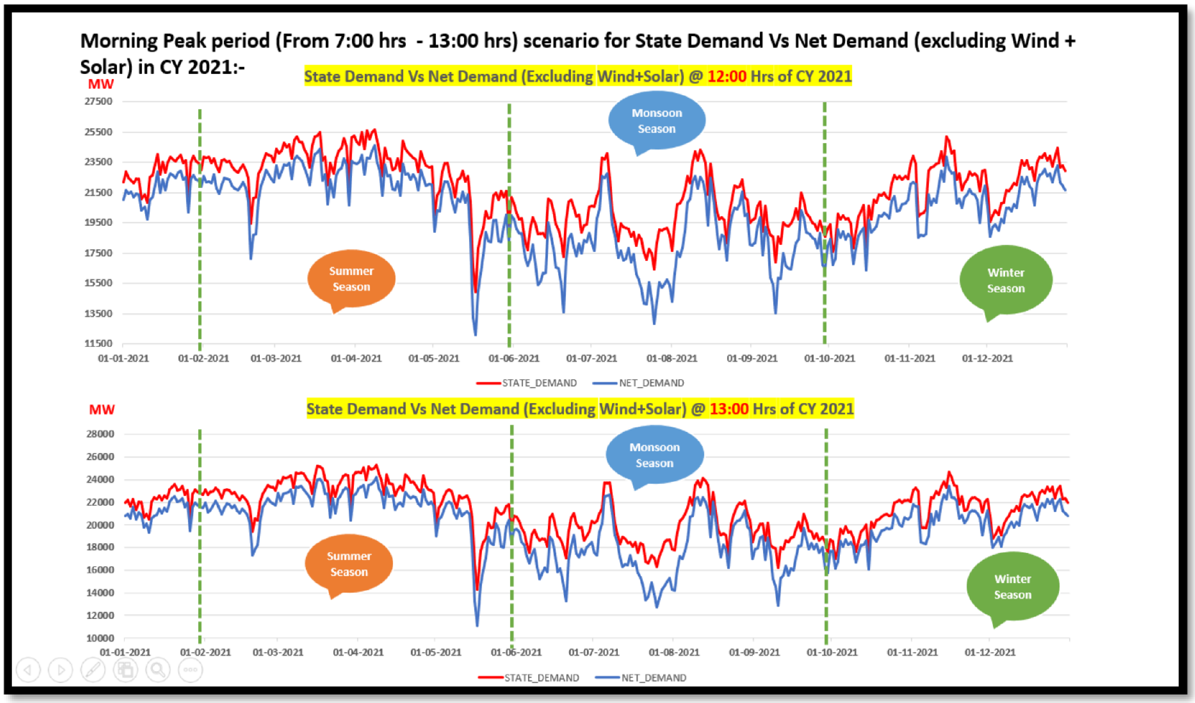


Figure 88: State Demand Vs Net Demand @ 12:00 Hrs and 13:00 Hrs in CY 2021

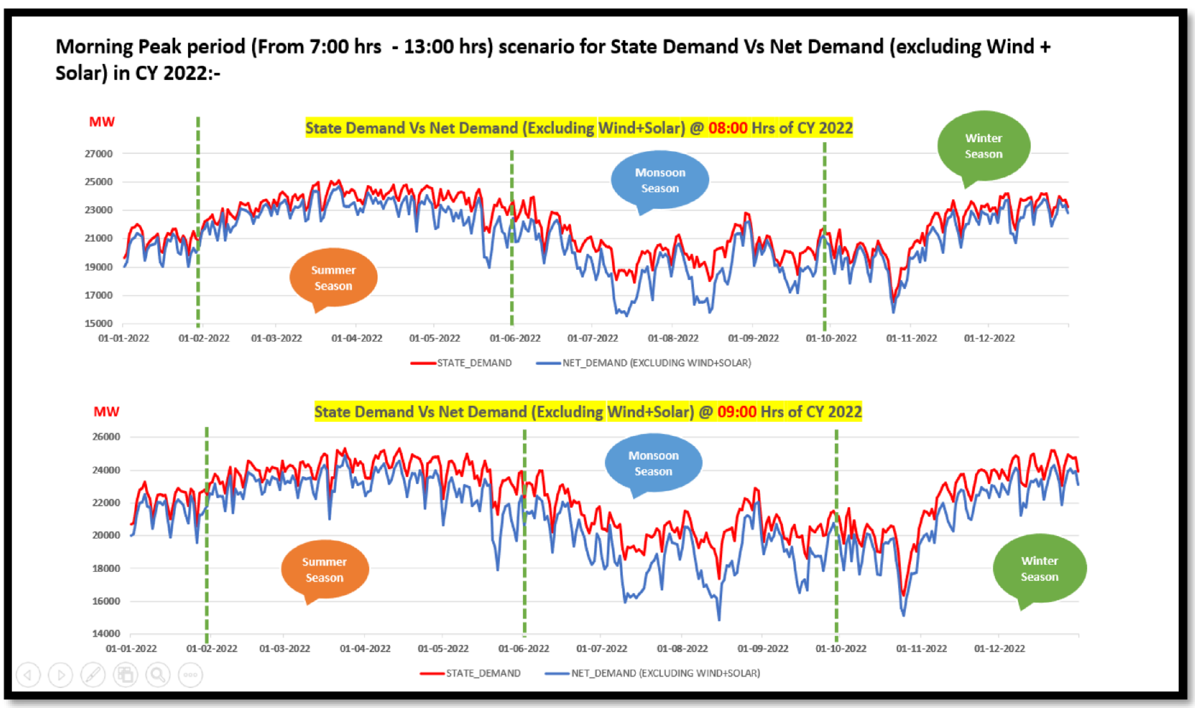


Figure 89: State Demand Vs Net Demand @ 08:00 Hrs and 09:00 Hrs in CY 2022

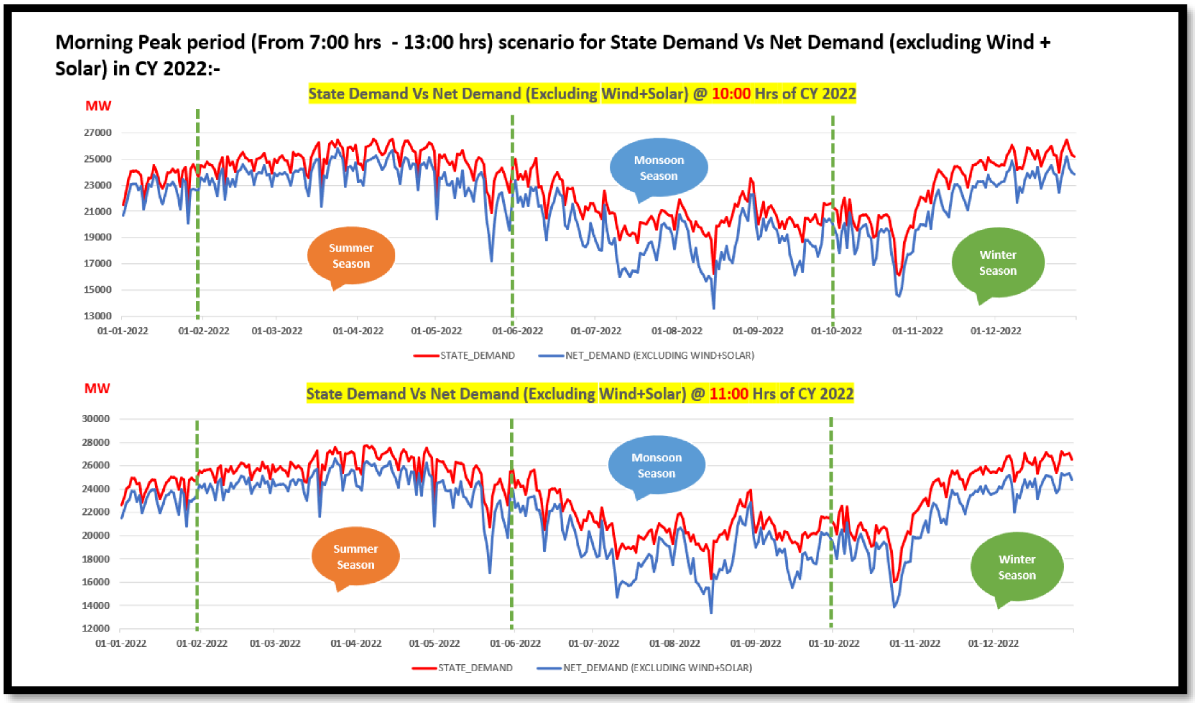


Figure 90: State Demand Vs Net Demand @ 10:00 Hrs and 11:00 Hrs in CY 2022

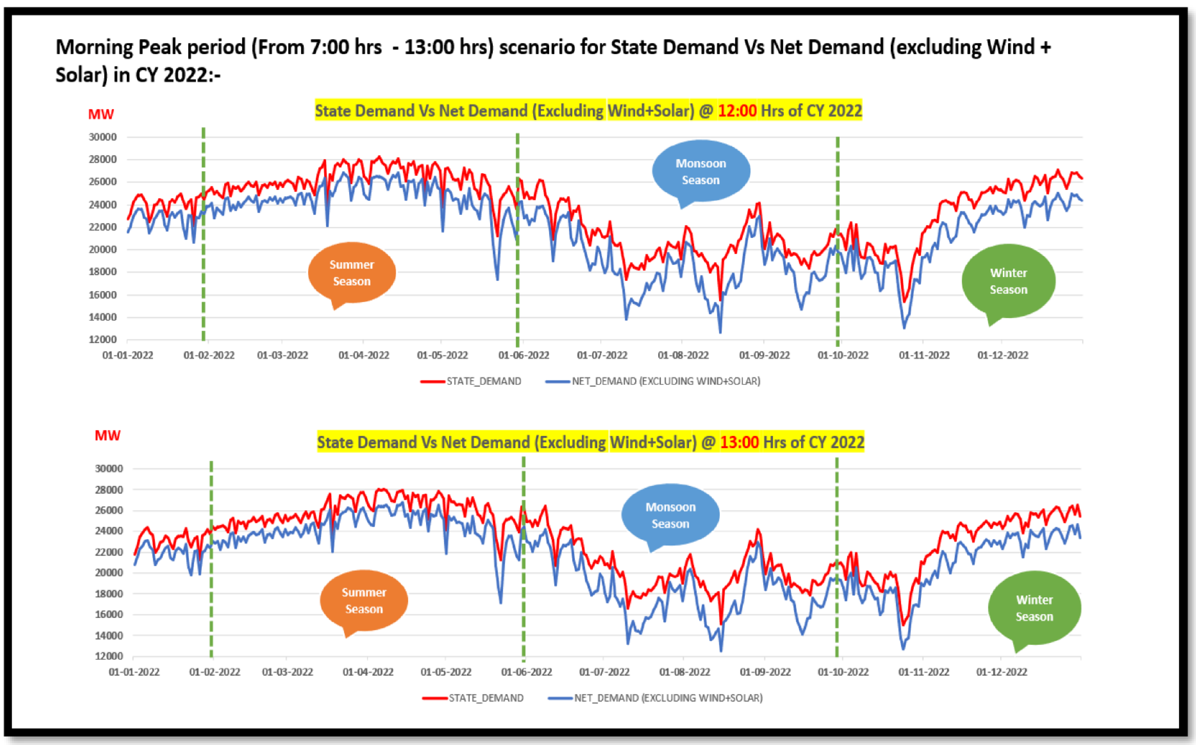


Figure 91: State Demand Vs Net Demand @ 12:00 Hrs and 13:00 Hrs in CY 2022

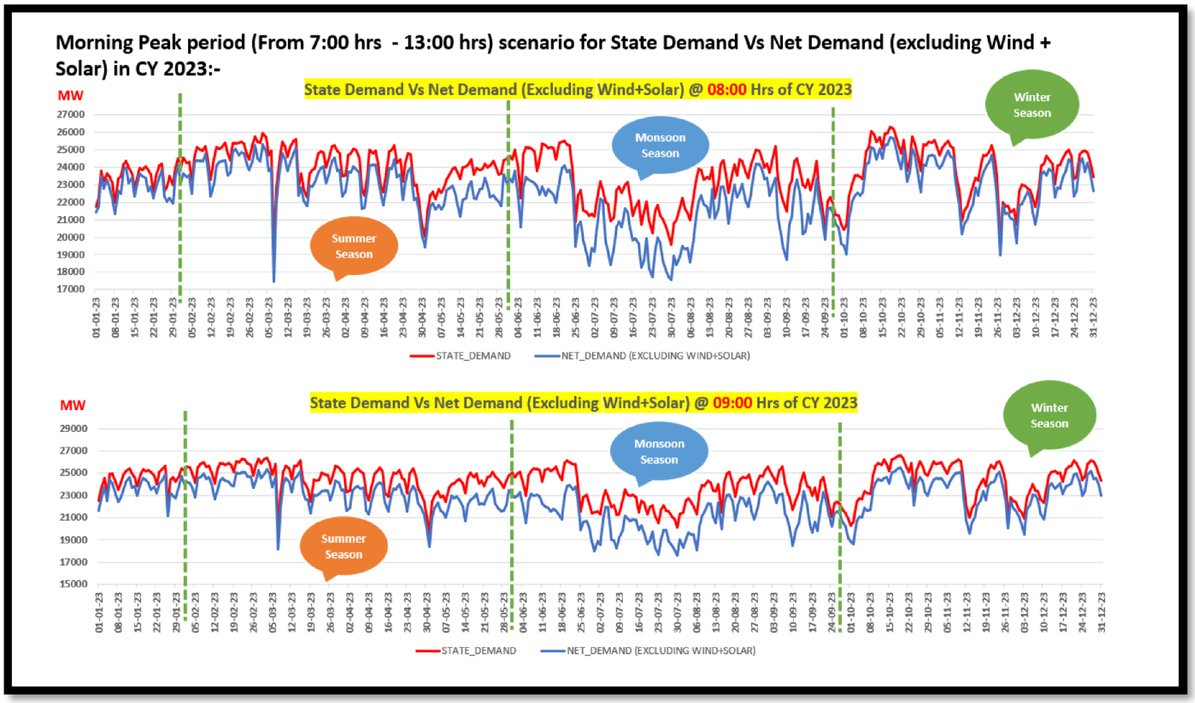


Figure 92: State Demand Vs Net Demand @ 08:00 Hrs and 09:00 Hrs in CY 2023

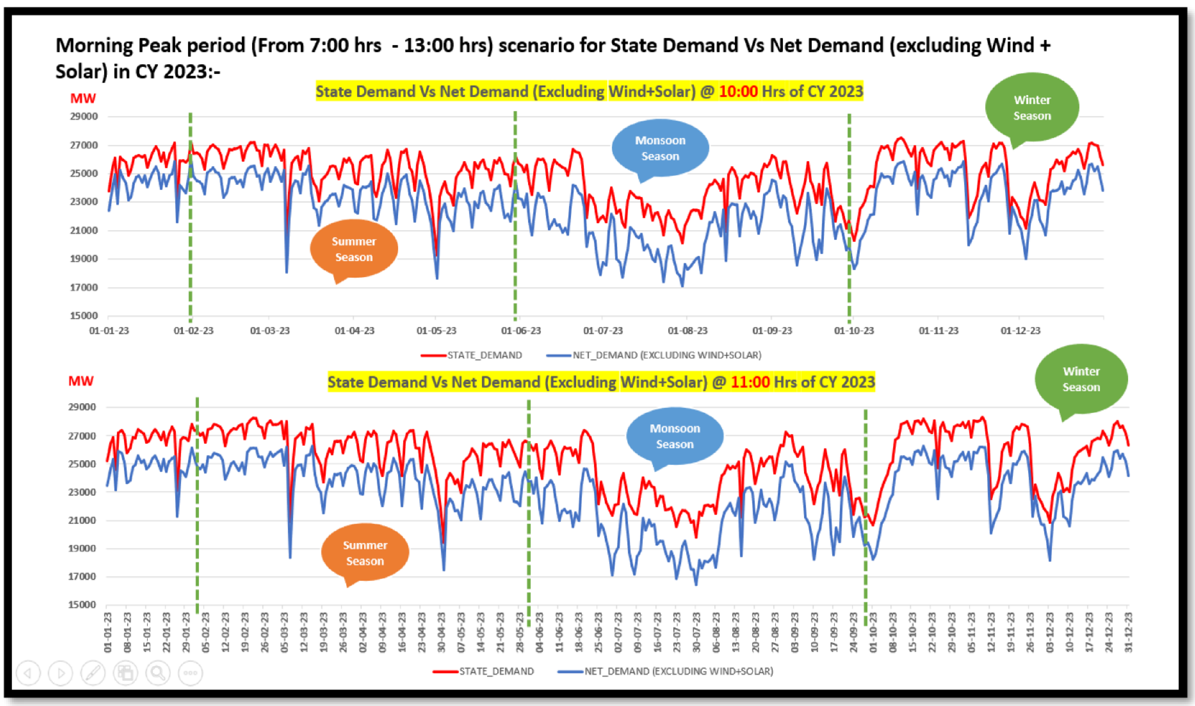


Figure 93: State Demand Vs Net Demand @ 10:00 Hrs and 11:00 Hrs in CY 2023

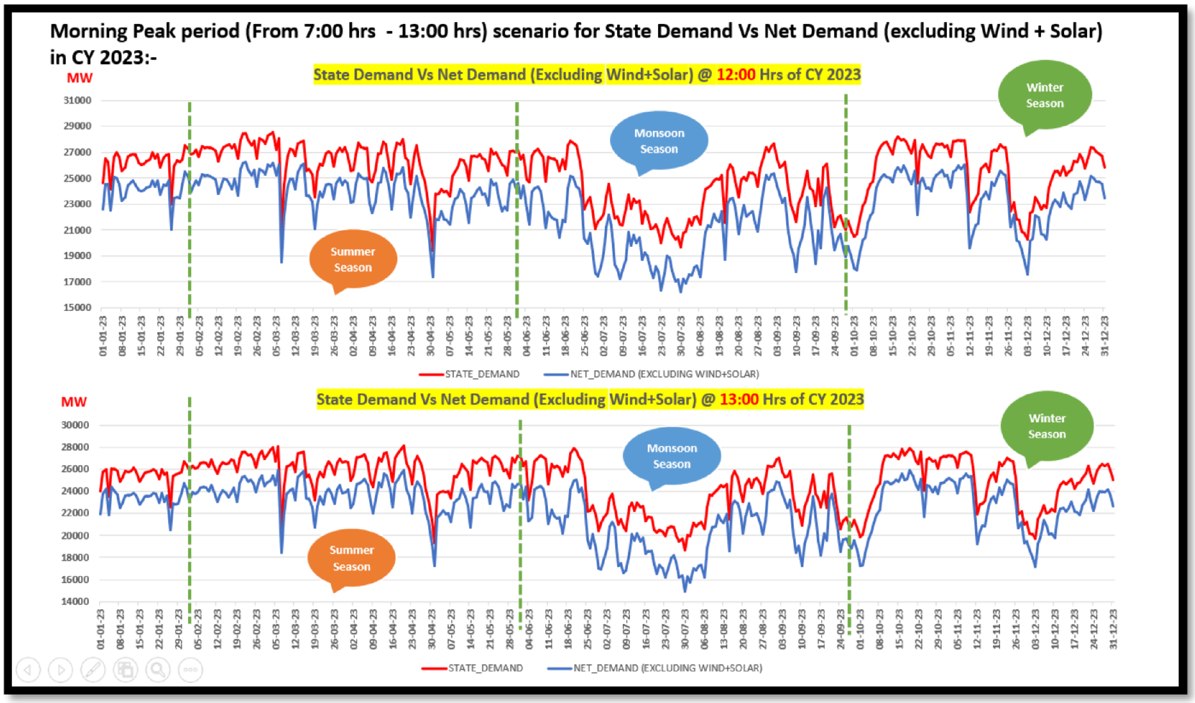


Figure 94: State Demand Vs Net Demand @ 12:00 Hrs and 13:00 Hrs in CY 2023

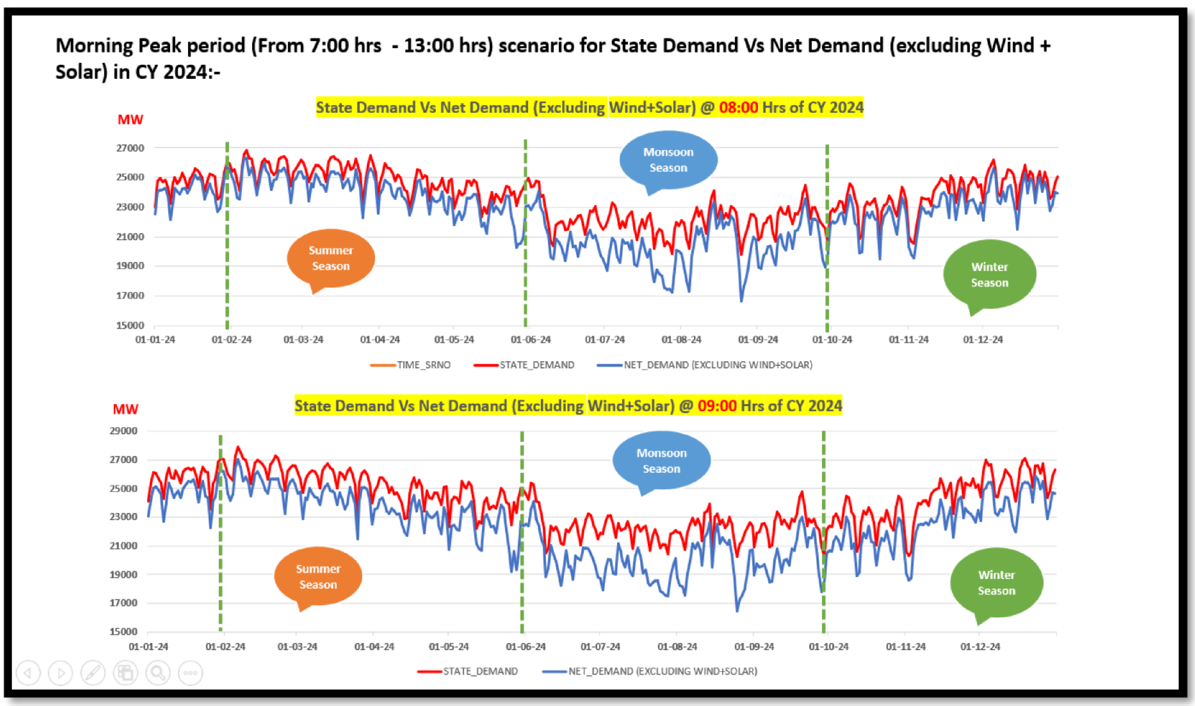


Figure 95: State Demand Vs Net Demand @ 08:00 Hrs and 09:00 Hrs in CY 2024

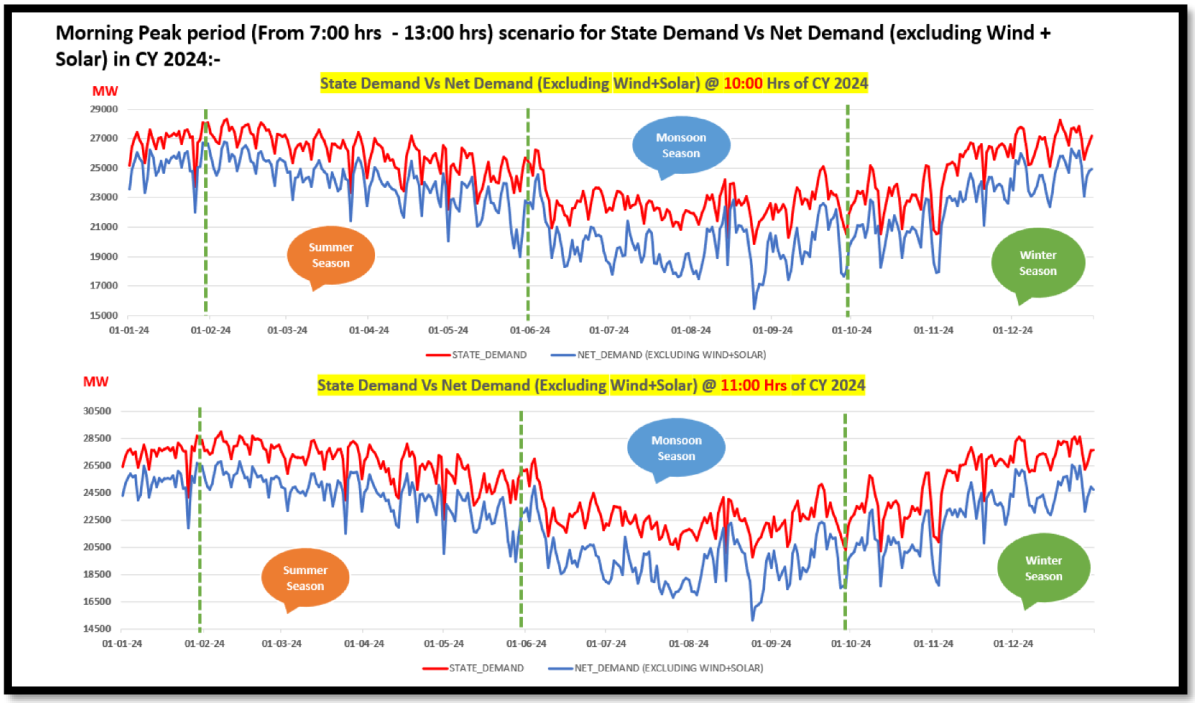


Figure 96: State Demand Vs Net Demand @ 10:00 Hrs and 11:00 Hrs in CY 2024

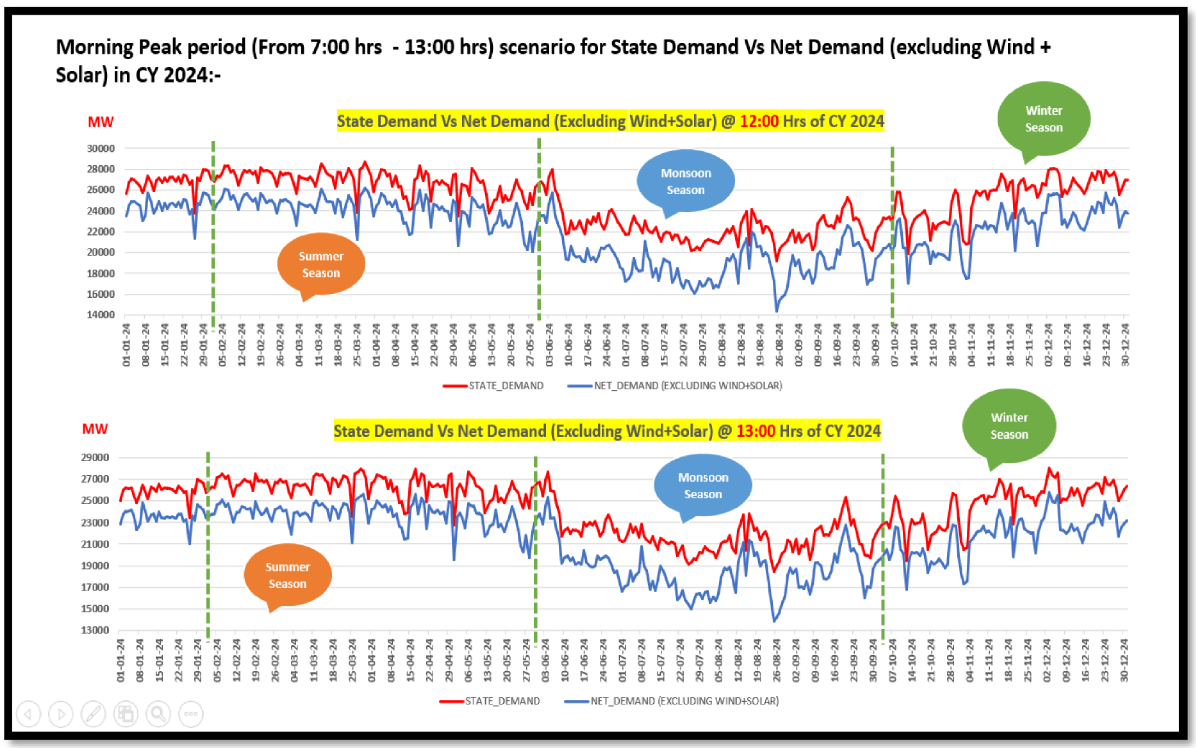


Figure 97: State Demand Vs Net Demand @ 12:00 Hrs and 13:00 Hrs in CY 2024

7.3 Evening Peak period (From 18:00 hrs - 22:00 hrs) scenario for State Demand Vs Net Demand in CY 2020-2024

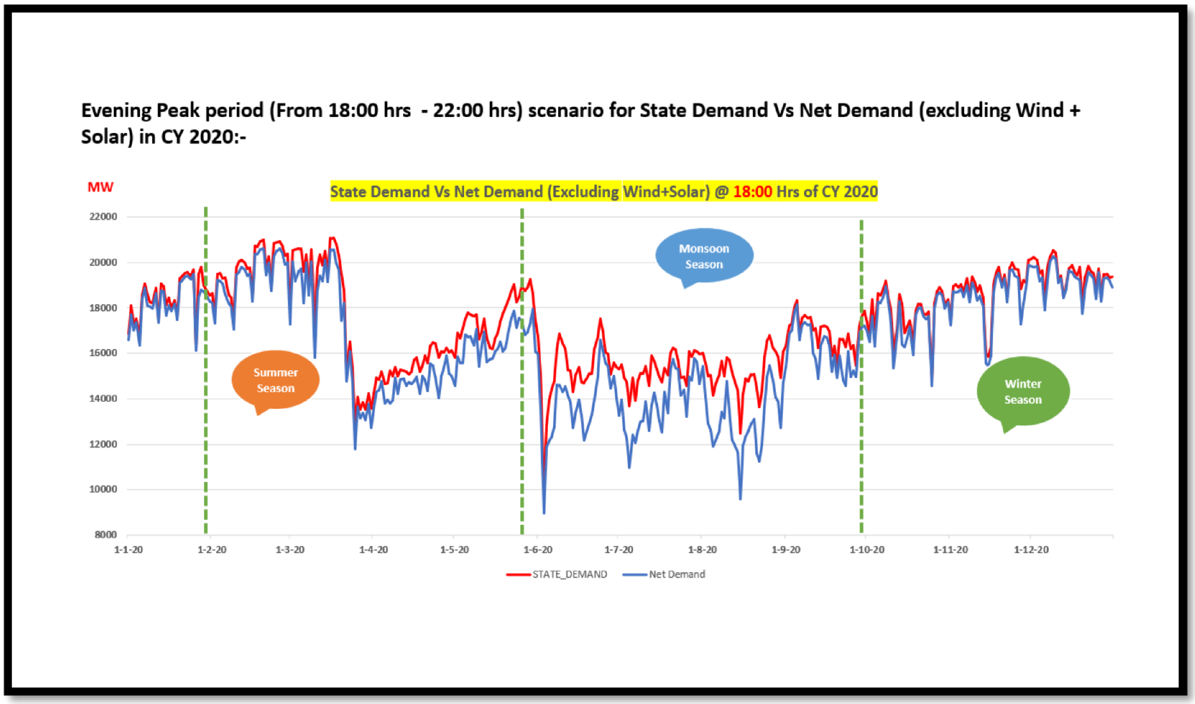


Figure 98: State Demand Vs Net Demand @ 18:00 Hrs in CY 2020

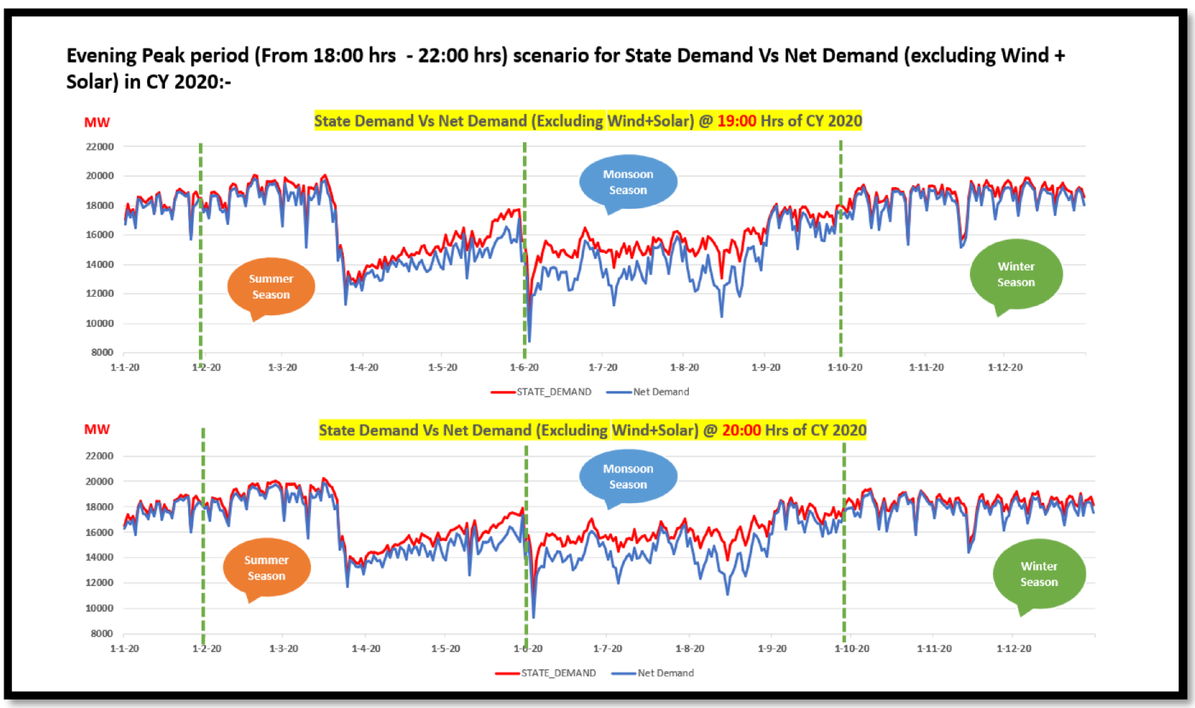


Figure 99: State Demand Vs Net Demand @ 19:00 Hrs and 20:00 Hrs in CY 2020

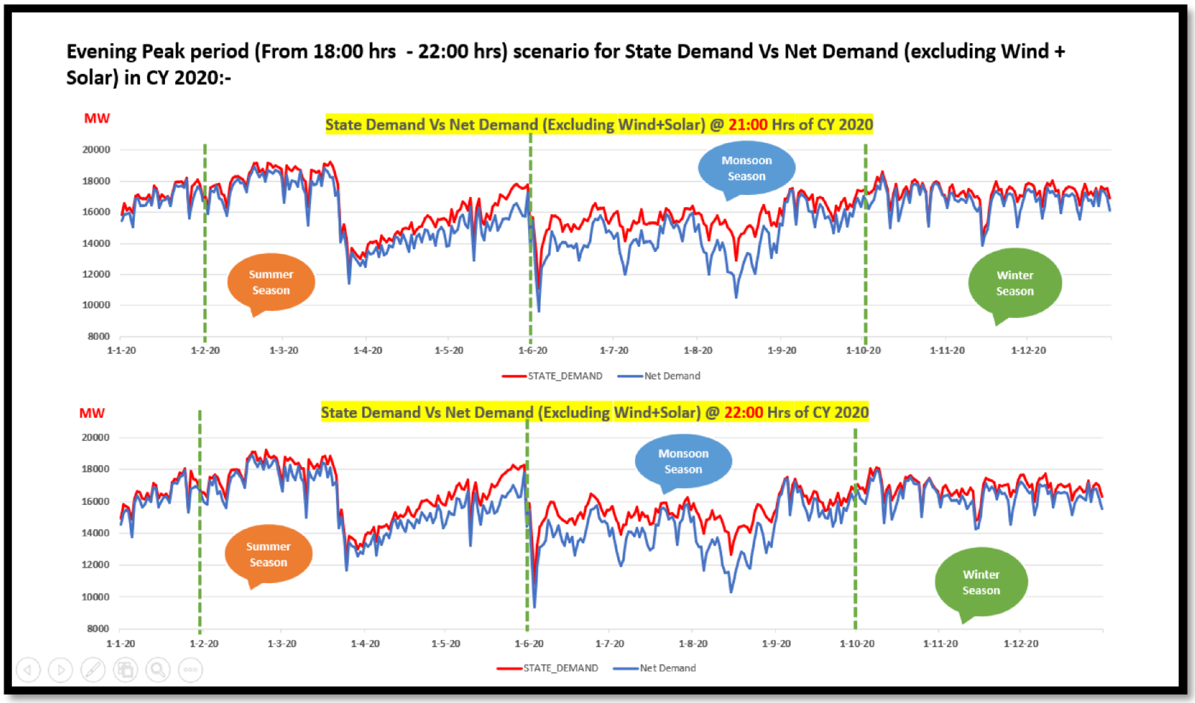


Figure 100: State Demand Vs Net Demand @ 21:00 Hrs and 22:00 Hrs in CY 2020

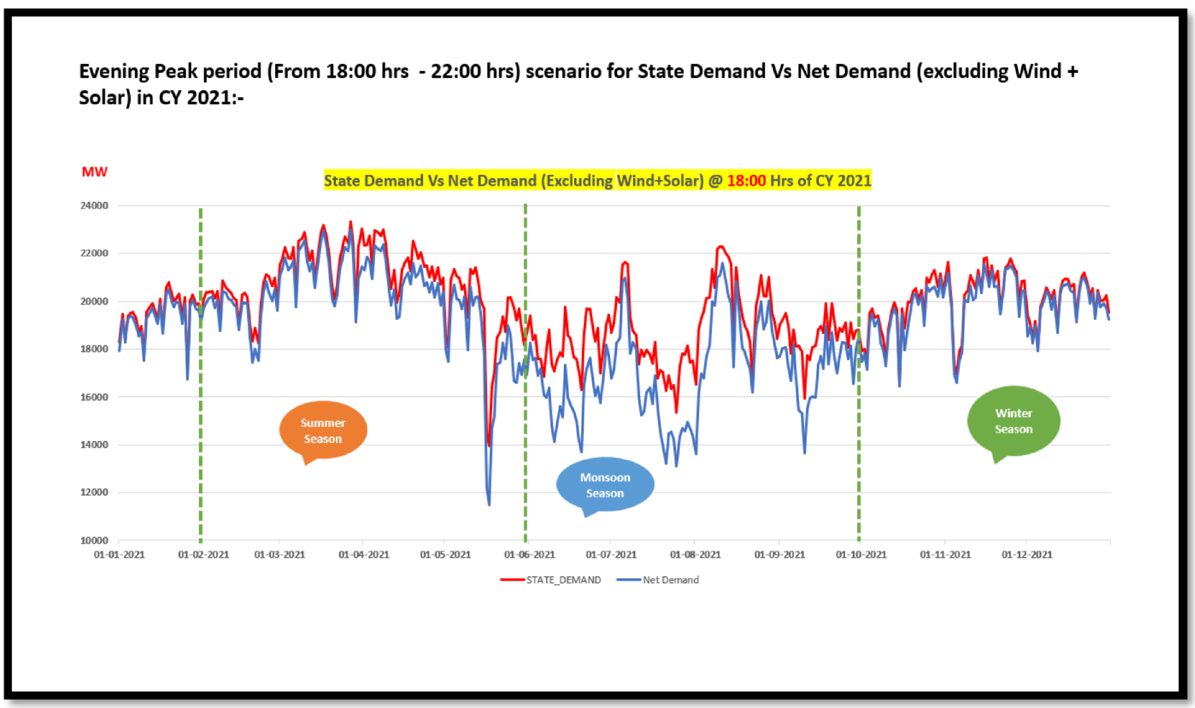


Figure 101: State Demand Vs Net Demand @ 18:00 Hrs in CY 2021

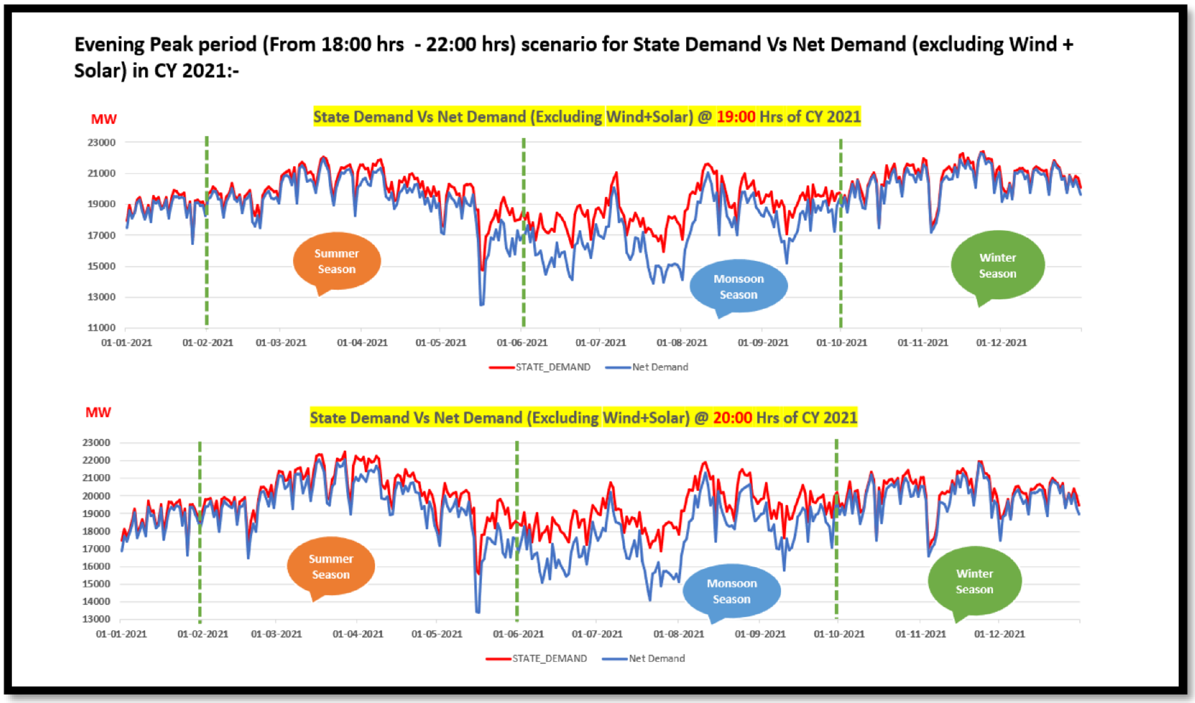


Figure 102: State Demand Vs Net Demand @ 19:00 Hrs and 20:00 Hrs in CY 2021

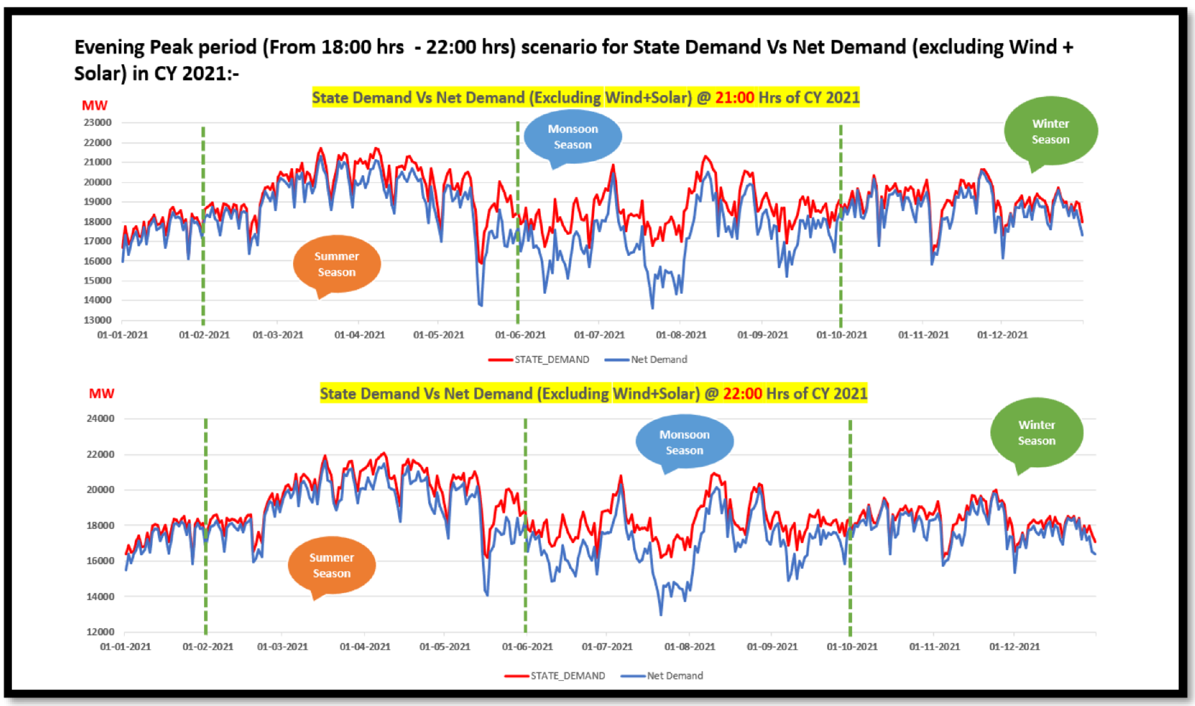


Figure 103: State Demand Vs Net Demand @ 21:00 Hrs and 22:00 Hrs in CY 2021

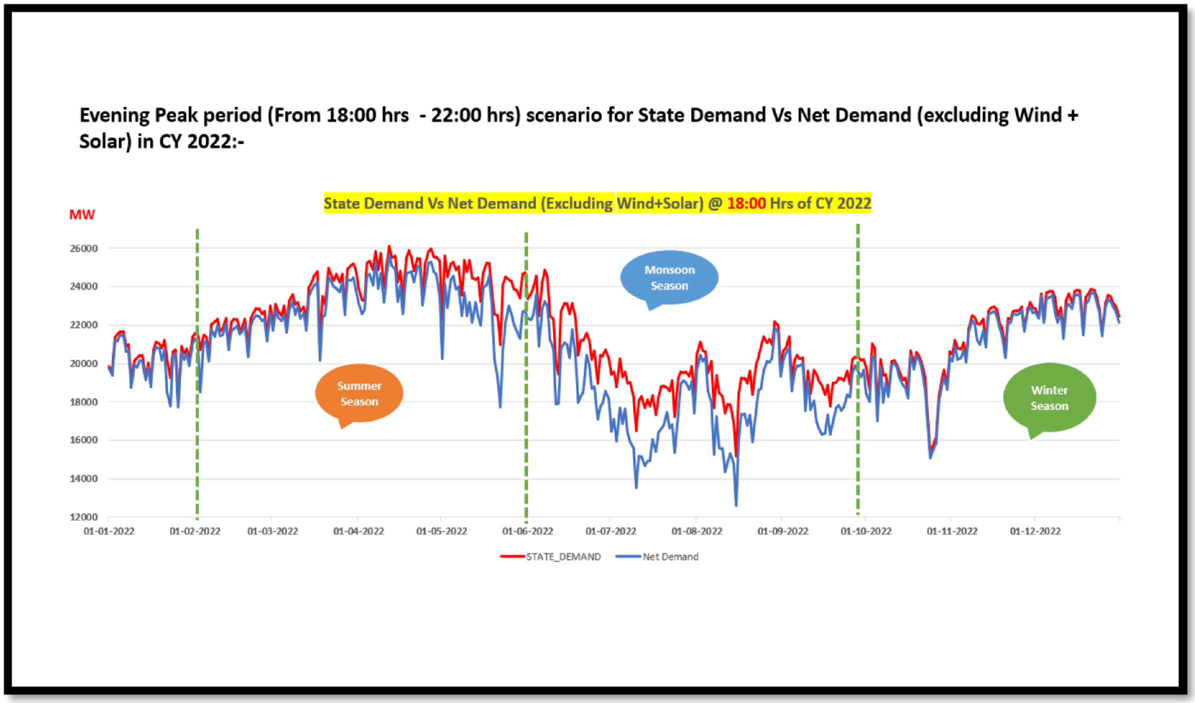


Figure 104: State Demand Vs Net Demand @ 18:00 Hrs in CY 2022

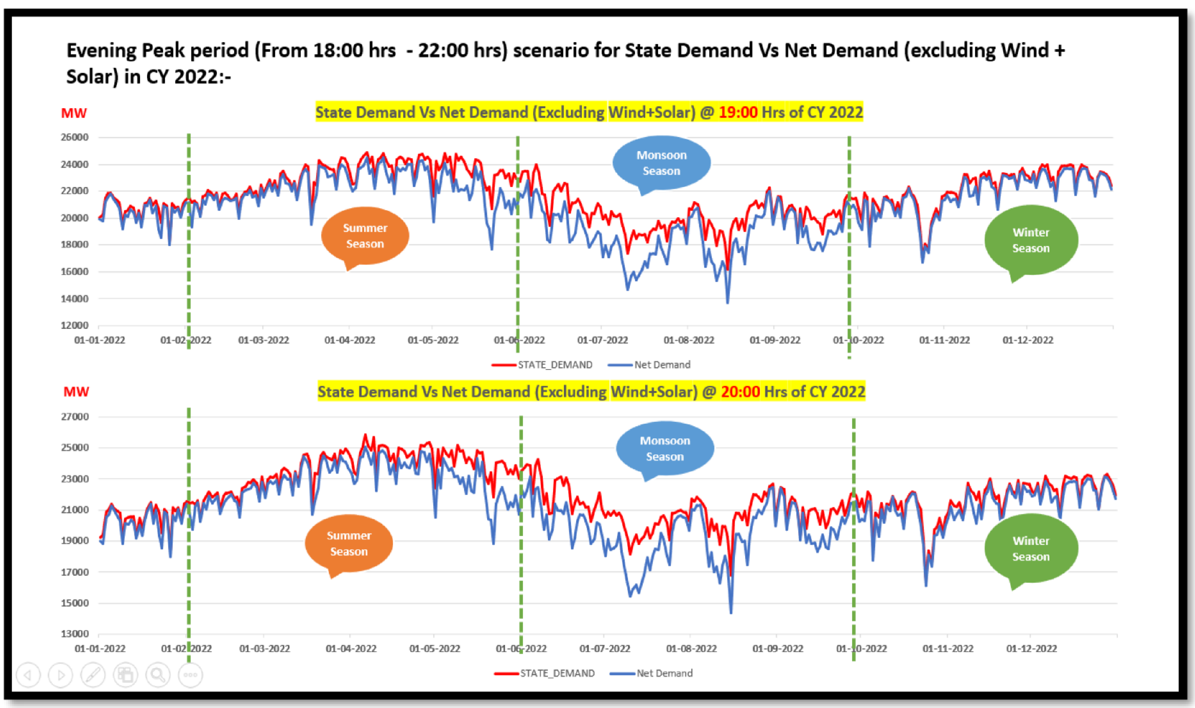


Figure 105: State Demand Vs Net Demand @ 19:00 Hrs and 20:00 Hrs in CY 2022

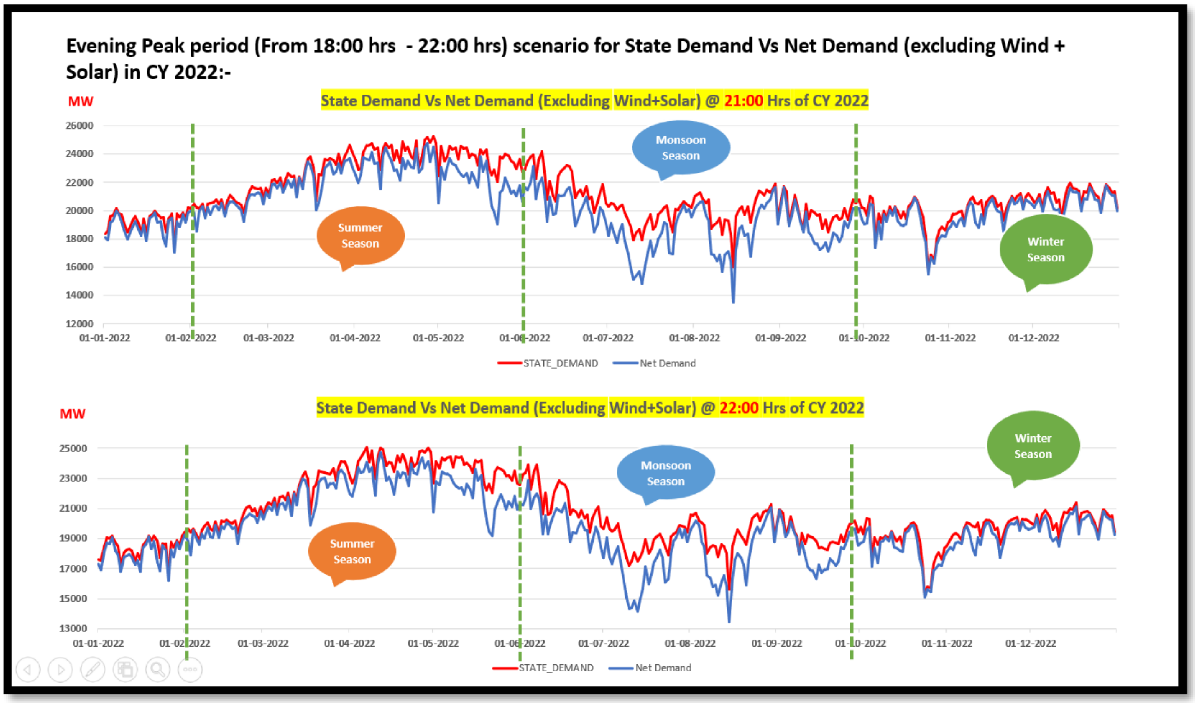


Figure 106: State Demand Vs Net Demand @ 21:00 Hrs and 22:00 Hrs in CY 2022

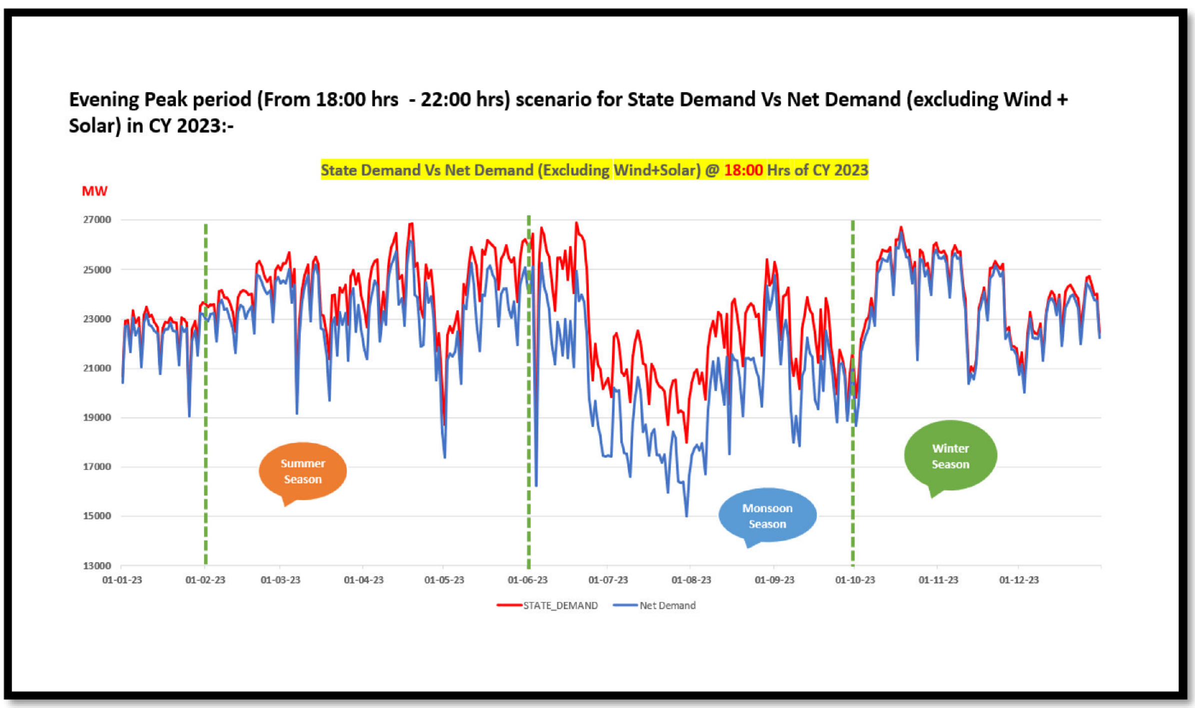


Figure 107: State Demand Vs Net Demand @ 18:00 Hrs in CY 2023

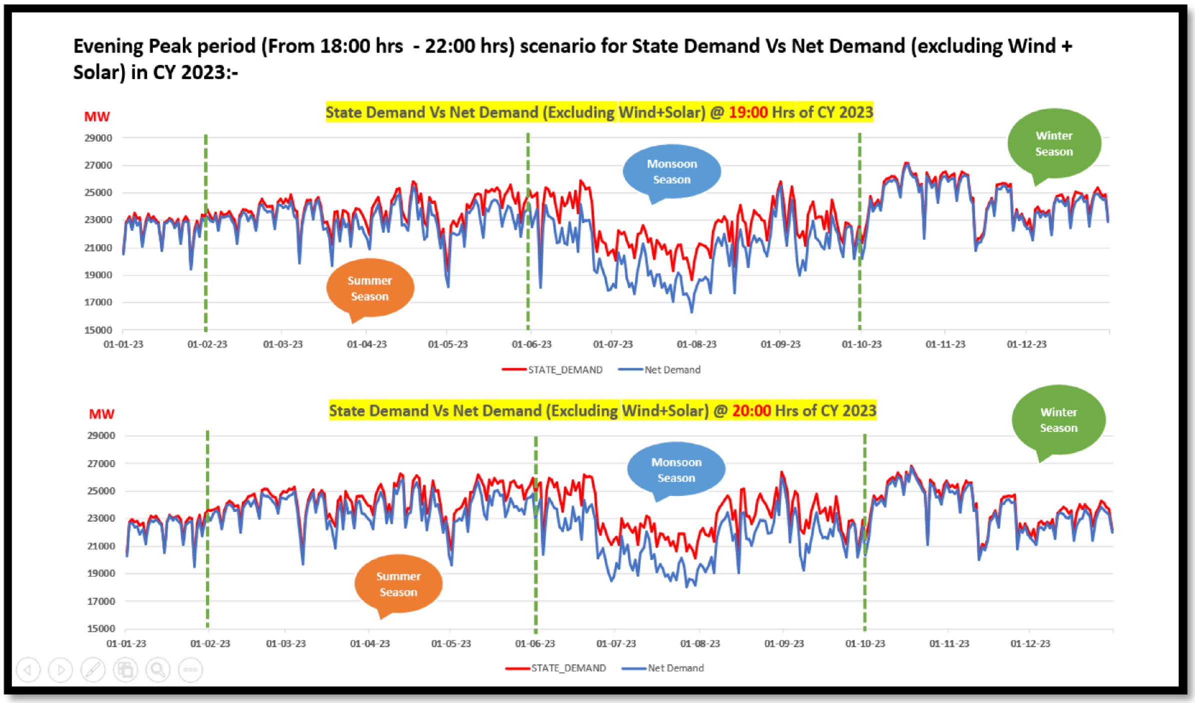


Figure 108: State Demand Vs Net Demand @ 19:00 Hrs and 20:00 Hrs in CY 2023

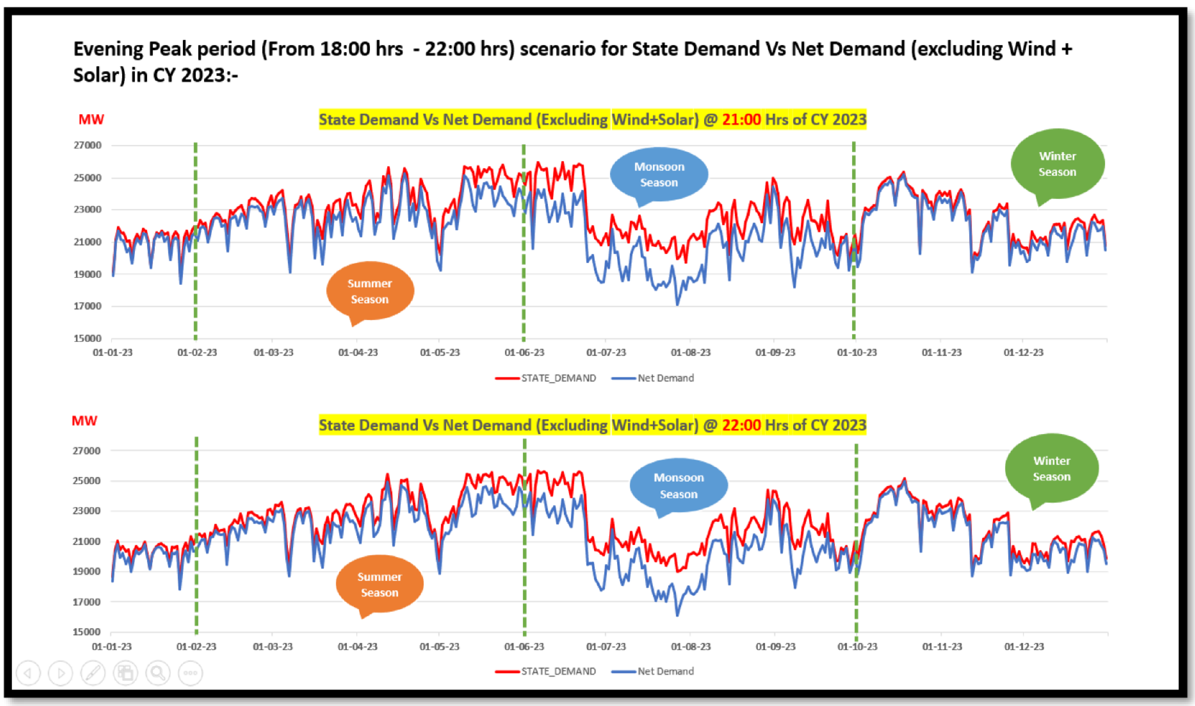


Figure 109: State Demand Vs Net Demand @ 21:00 Hrs and 22:00 Hrs in CY 2023

Evening Peak period (From 18:00 hrs - 22:00 hrs) scenario for State Demand Vs Net Demand (excluding Wind + Solar) in CY 2024:-

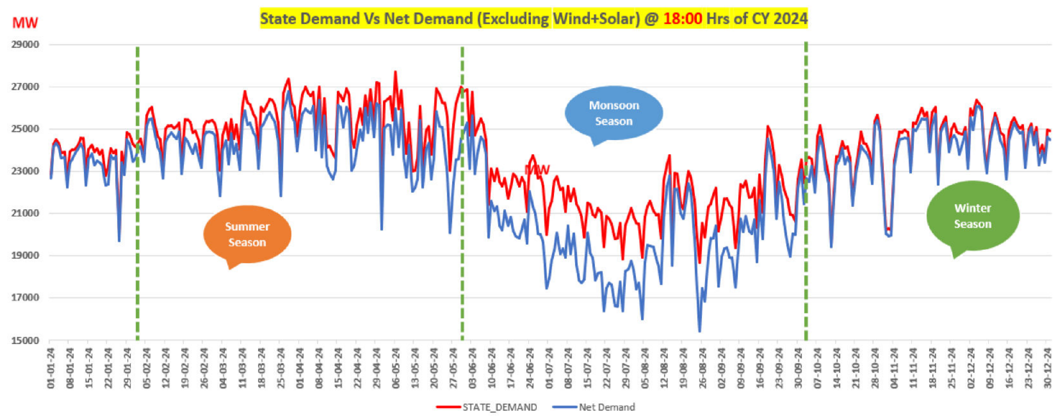
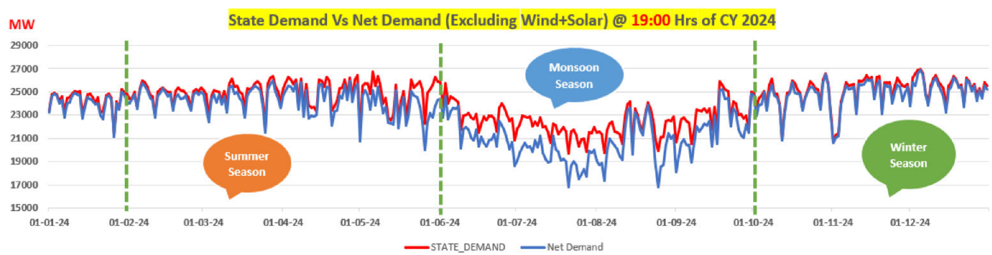


Figure 110: State Demand Vs Net Demand @ 18:00 Hrs in CY 2024

Evening Peak period (From 18:00 hrs - 22:00 hrs) scenario for State Demand Vs Net Demand (excluding Wind + Solar) in CY 2024:-



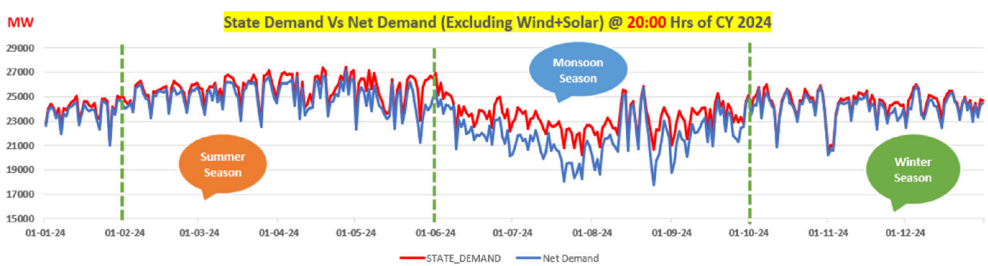
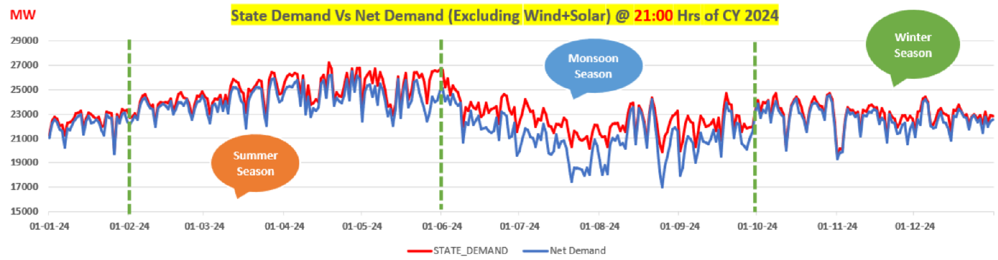


Figure 111: State Demand Vs Net Demand @ 19:00 Hrs and 20:00 Hrs in CY 2024

Evening Peak period (From 18:00 hrs - 22:00 hrs) scenario for State Demand Vs Net Demand (excluding Wind + Solar) in CY 2024:-



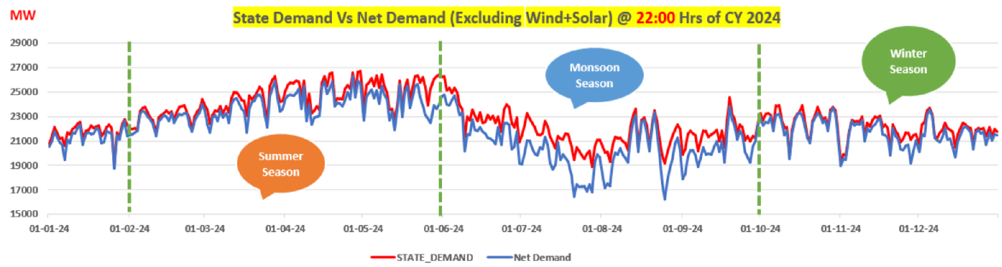


Figure 112: State Demand Vs Net Demand @ 21:00 Hrs and 22:00 Hrs in CY 2024

8. State Demand Ramp – Time Duration Curves (2015-2024)

8.1 Introduction

This chapter presents the State demand ramp which is computed as the difference in electricity demand between two consecutive hourly blocks. For example, the ramp at the 2nd hour represents the difference between the demand recorded at the 2nd hour and the 1st hour. This calculation is repeated across all hourly intervals throughout the day.

8.2 State Demand Ramp Time Duration Profiles from 2015 to 2024

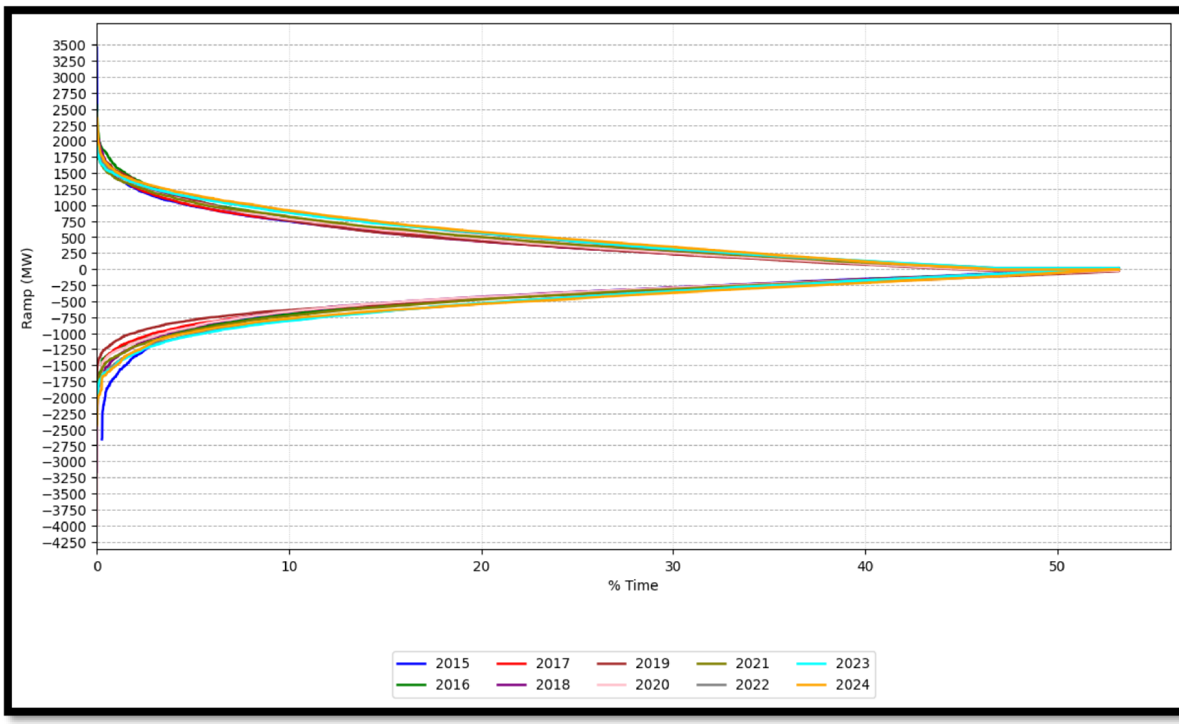


Figure 113: State Demand Ramp Time Duration Profiles from 2015 to 2024

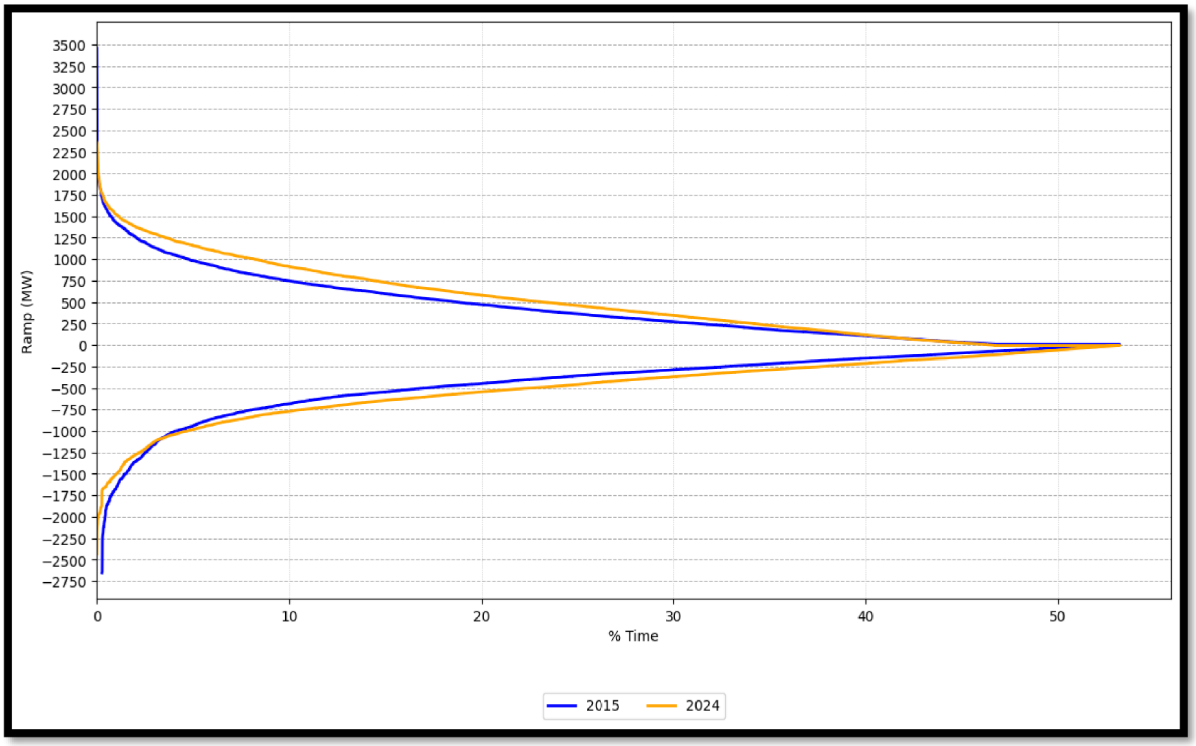


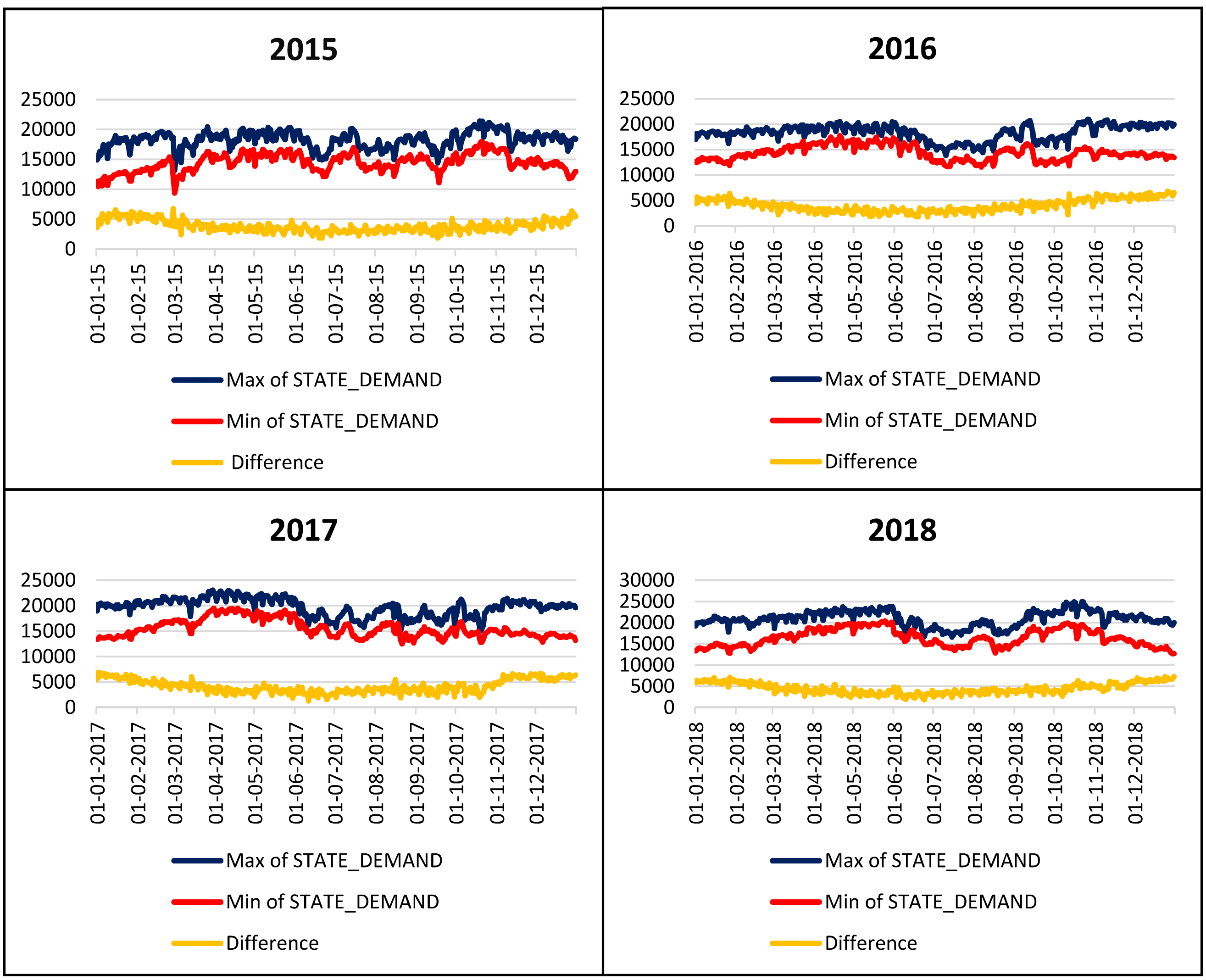
Figure 114: State Demand Ramp Time Duration Profile for 2015 & 2024

Demand ramp can be positive, indicating an increase in demand over the previous hour, or negative, indicating a decrease. The Figure 114 presents separate demand ramp curves for 2015 and 2024, distinctly illustrating positive and negative ramps. The curves indicate that the magnitude of hourly demand ramps in 2024 is higher compared to 2015.

9. Daily Maximum, Minimum - State Demand and their Difference

This chapter presents the daily maximum state demand, daily minimum state demand, and their difference profiles over the ten years (2015-2024). It also examines the yearly maximum and minimum of daily peaks, the yearly maximum and minimum of daily minimum demand, and the corresponding yearly differences. This chapter further explores the yearly maximum and yearly minimum of the daily demand difference and their corresponding delta, defined as the yearly difference, to capture variations in demand spread across years.

In Figure-115, the **daily maximum demand curve** indicates the highest demand recorded on each day, the **daily minimum demand curve** indicates the lowest demand recorded on the same day, and the **daily difference curve** represents the difference between these two values, indicating the **intra-day demand spread for each day** over the ten-year period.



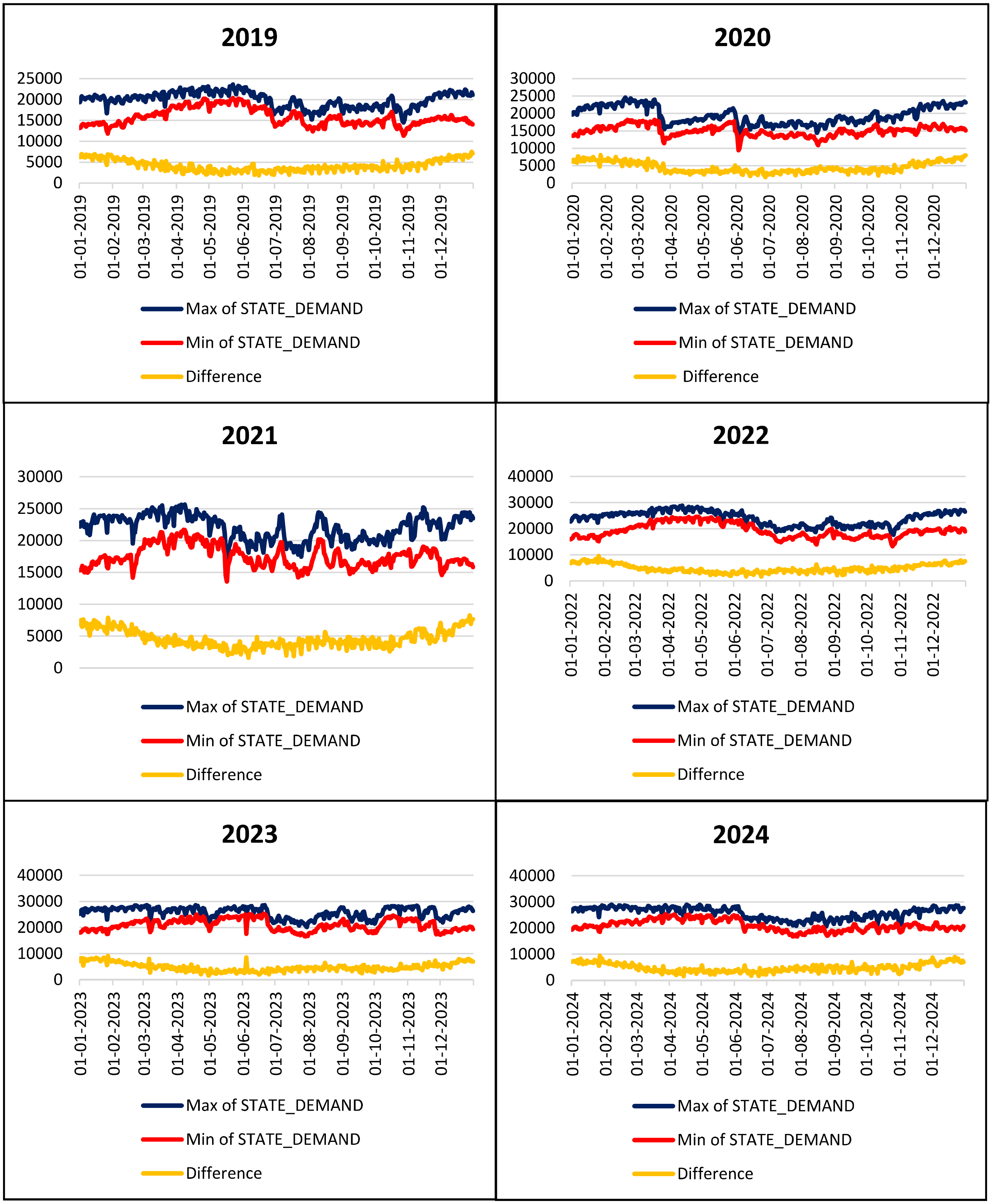
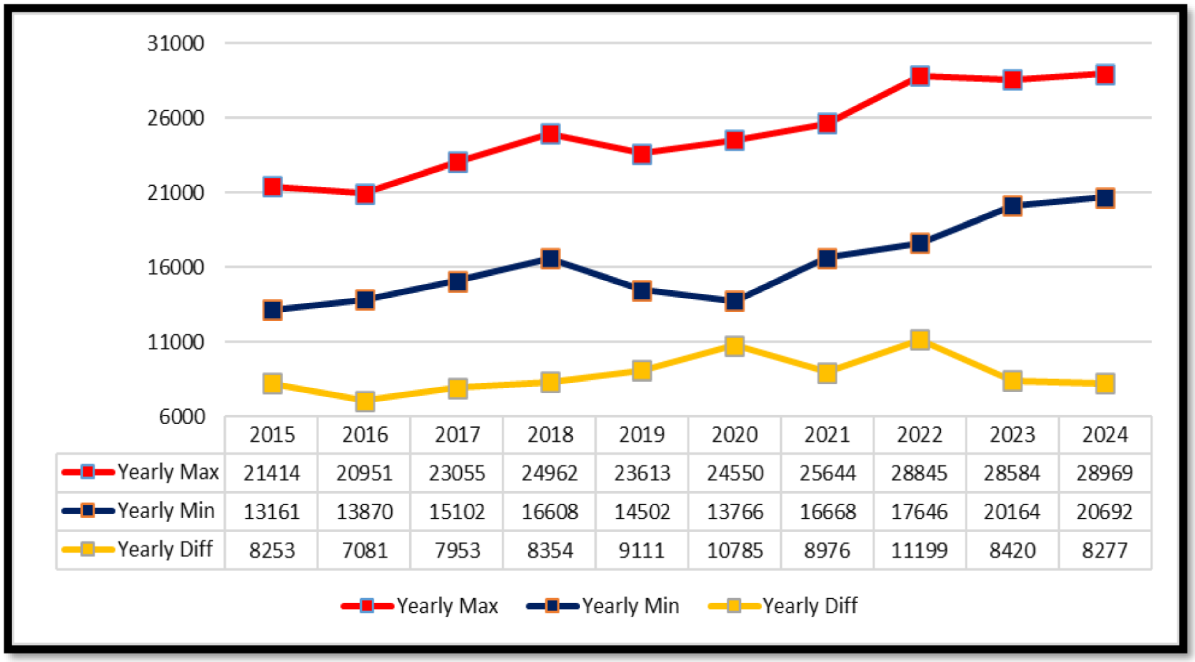


Figure 115: Daily Maximum, Minimum of State Demand & their Difference

- Rising minimum demand implies that more firm generation must remain on bar throughout the year.

9.1 Yearly Maximum, Minimum out of Daily peak Demand & their Difference



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Yearly Max	21414	20951	23055	24962	23613	24550	25644	28845	28584	28969
Yearly Min	13161	13870	15102	16608	14502	13766	16668	17646	20164	20692
Yearly Diff	8253	7081	7953	8354	9111	10785	8976	11199	8420	8277

Figure 116: Yearly Maximum, Minimum out of Daily peak Demand & their Difference

9.1.1 Yearly Maximum of Daily Peaks

Yearly Maximum (out of daily peaks) represents:

- The **highest observed daily peak demand** in a given year.
- The **absolute maximum load** the power system had to serve in a given year.
- The maximum demand has shown a **steady upward trend** over the decade. It increased from **21,414 MW** in 2015 to **28,969 MW** in 2024. This corresponds to a **growth of approximately 35.3%**.

9.1.2 Yearly Minimum of Daily Peaks

Yearly Minimum (out of daily peaks) represents:

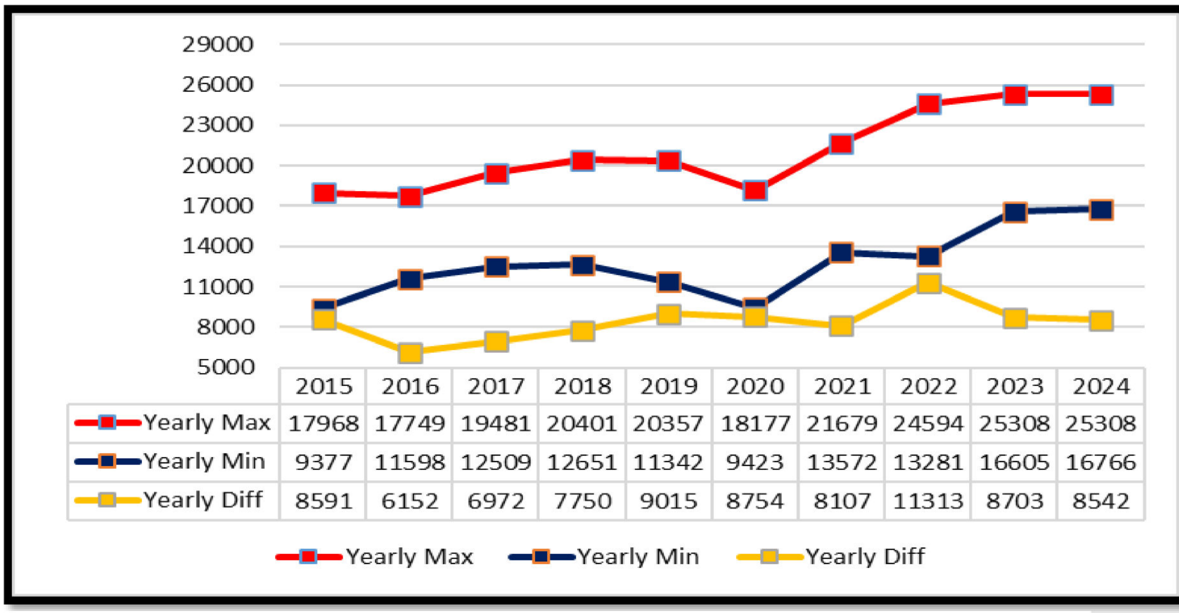
- The **lowest observed daily peak demand** in a given year.
- The minimum demand has increased from **13,161 MW** in 2015 to **20,692 MW** in 2024. This represents a **57.2% increase**, indicating a rise in base-load consumption.

9.1.3 Yearly Difference [Yearly Max of Daily Peaks - Yearly Min of Daily Peaks]

Yearly Difference represents:

- The spread between the highest and lowest daily peaks within a year.
- Indicates the **demand spread** the system experiences across a year.

9.2 Yearly Maximum, Minimum out of Daily Minimum Demand & their Difference



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Yearly Max	17968	17749	19481	20401	20357	18177	21679	24594	25308	25308
Yearly Min	9377	11598	12509	12651	11342	9423	13572	13281	16605	16766
Yearly Diff	8591	6152	6972	7750	9015	8754	8107	11313	8703	8542

Figure 117: Yearly Maximum, Minimum out of Daily Minimum Demand & their Difference

The Figure-117 illustrates the yearly maximum, minimum, and variability of daily minimum demand from 2015 to 2024. These indicators highlight how the system’s base load has evolved, providing insights into the lowest demand levels and their implications for power system planning and operation.

9.2.1 Yearly Maximum (of daily minimums):

- The *highest observed daily minimum demand* in a year.
- Shows the **heaviest base load condition** during the year
- The **maximum value out of daily minimum demand** shows an overall upward trajectory across the decade.
- It rose from **17,968 MW in 2015** to **25,308 MW in 2024**, representing a growth of approximately **+40.8%**.

9.2.2 Yearly Minimum of Daily Minimums

Yearly Minimum (of daily minimums):

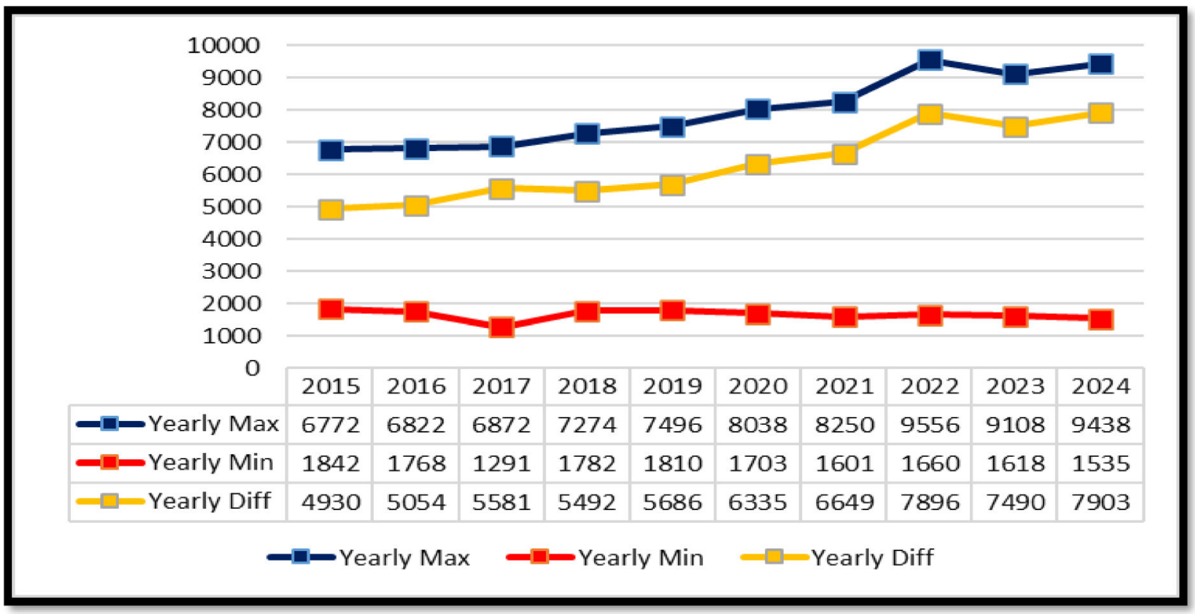
- The *lowest observed daily minimum demand* in a year.
- Represents the **absolute lowest load point** experienced by the grid.
- The **minimum of daily minimum demands** also increased from **9,377 MW in 2015** to **16,766 MW in 2024**, marking a **+78.8% growth**.

9.2.3 Yearly Difference [Yearly Max of Daily Minimum– Yearly Min of daily Minimum]

Yearly Difference:

- Range between the highest and lowest daily minimums in a year.
- Indicates **variation in the base load profile over a year**.
- Overall, the difference slightly reduced from **8,591 MW in 2015** to **8,542 MW in 2024**.

9.3 Yearly Maximum, Minimum out of Daily Difference



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Yearly Max	6772	6822	6872	7274	7496	8038	8250	9556	9108	9438
Yearly Min	1842	1768	1291	1782	1810	1703	1601	1660	1618	1535
Yearly Diff	4930	5054	5581	5492	5686	6335	6649	7896	7490	7903

Figure 118: Yearly Maximum, Minimum out of Daily Difference

Daily Difference (for a given day):

- The difference between daily peak demand observed on a given day and daily minimum demand on the same day.
- It shows **intra-day demand spread.**

9.3.1 Yearly Maximum of Daily Differences

Yearly Maximum (out of daily differences):

- It indicates highest intra-day demand spread in a given year
- It increased from **6,772 MW in 2015** to **9,438 MW in 2024**, reflecting a **+39.4% growth** over the decade.

9.3.2 Yearly Minimum of Daily Differences

Yearly Minimum (of daily differences):

- The **smallest** intra-day demand spread observed in the year.
- The **minimum daily difference** started at **1,842 MW in 2015** and ended at **1535 MW in 2024**, showing % decline of 16.7%.

9.3.3 Yearly Difference [Yearly Max of Daily Difference – Yearly Min of Daily Difference]

- **Yearly Difference (Max – Min of daily differences):**
    - It represents the range of intra-day variability across the year.
    - It shows **how much the intra-day demand spread itself fluctuates year to year**.
- The spread (difference between yearly max and min of daily differences) has grown from **4,930 MW in 2015** to **7,903 MW in 2024**, a rise of **+60.3%**.

10. Quarter-wise Daily Peak State Demand Profiles

10.1 Introduction

This topic presents the quarter-wise daily peak state demand (MW) patterns observed from 2015 to 2024. Each graph represents daily peak values for a respective quarter—Q1 (Jan–Mar), Q2 (Apr–Jun), Q3 (Jul–Sep), and Q4 (Oct–Dec).

10.2 Daily Peak Demand Profile from Q1 to Q4

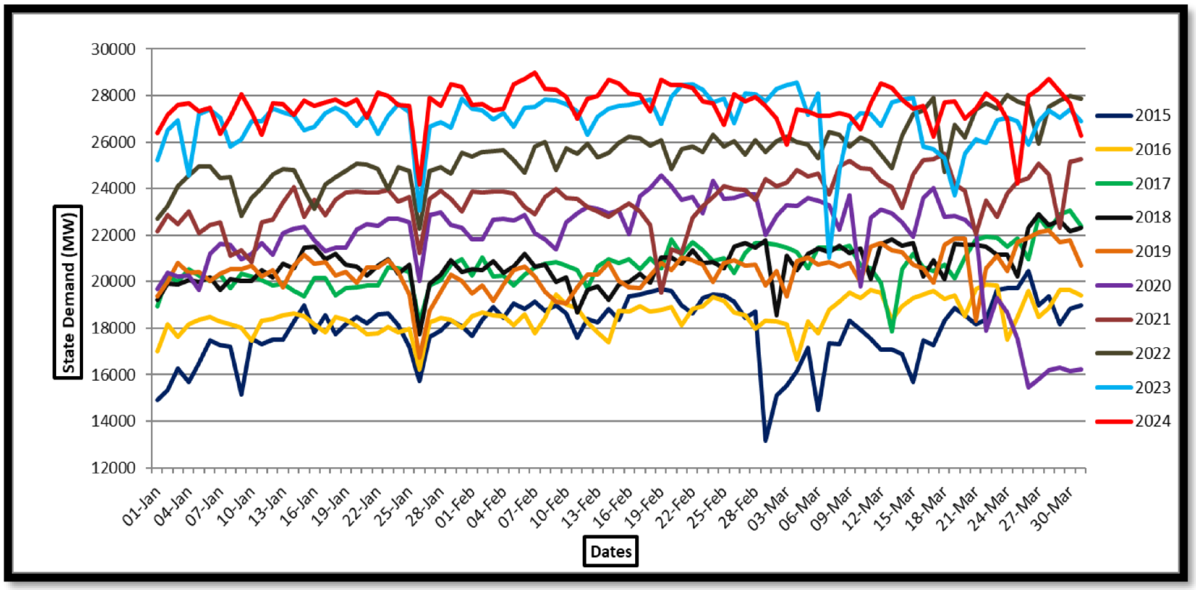


Figure 119: Daily Peak Demand Profile for Q1 [Jan-March]

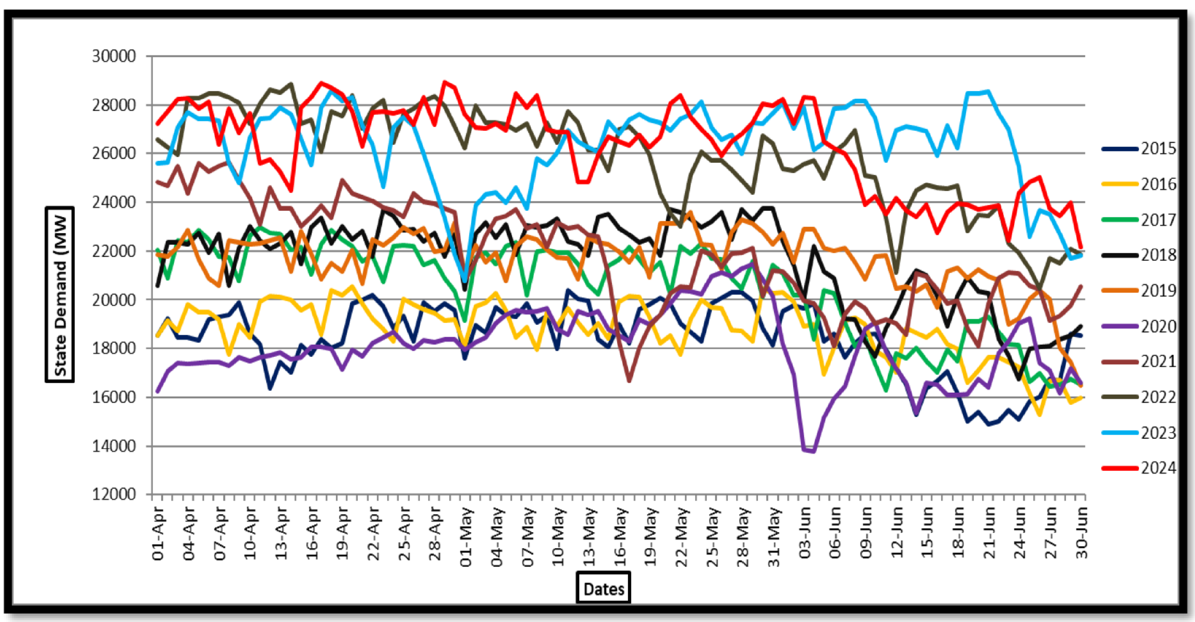


Figure 120: Daily Peak Demand Profile for Q2 [Apr-June]

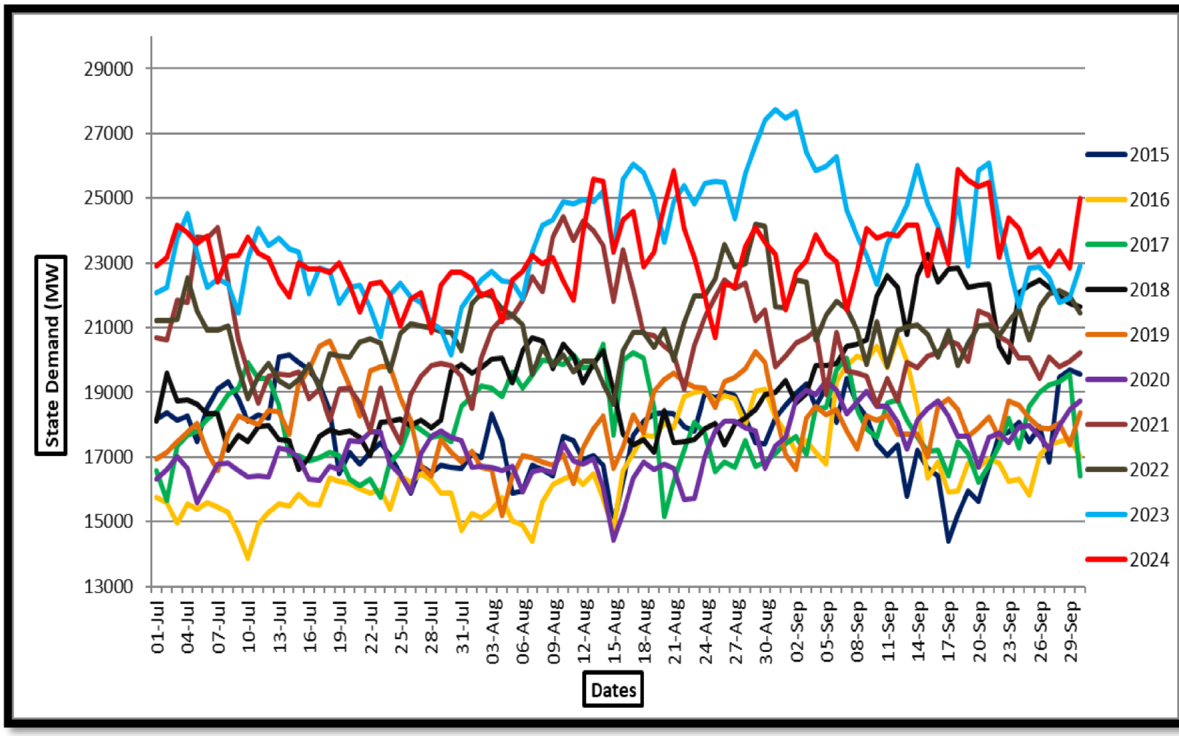


Figure 121: Daily Peak Demand Profile for Q3 [Jul-Sep]

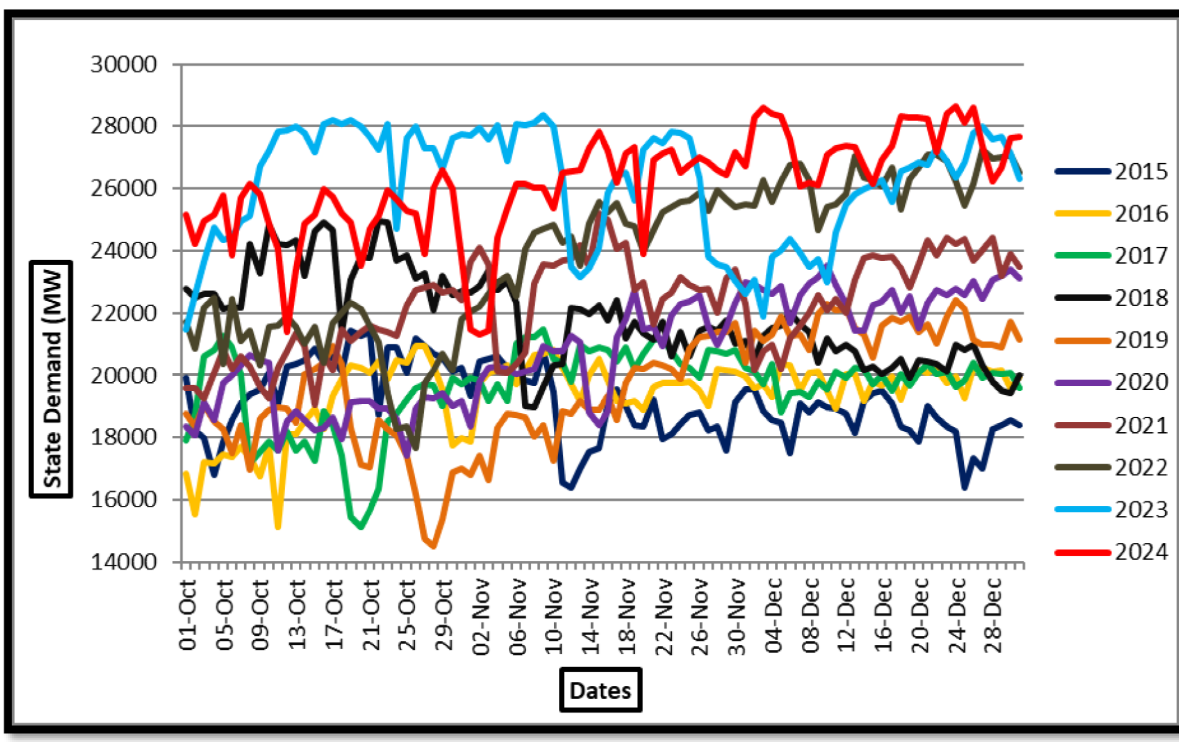


Figure 122: Daily Peak Demand Profile for Q4 [Oct-Dec]

Table 12: Quarter wise demand Bandwidth

Quarter	**Months**	**Minimum Daily Peak (MW)**	**Maximum Daily Peak (MW)**	**Demand Bandwidth in each Quarter (MW)**
Q1	Jan–Mar	13,161 *(01.03.2015)*	28,969 *(07.02.2024)*	15,808
Q2	Apr–Jun	13,766 *(04.06.2020)*	28,924 *(29.04.2024)*	15,158
Q3	Jul–Sep	13,870 *(10.07.2016)*	27,746 *(31.08.2023)*	13,876
Q4	Oct–Dec	14,502 *(28.10.2019)*	28,632 *(24.12.2024)*	14,130

The above table and quarter-wise peak demand profiles (Fig.27-30) indicate that Q1 and Q2 have the largest demand spread. Q3 shows the lowest demand spread, while Q4 lies between these extremes with moderate spread. The minimum and maximum daily peak values within each quarter occur on different days, months, and year of the respective quarter, as evident from the spread observed in the quarter-wise profiles.

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11. Hourly Occurrences of Daily Peak Demand (2015 - 2024)

11.1 Introduction

This topic presents behavior of **daily peak demand occurrences** segmented on hourly basis from the year **2015 to 2024**. The 24-hour day is divided into 24 one-hour blocks, starting from 00:00–01:00 (Block 1) to 23:00–24:00 (Block 24).

11.2 Key Observations

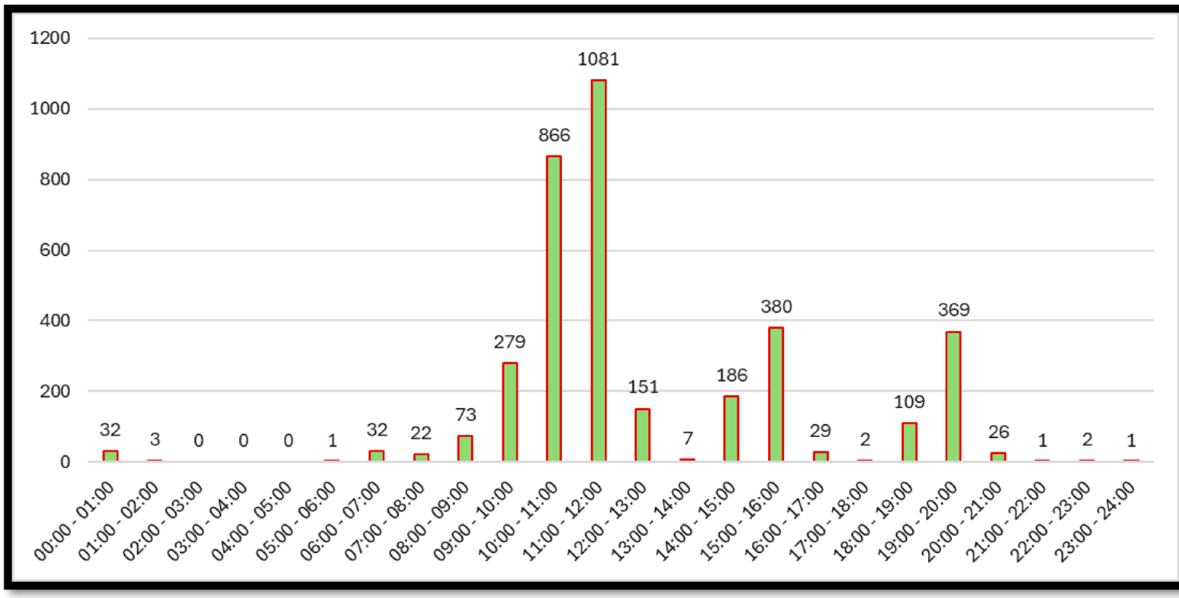

Figure 123: Daily Peak Demand Occurrences per Hourly Block (2015 - 2024)

- The **11:00–12:00** block (**Block 12**) reported the **maximum peak demand occurrences — 1081 times**, accounting for **29.60%** of all recorded peak instances (Figure 123)
- The **10:00–11:00** block (**Block 11**) follows, with **866 occurrences** making up **23.71%** of total occurrences.
- The **15:00–16:00** (Block 16), **20:00–21:00** (Block 21), and **13:00–14:00** (Block 14) also show significant contributions to daily peak demand occurrences.
- Peak demand during **night hours (00:00–06:00)** is minimal and nearly negligible in terms of percentage contribution (<1% for each).

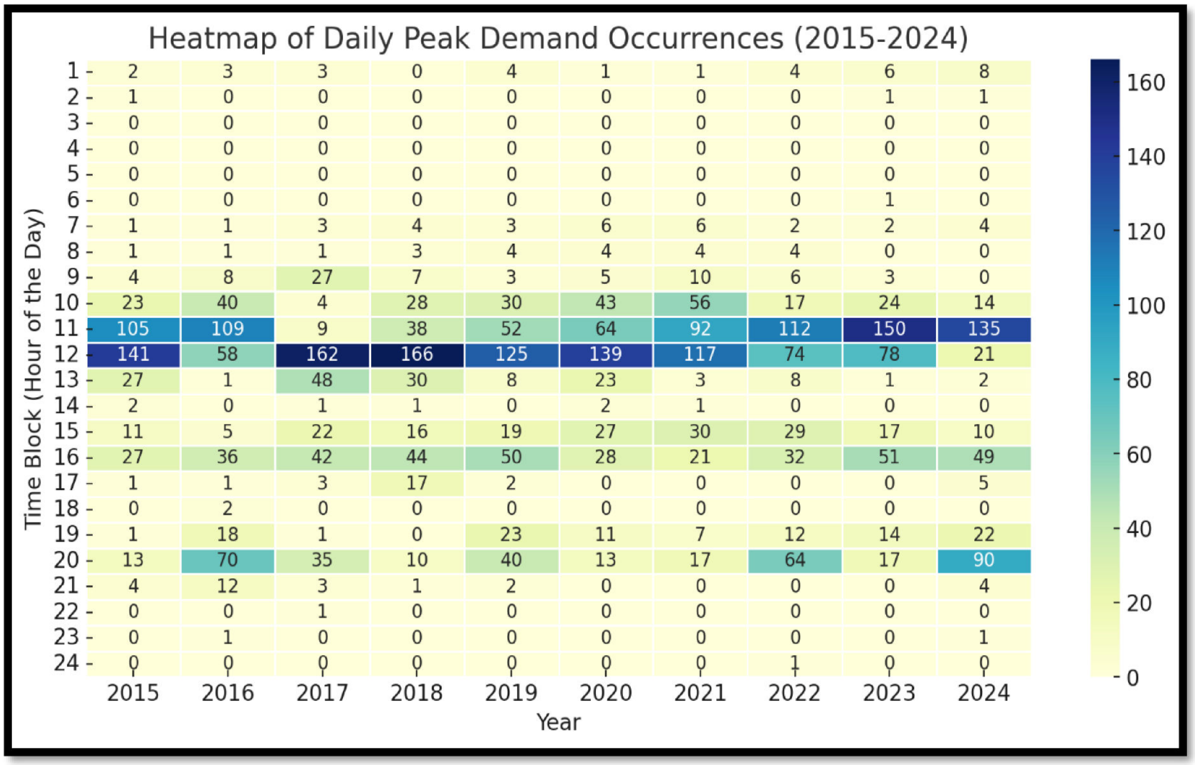

Figure 124: Heatmap of Daily Peak Occurrences (2015-2024)

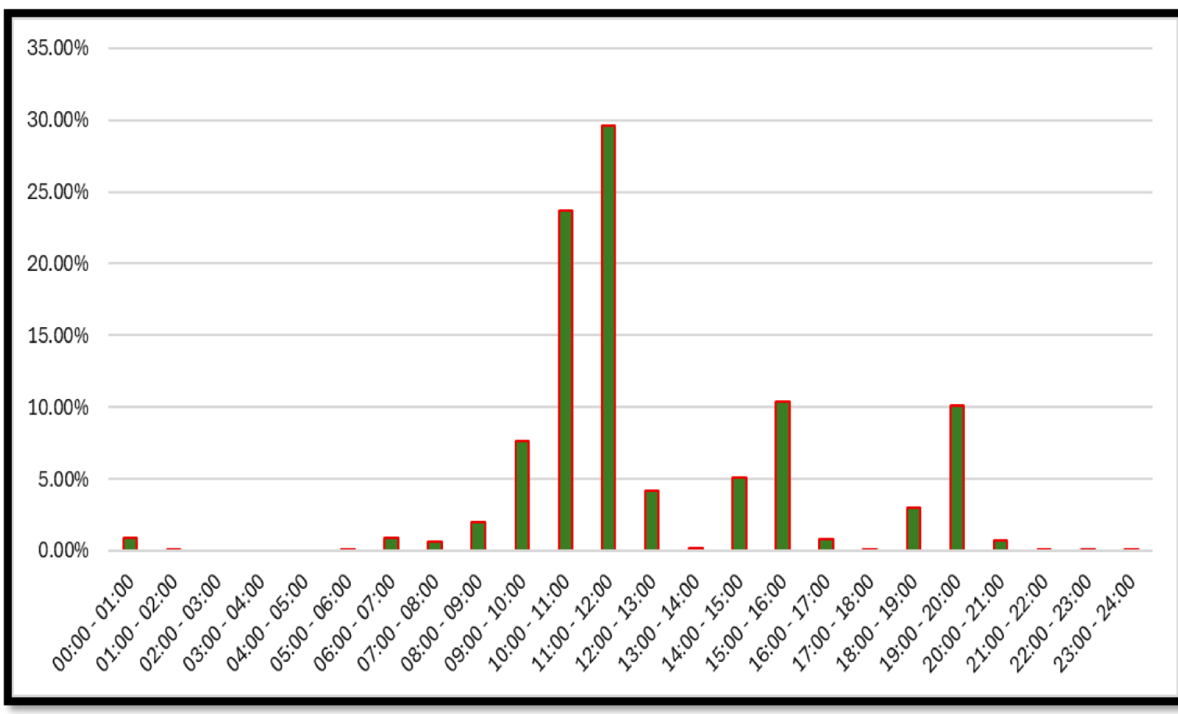

Figure 125: Peak Demand Occurrences (in %) per Hourly Block from 2015 to 2024

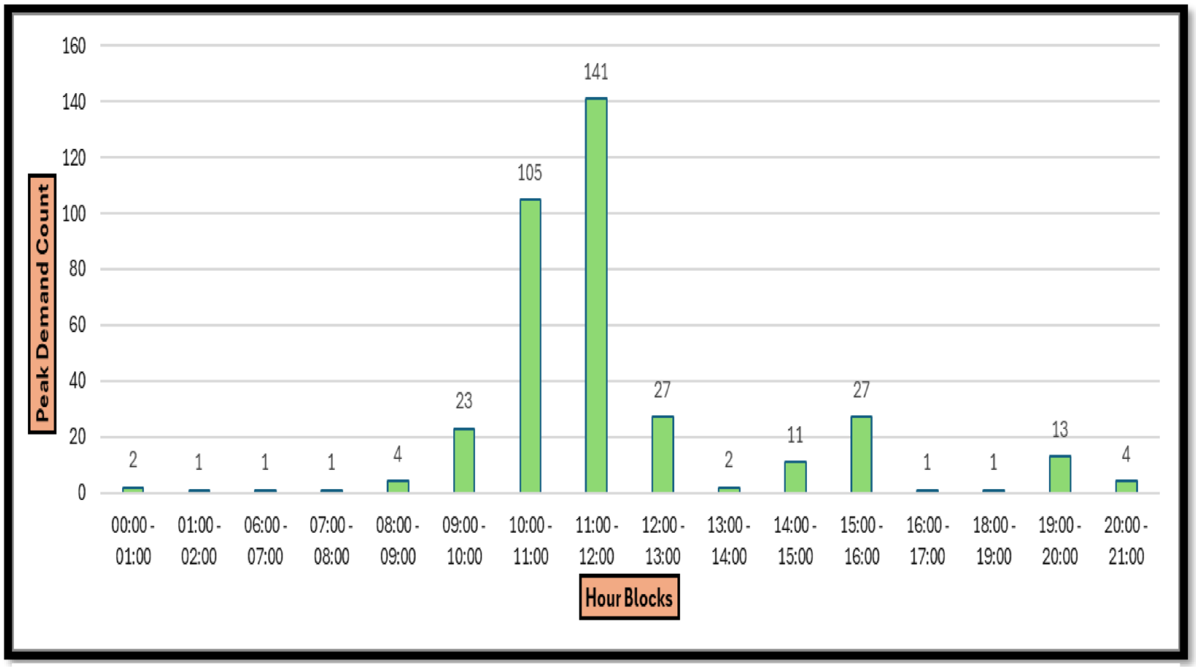

Figure 126: Daily Peak Demand Occurrences per Hourly block (2015)

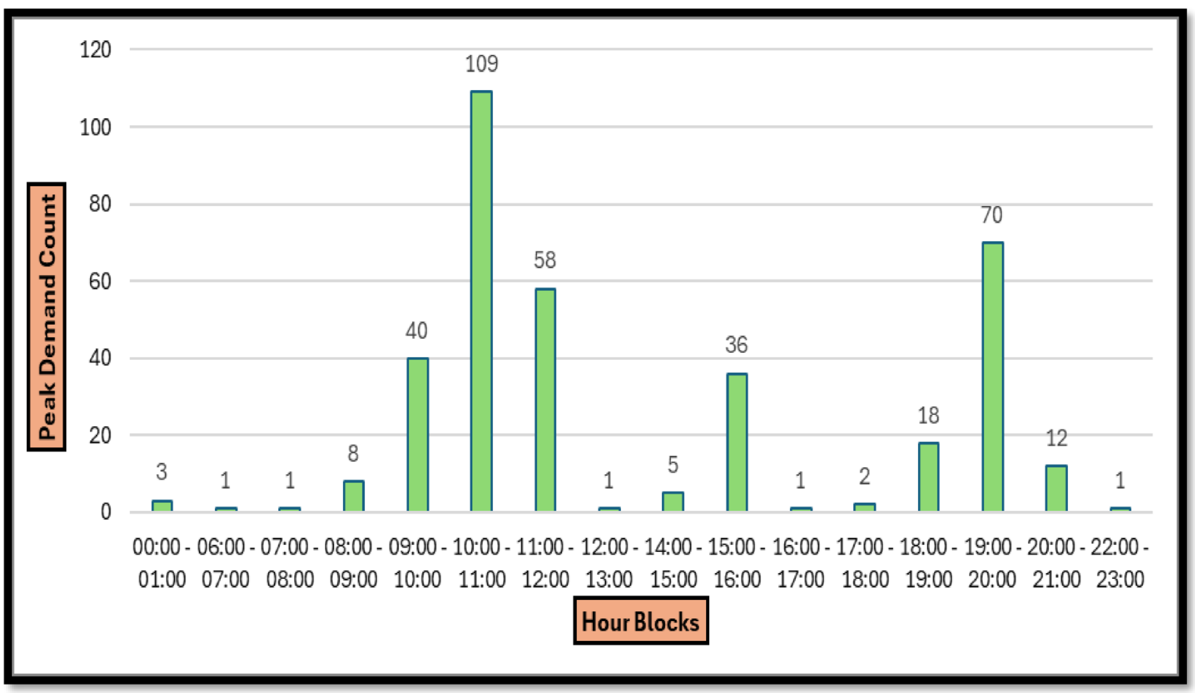

Figure 127: Daily Peak Demand Occurrences per Hourly block (2016)

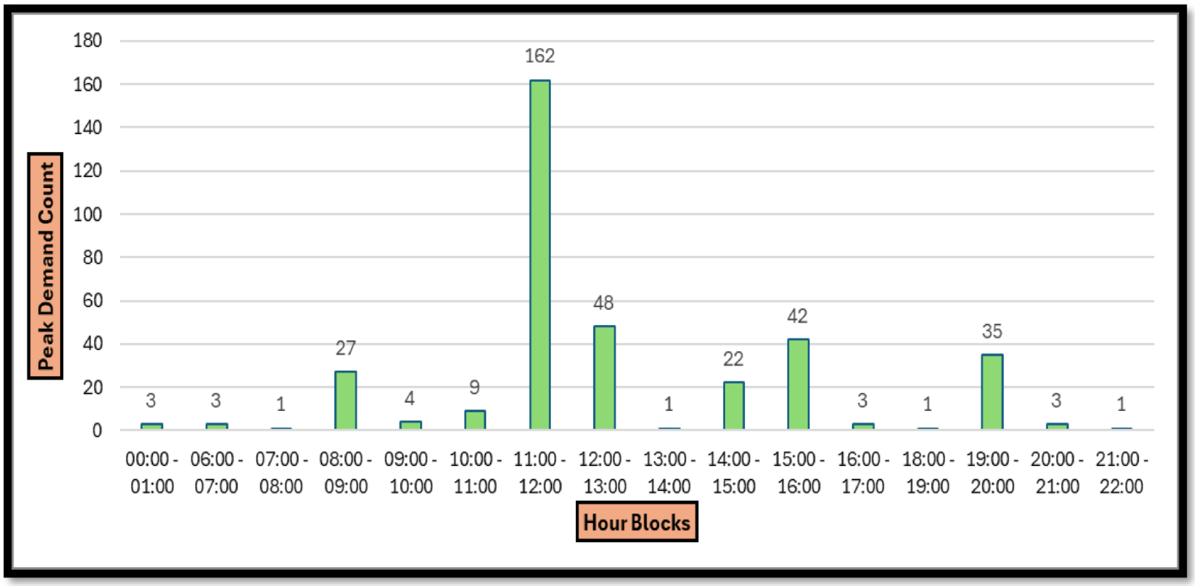

Figure 128: Daily Peak Demand Occurrences per Hourly block (2017)

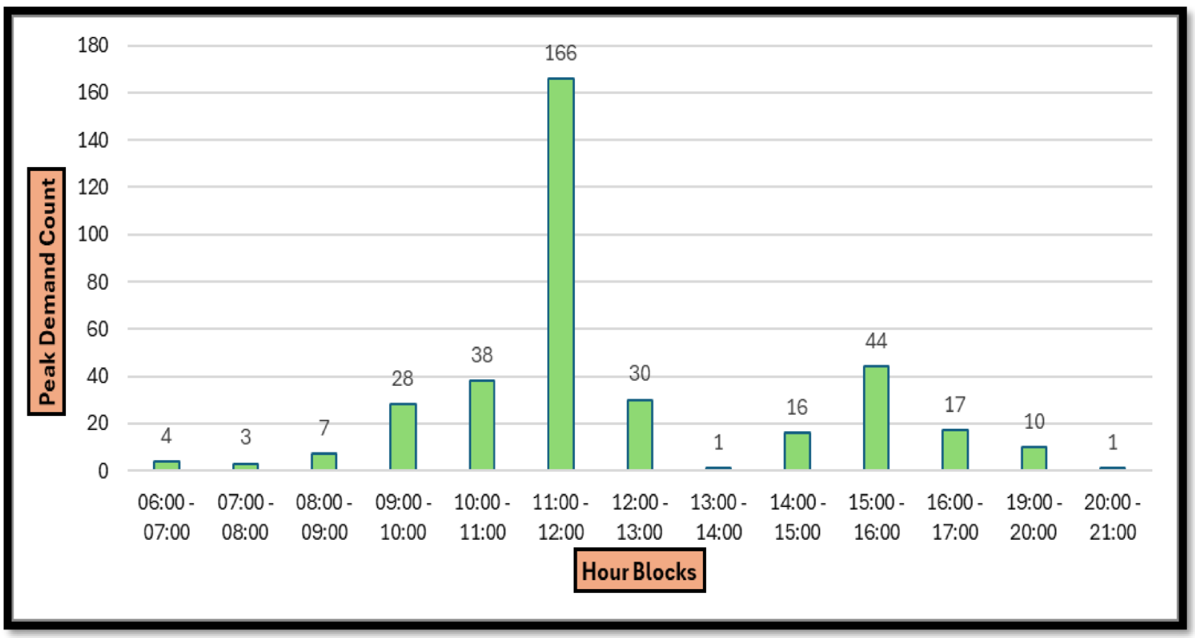

Figure 129: Daily Peak Demand Occurrences per Hourly block (2018)

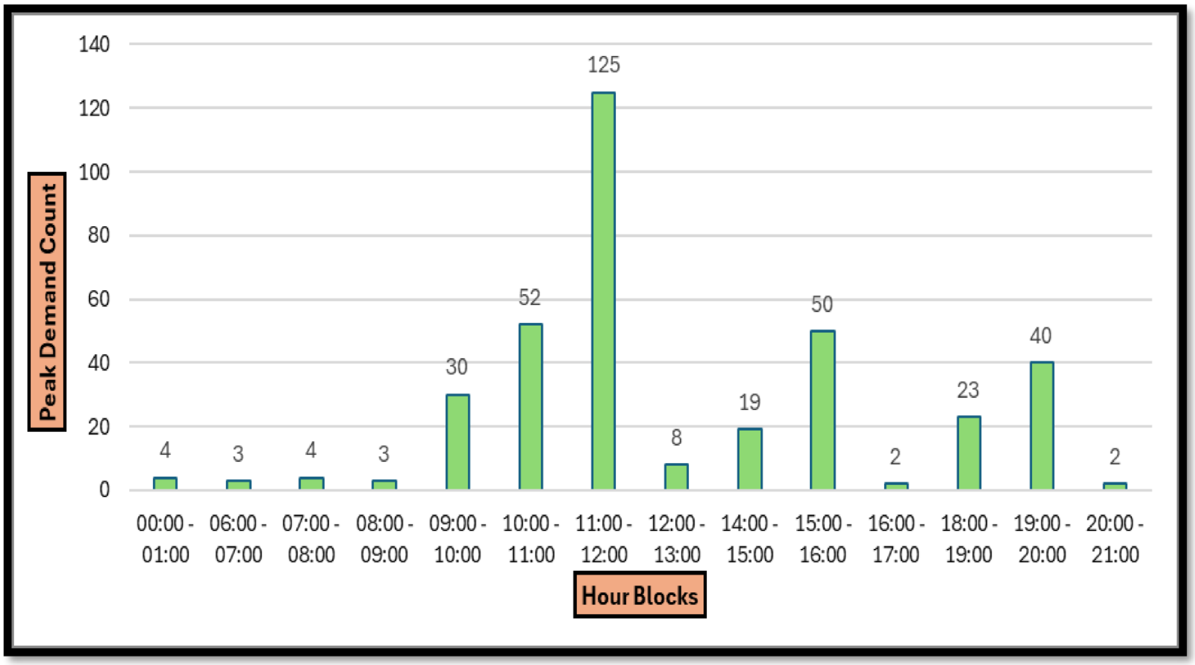

Figure 130: Daily Peak Demand Occurrences per Hourly block (2019)

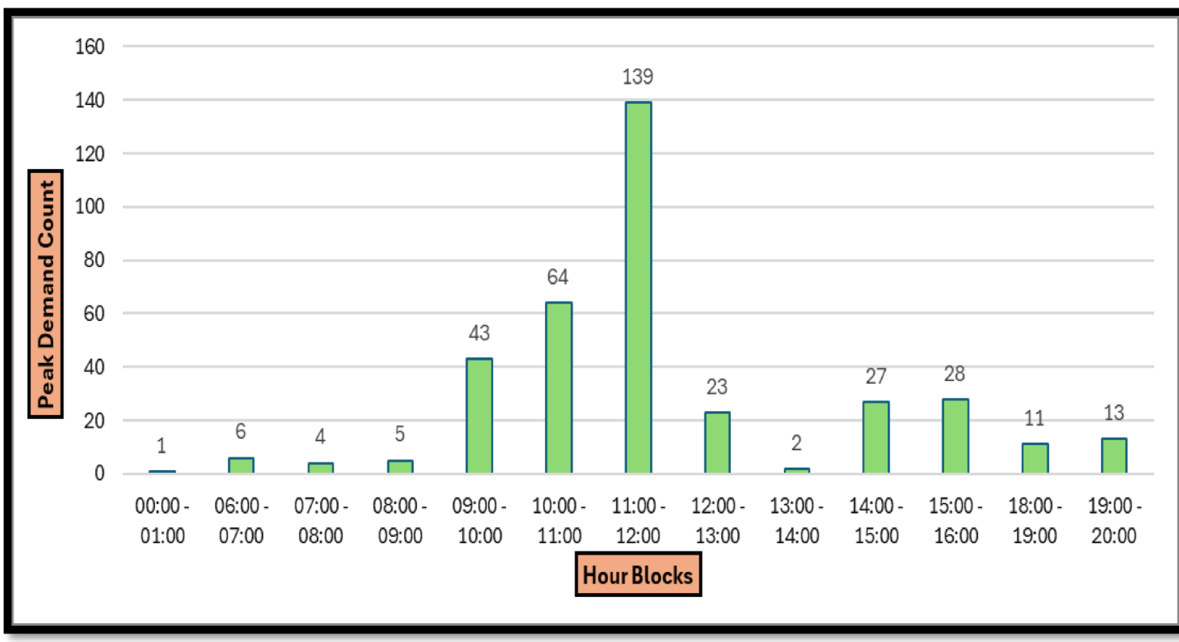

Figure 131: Daily Peak Demand Occurrences per Hourly block (2020)

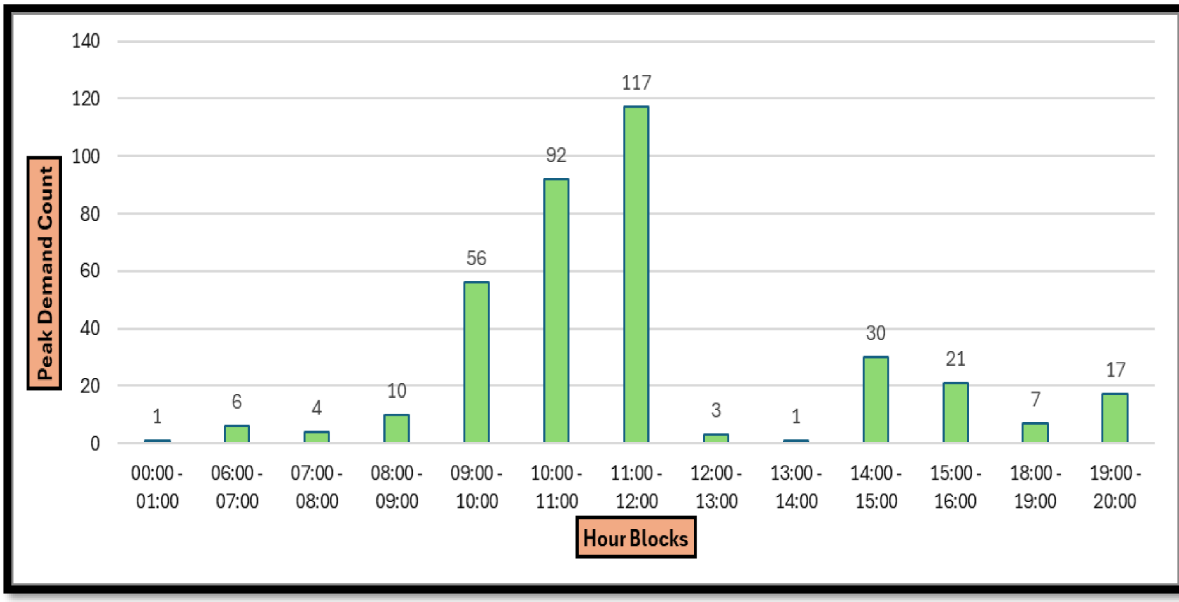

Figure 132: Daily Peak Demand Occurrences per Hourly block (2021)

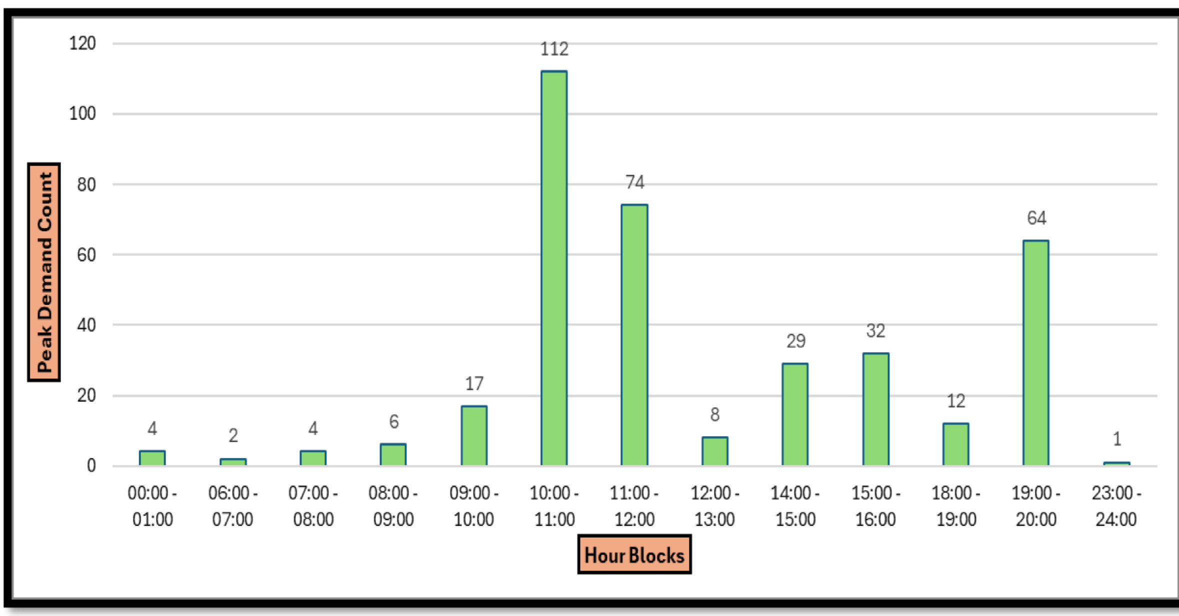

Figure 133: Daily Peak Demand Occurrences per Hourly block (2022)

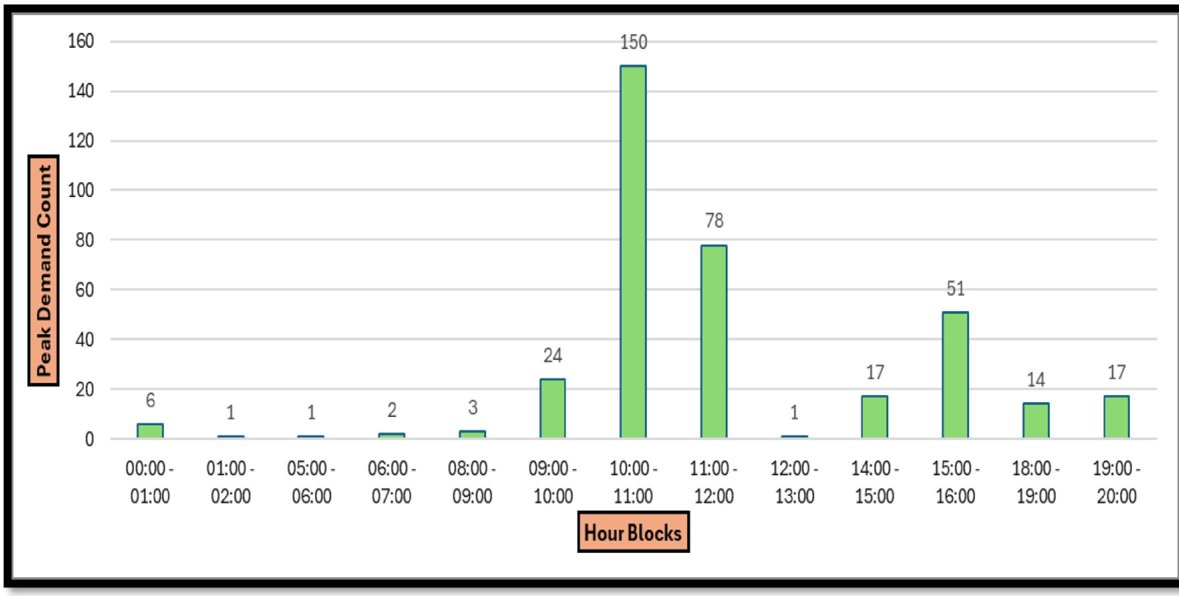

Figure 134: Daily Peak Demand Occurrences per Hourly block (2023)

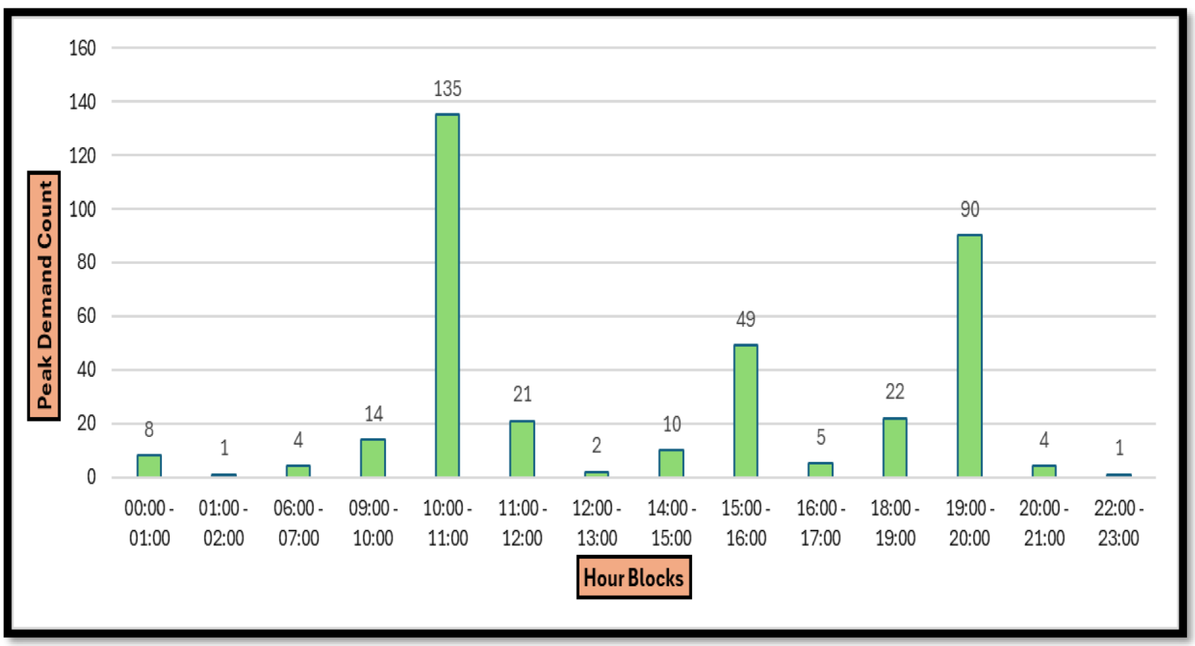

Figure 135: Daily Peak Demand Occurrences per Hourly block (2024)

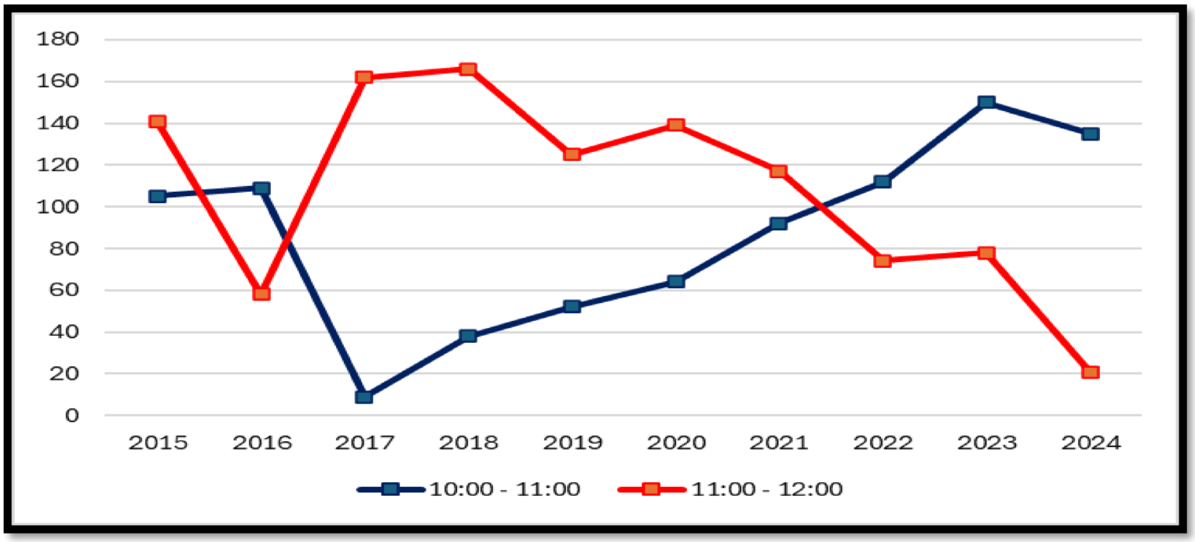

Figure 136: Daily Peak Demand occurrences in 10:00-11:00 & 11:00-12:00 hourly block

Figure 136 shows that peak occurrences have increased in the **10:00–11:00** block between 2017 and 2023 — from **9 to 150**. The **11:00–12:00** block also consistently maintains a **high occurrence rate**, with more than **100 peaks each year** from 2018 onwards.

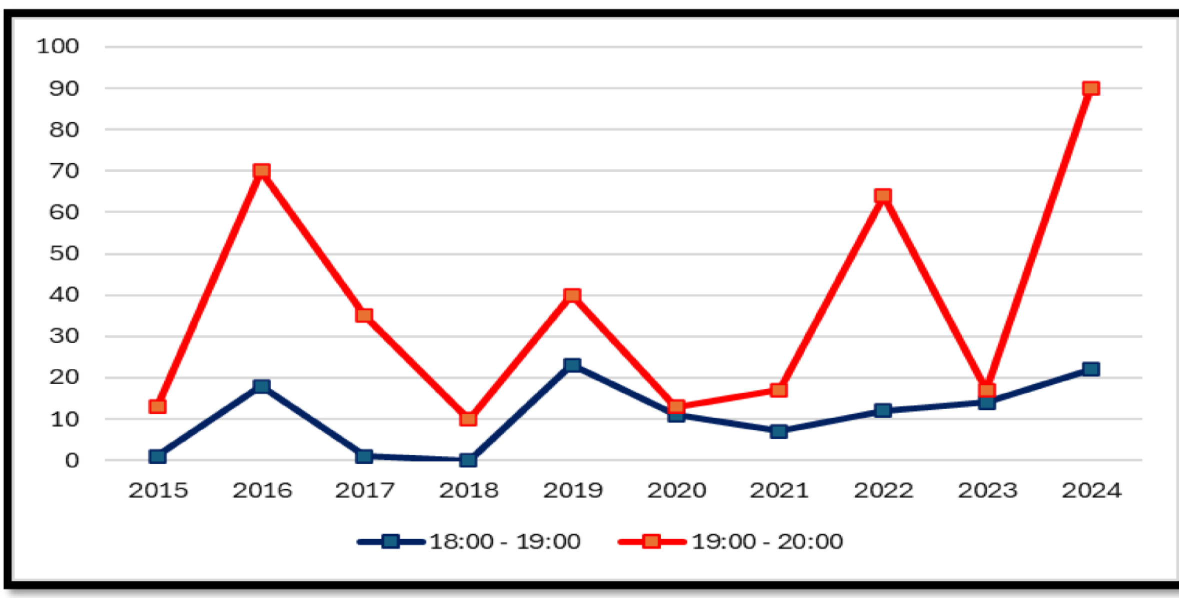

Figure 137: Daily Peak Demand occurrences in 18:00-19:00 & 19:00-20:00 hourly block

Figure 137 explores early evening blocks (18:00–20:00), showing a **rise** in peak occurrences — particularly **19:00–20:00**, which has grown from **13 in 2015 to 90 in 2024**.

Summary Statistics

Table 13: Hourly Block-wise Distribution of Daily Peak Demand Occurrences (2015–2024)

Hourly Block	Total Occurrences	Percentage (%)
11:00–12:00	1081	29.60%
10:00–11:00	866	23.71%
15:00–16:00	380	10.41%
20:00–21:00	369	10.10%
12:00–13:00	151	4.13%
Others (<100)	Remaining blocks	<4% each

Conclusion

The analysis confirms that **daily peak demand** occurred during **mid-morning to early afternoon**, especially between **10:00 to 12:00 Hrs**. There is a **clear and consistent pattern** across the years. Evening peaks (especially around **19:00–20:00**) are also on the rise with evolving consumption patterns.

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12. Intrastate energy Mix and Interstate Contribution 2015-2025

12.1. Introduction

This topic presents a comprehensive picture of the year-wise percentage contributions of various energy sources in the energy mix from 2015 to 2024. The focus is on the key sources—Thermal, Solar, Wind, Hydro, Gas, and Inter-State Transmission System (ISTS).

- Thermal Generation is the sum of MSPGCL Thermal, TPCL Thermal, AEML Thermal, other intrastate IPPs
- Hydro is the sum of MSPGCL Hydro and TPCL Hydro
- Gas is the sum of MSPGCL Gas, PGPL, TPCL Gas
- ISTS drawal is treated as a single resource and not analysed for specific kinds of resources

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12.2. Year-wise Contribution Overview (2015–2024)

The following Sankey chart illustrates the year-wise percentage contributions of each major energy resource:

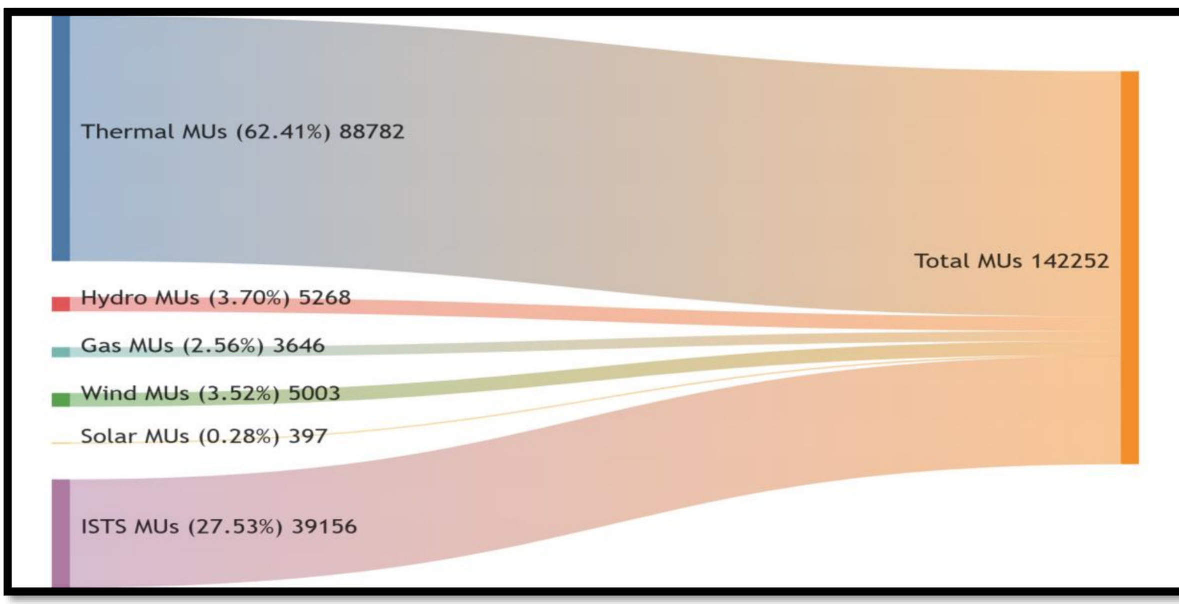

Figure 138: Percentage Contribution of Energy Resources – 2015

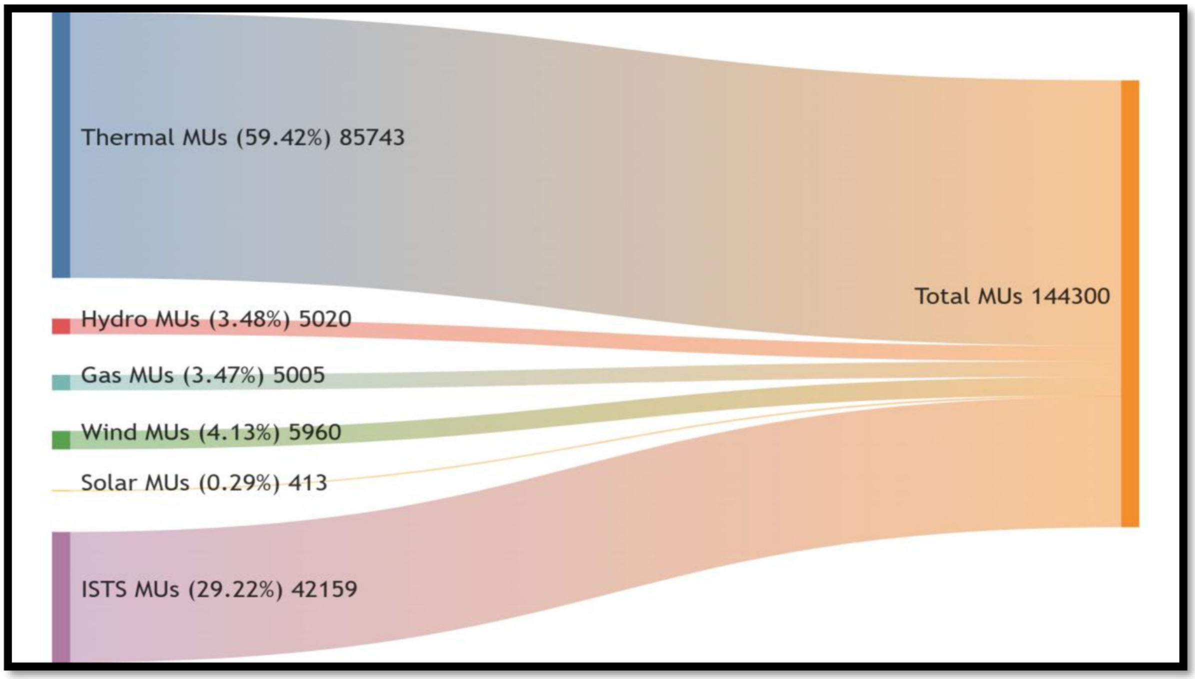

Figure 139: Percentage Contribution of Energy Resources – 2016

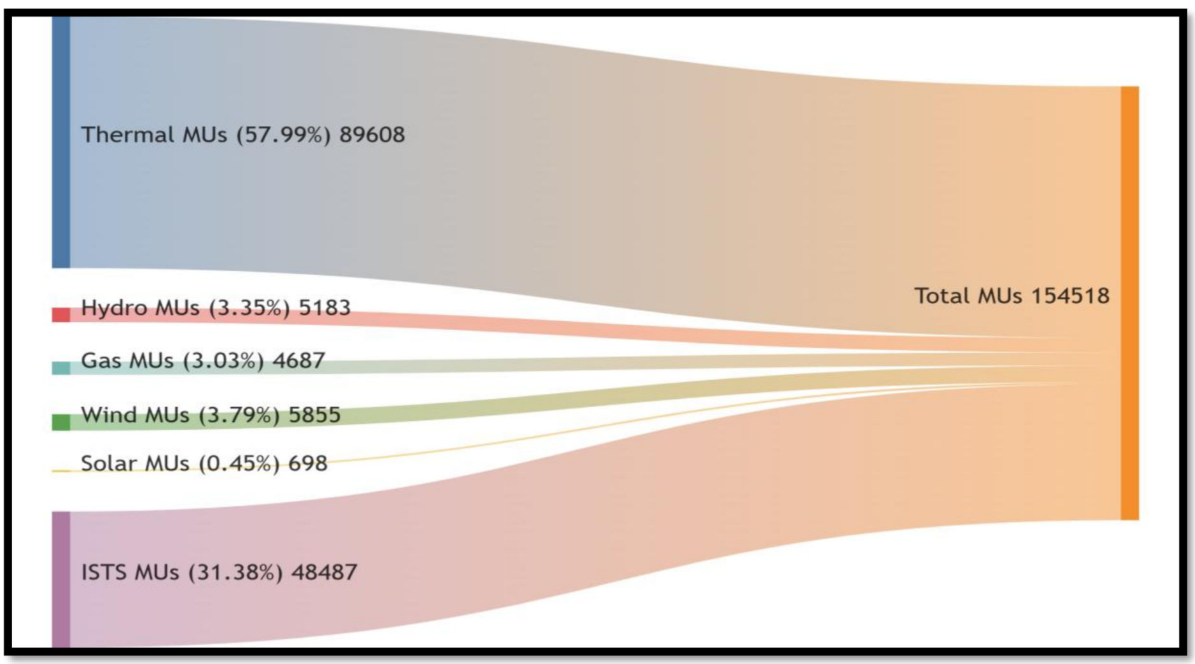

Figure 140: Percentage Contribution of Energy Resources – 2017

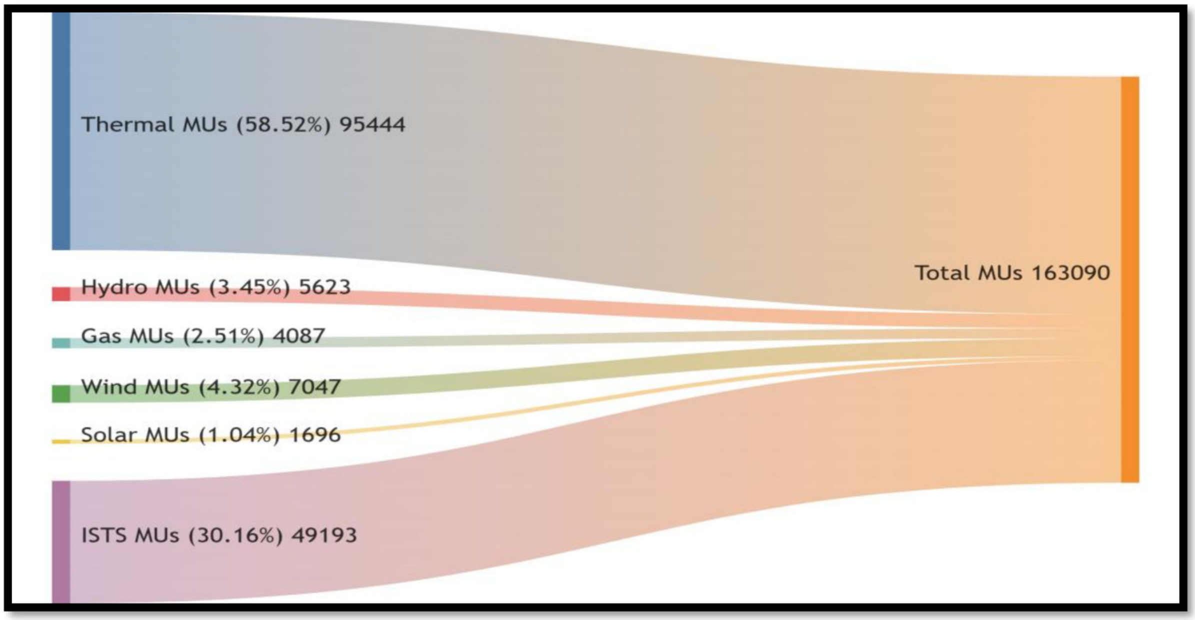

Figure 141: Percentage Contribution of Energy Resources – 2018

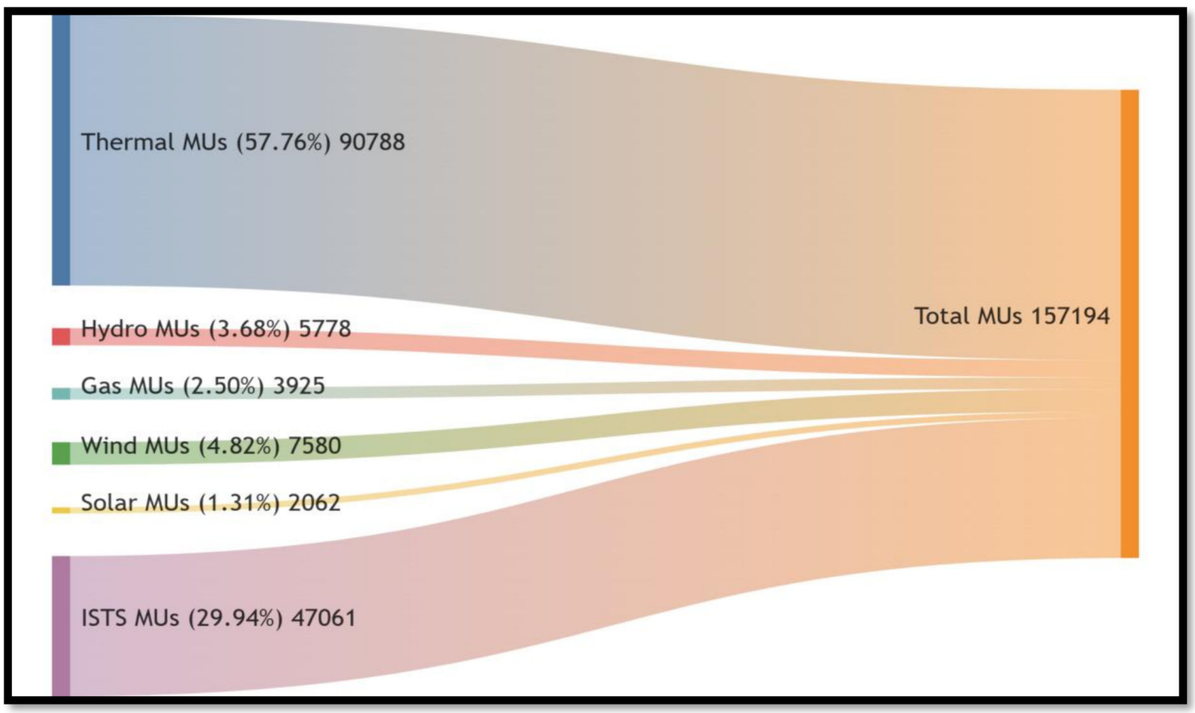

Figure 142: Percentage Contribution of Energy Resources – 2019

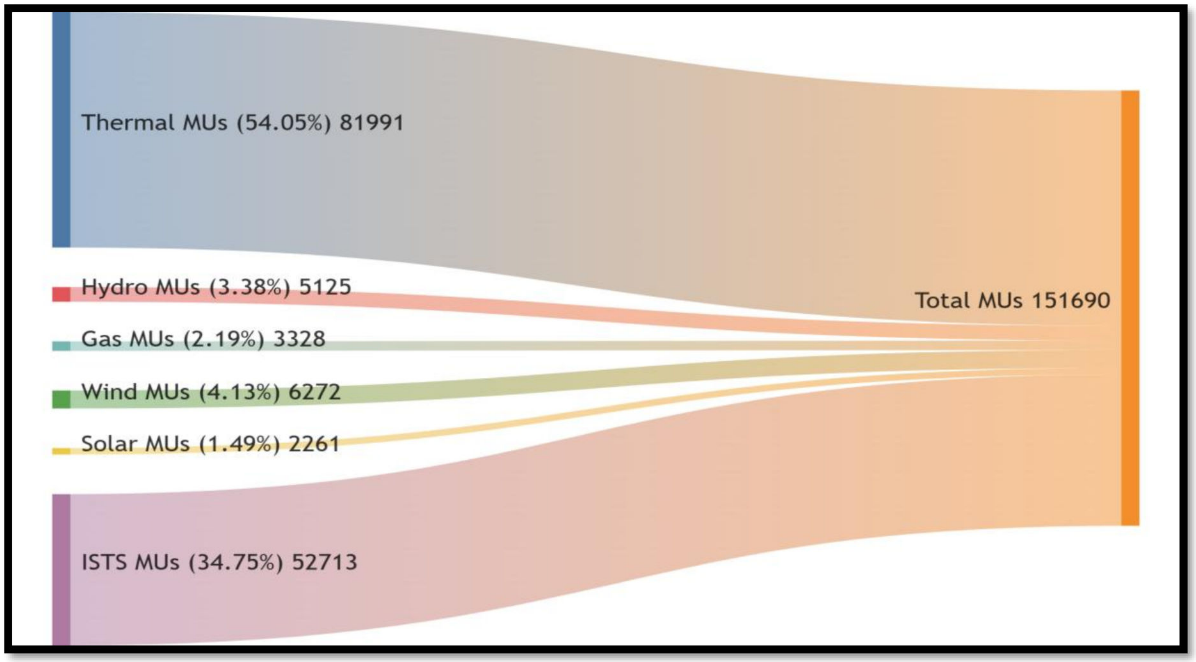

Figure 143: Percentage Contribution of Energy Resources – 2020

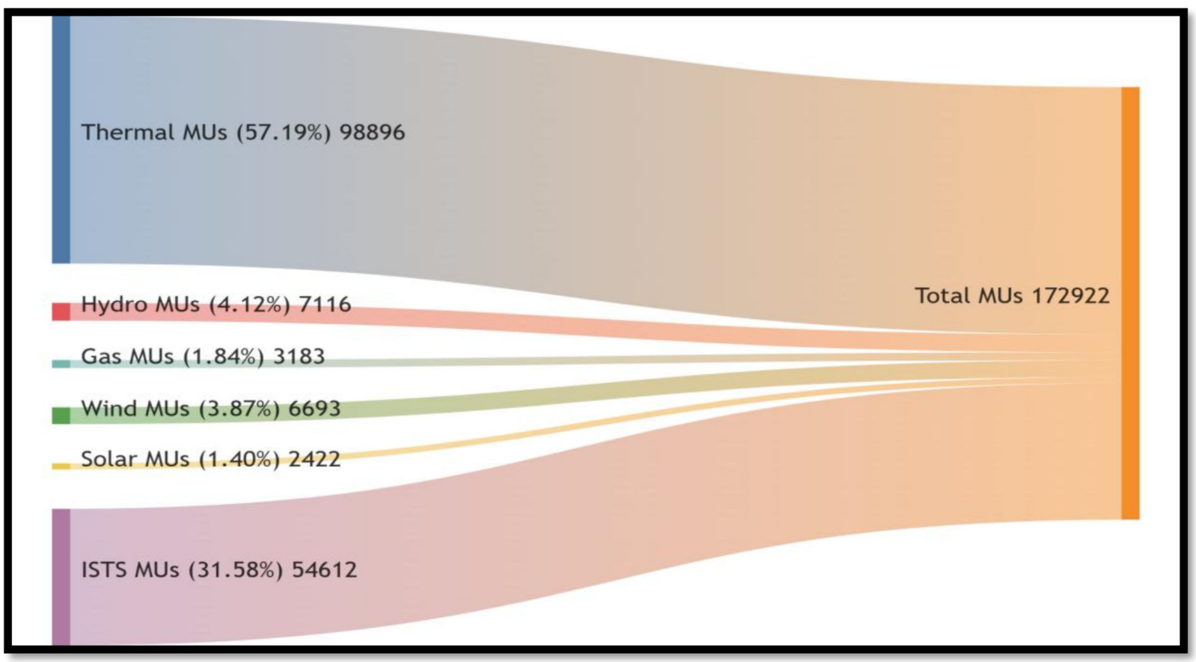

Figure 144: Percentage Contribution of Energy Resources – 2021

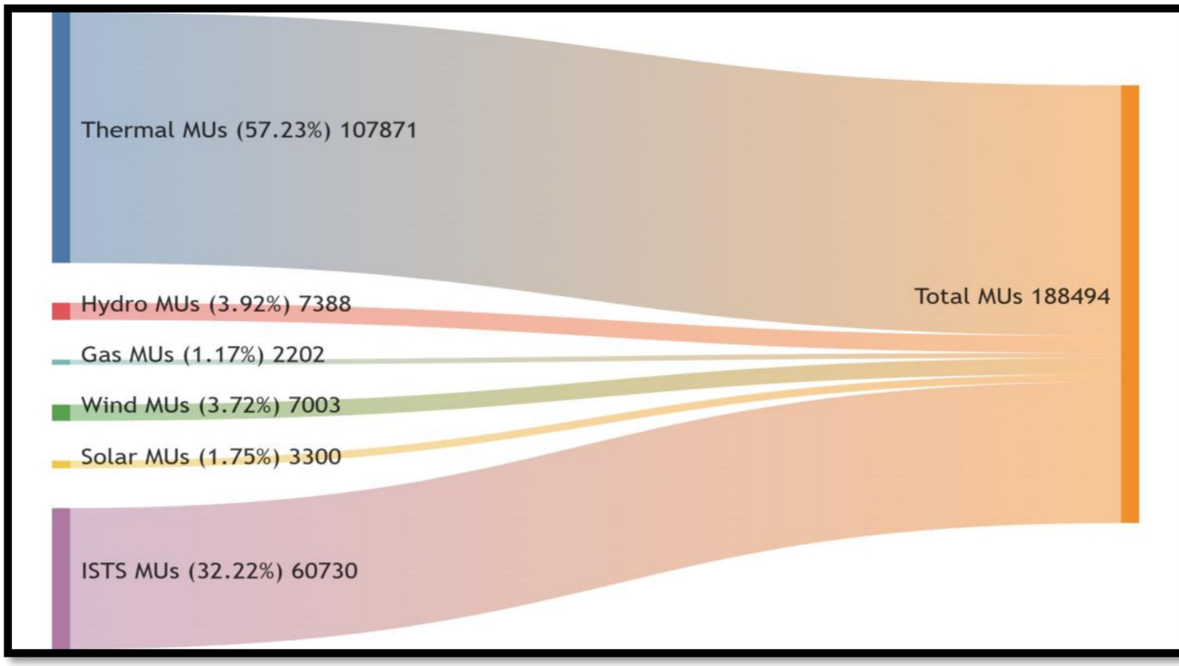

Figure 145: Percentage Contribution of Energy Resources – 2022

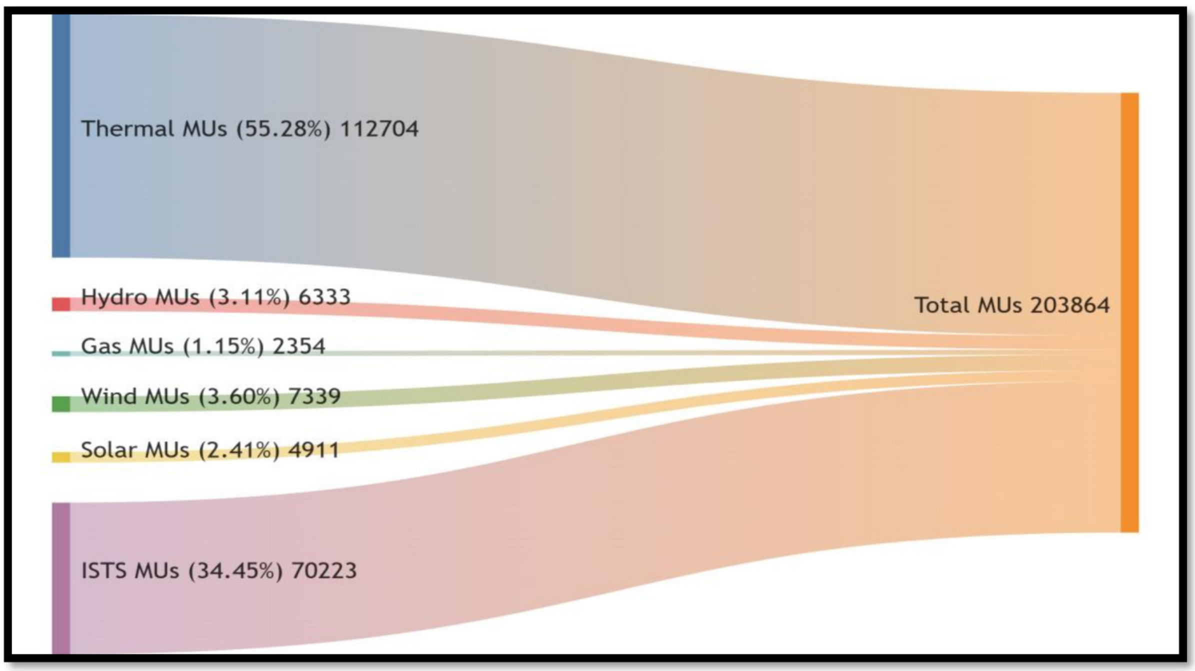

Figure 146: Percentage Contribution of Energy Resources – 2023

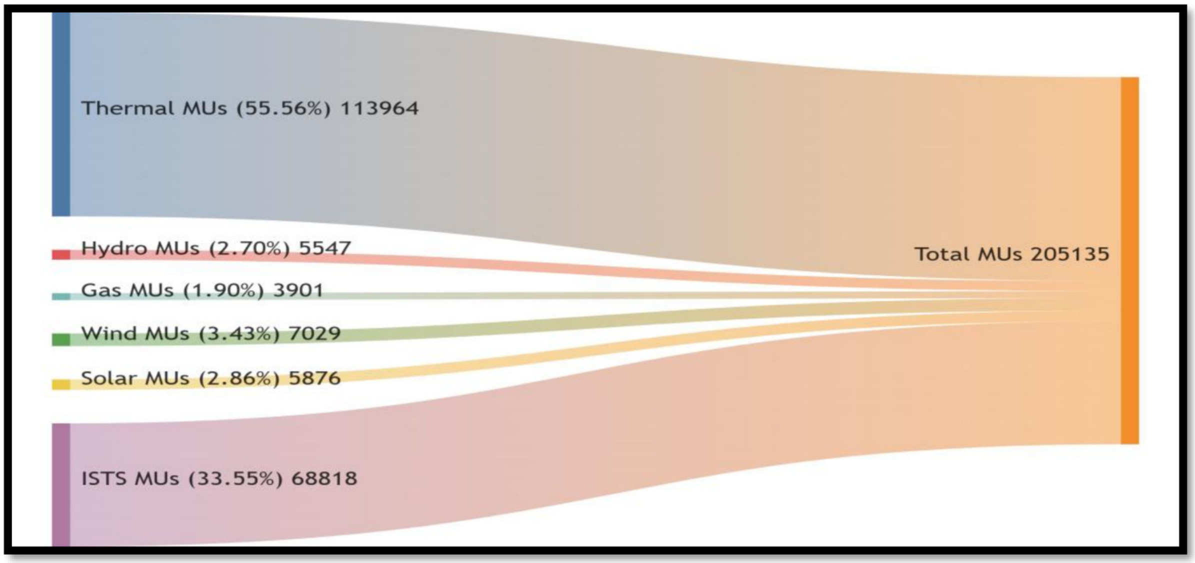

Figure 147: Percentage Contribution of Energy Resources – 2024

12.3 Key Observations

12.3.1 Thermal Power

- Thermal power remains the dominant source of energy, contributing over 55% in 2024.
- There is a gradual decline from 62.4% in 2015 to 55.6% in 2024, indicating a transition towards diversification.
- The trend of ISTS drawal remained in a narrow band of @30-34 % for all the years under observation.

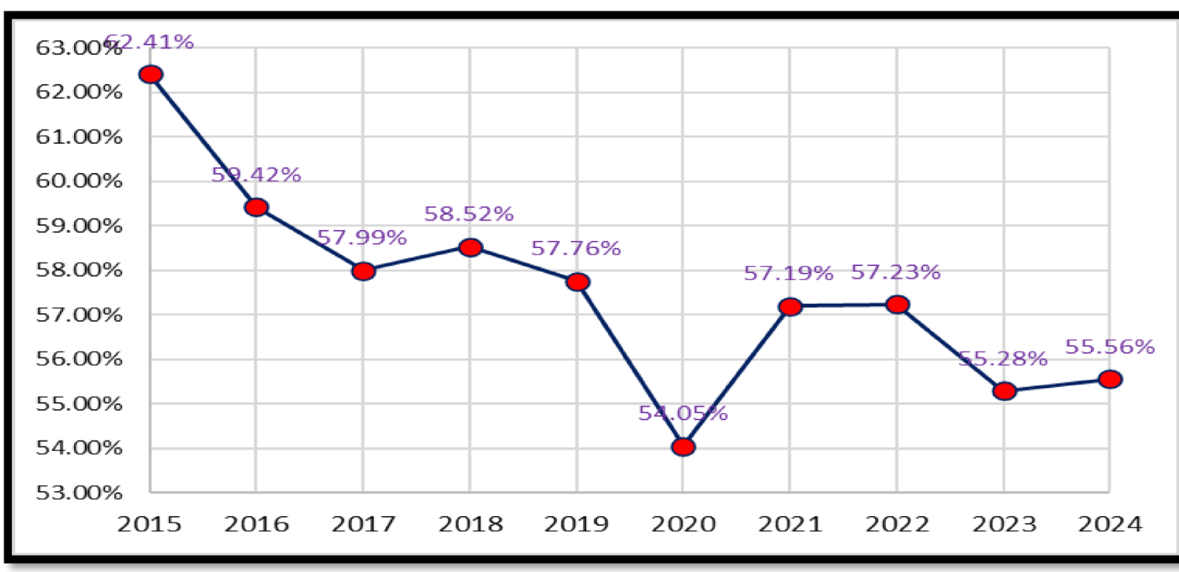

Figure 148: Yearly Percentage Contribution of intrastate - Thermal

12.3.2 Intrastate Solar Power

Solar energy shows a consistent upward trend, growing from 0.5% in 2015 to 2.9% in 2024.

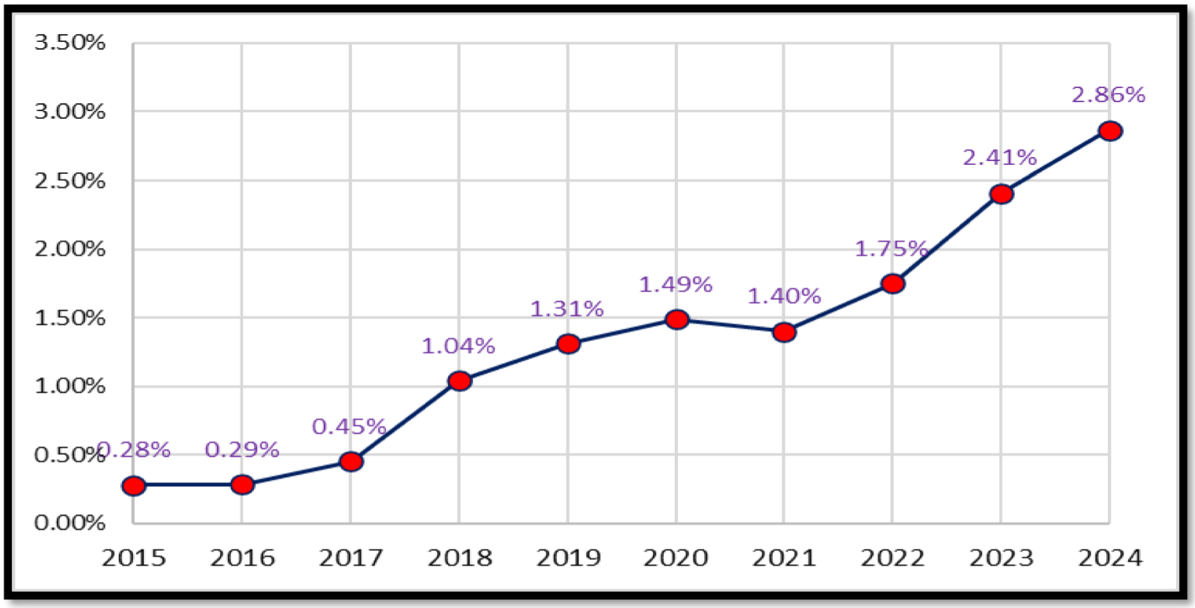

Figure 149: Yearly Percentage Contribution of Solar

12.3.3 Wind Power

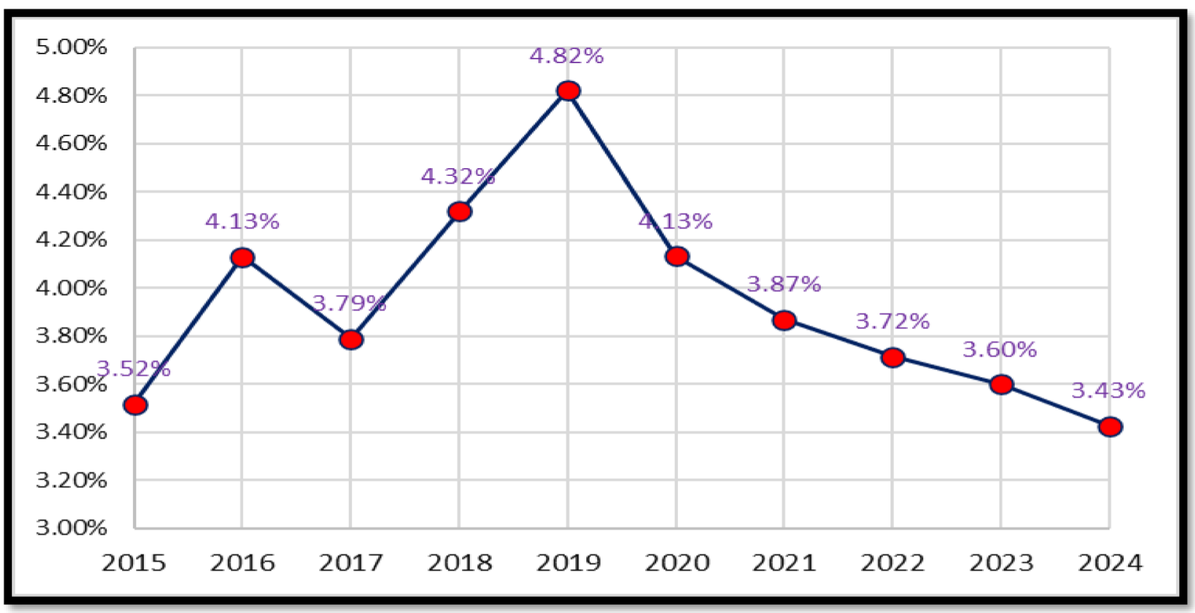

Figure 150: Yearly Percentage Contribution of Wind

- Peaked at 4.8% (2019) but has since steadily declined to 3.4% (2024).

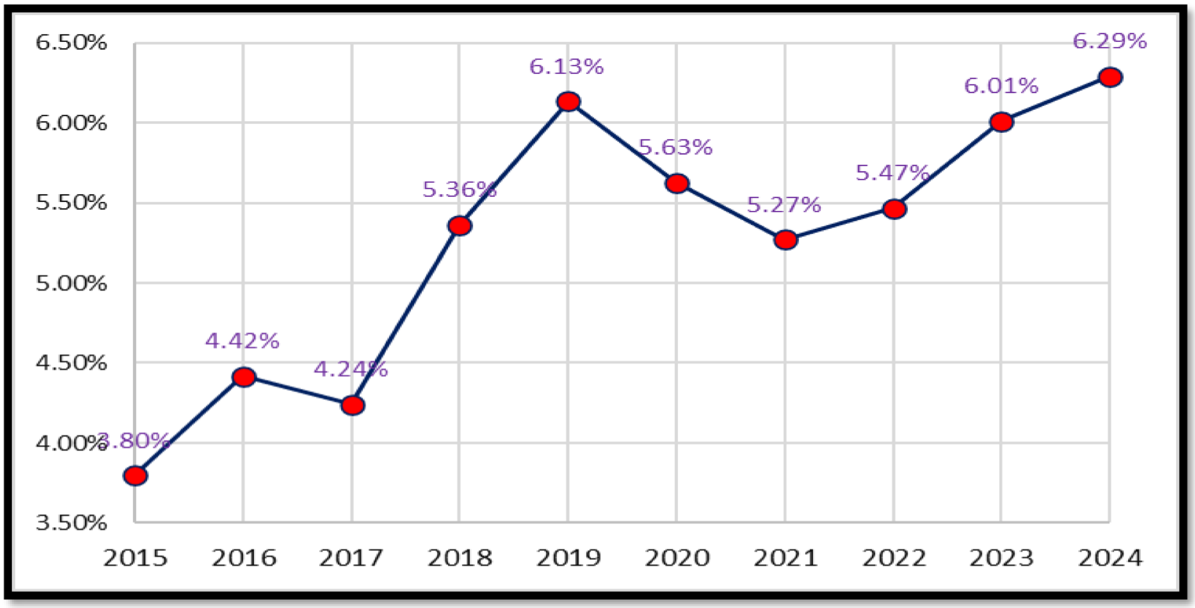

Figure 151: Yearly Percentage Contribution of RE (Wind + Solar)

12.3.4 Hydro Power

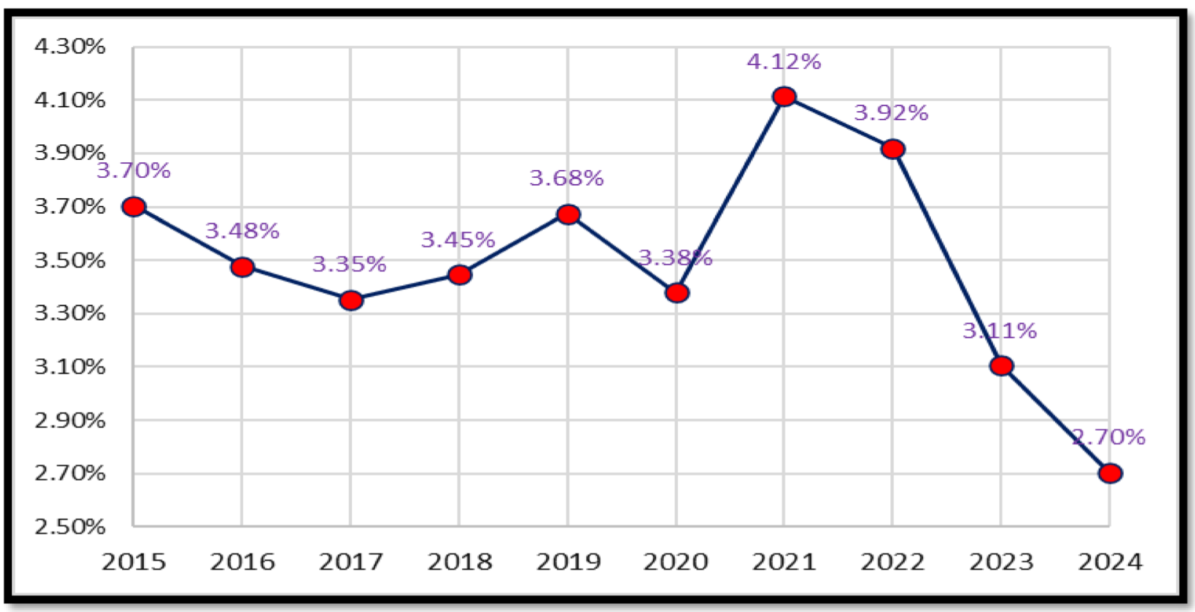

Figure 152: Yearly Percentage Contribution of Hydro

There was not any change in the hydro installed capacity in the state during this period. The hydro energy generation is mainly constrained by the availability of water. Hence, with increased demand the overall percentage share from hydro resources seen to be declined in later years of the decade.

12.3.5 Gas

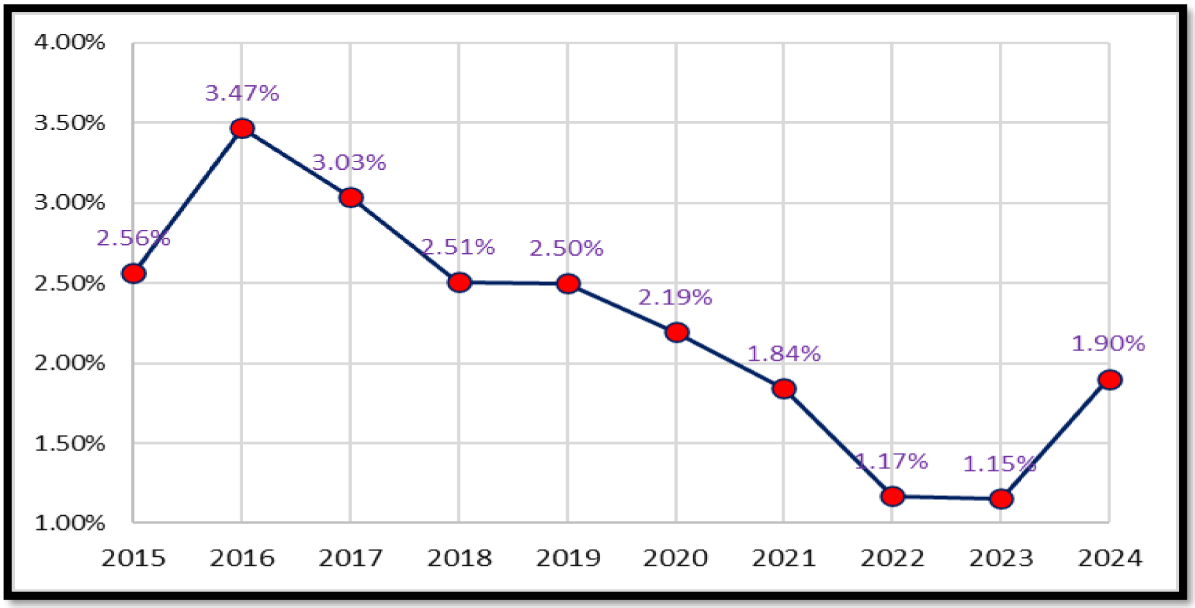

Figure 153: Yearly Percentage Contribution of Gas

12.3.6 ISTS (Inter-State Transmission System)

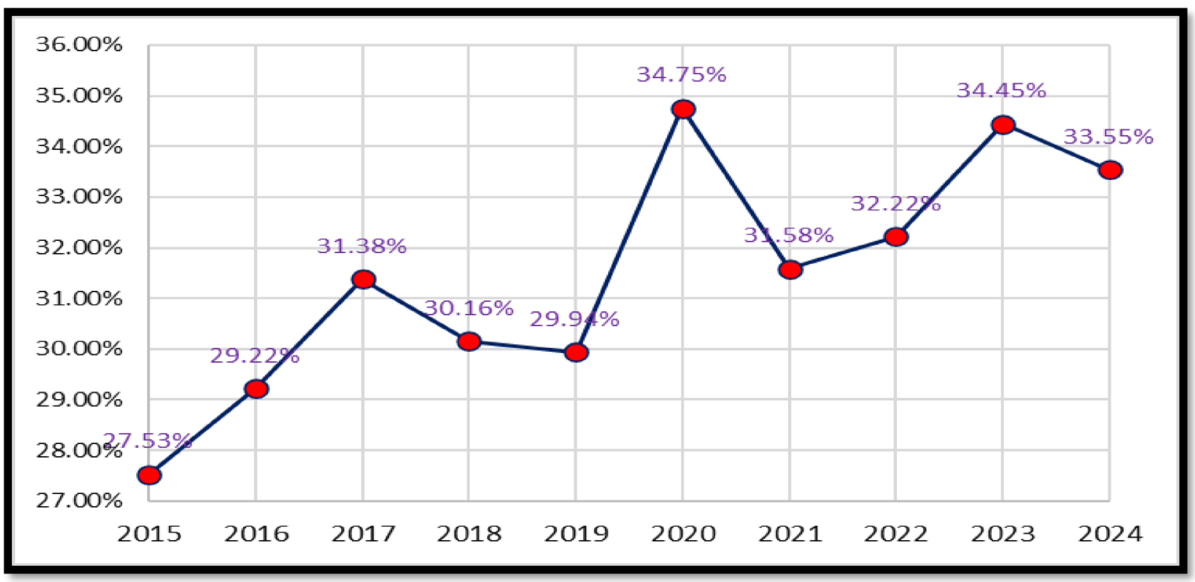

Figure 154: Yearly Percentage Contribution of ISTS

ISTS drawal shows rising trend from **26.1% in 2015 to 33.5% in 2024.**

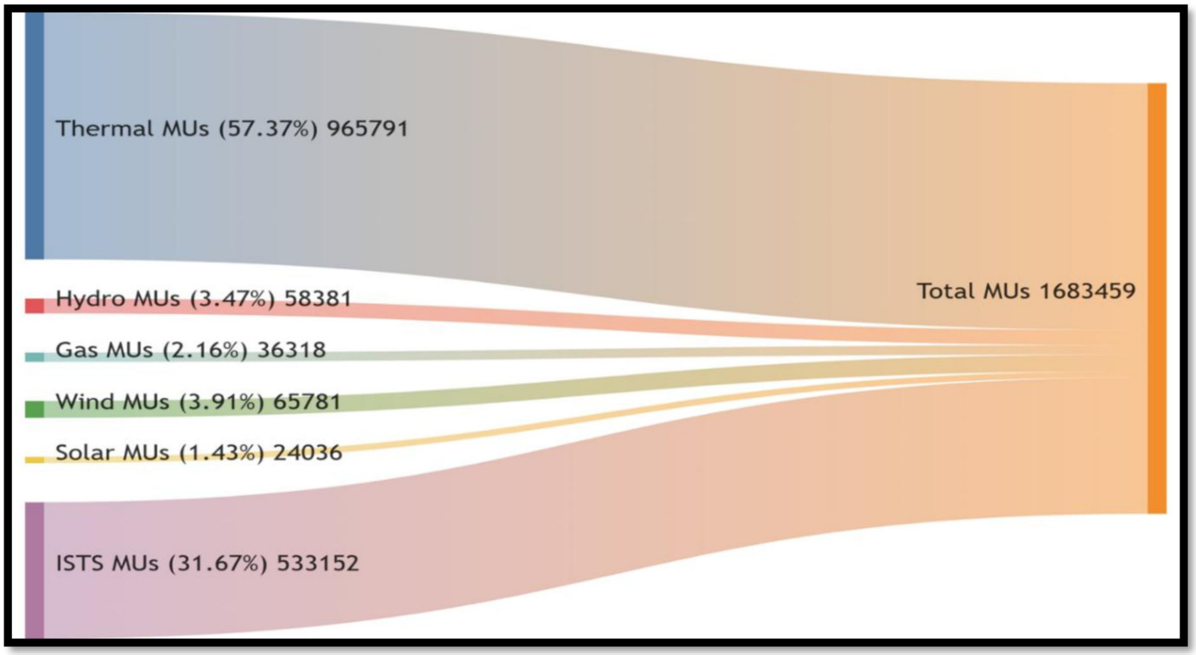

Figure 155: Resource-wise energy consumption in MUs and contribution in % for 10 years

- **Intrastate Thermal (57.37%)** and **ISTS drawal (31.67%)** dominate the total energy consumption over the decade.
- Renewables (Solar, Wind, Hydro combined) contribute around **8.81%** and Gas is at **2.16%**.

13. Daily Energy Patterns and Seasonal Trends Across Energy Resources

This chapter presents the daily energy consumption trends in Million Units (MUs) for thermal, Solar, Wind, Hydro, Gas across the period 2015 to 2024.

13.1 Daily Thermal Energy (in MUs) profile (2015-2024)

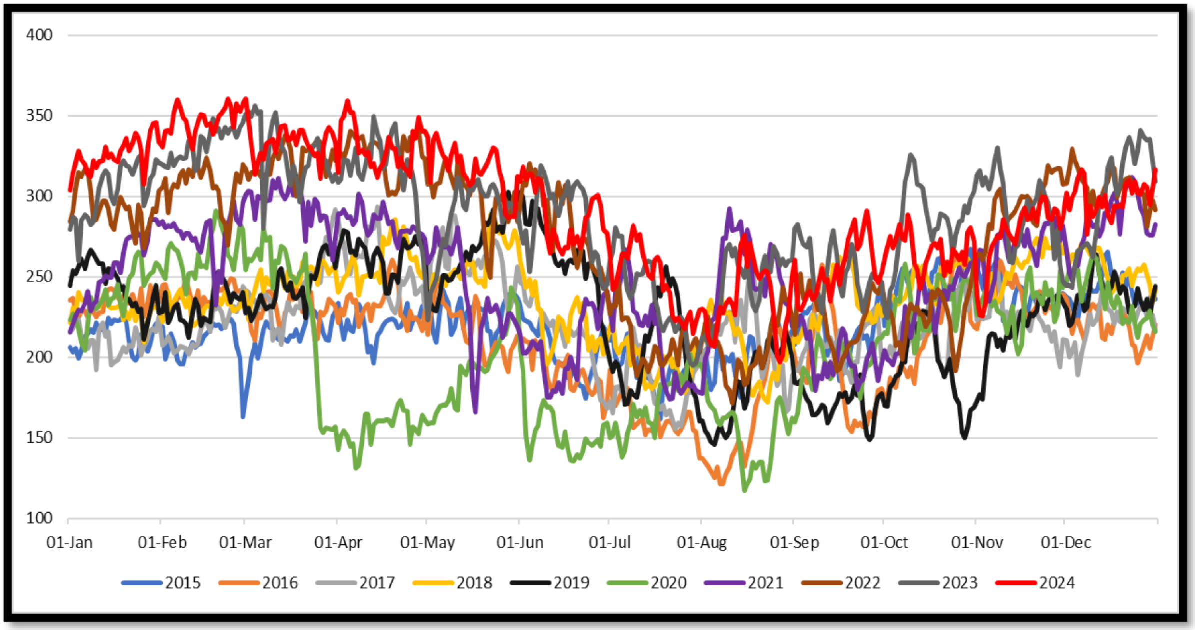

Figure 156: Daily Thermal Energy in MUs

Seasonal Variation in Daily Thermal Energy Drawn (in MUs) across all years.

- Summer (March to May) and Winter (November to February) periods record higher thermal energy consumption across all years.
- In contrast, the monsoon season (June to September) consistently shows a drop in daily thermal energy draw.

13.2 Daily Solar Energy (in MUs) profile (2015-2024)

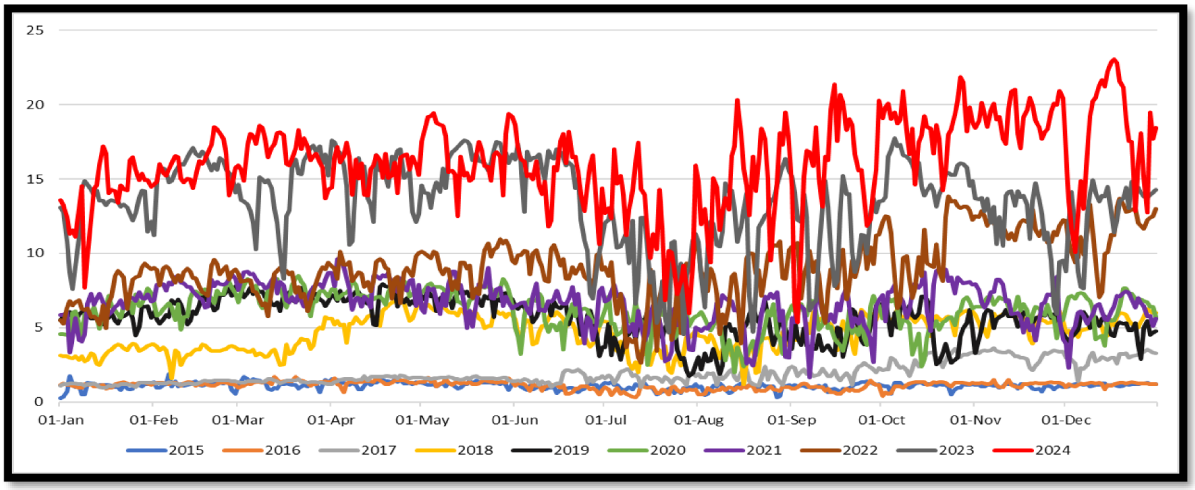

Figure 157: Daily Solar Energy in MUs

Observations

The Figure-157 illustrates the trend of daily solar energy generation over the period 2015 to 2024.

- Solar generation shows a distinct seasonal pattern, with higher generation during the summer and winter seasons.
- A dip in generation is observed during the monsoon season (June to September) across all years.

13.3 Daily Wind Energy (in MUs) profile (2015-2024)

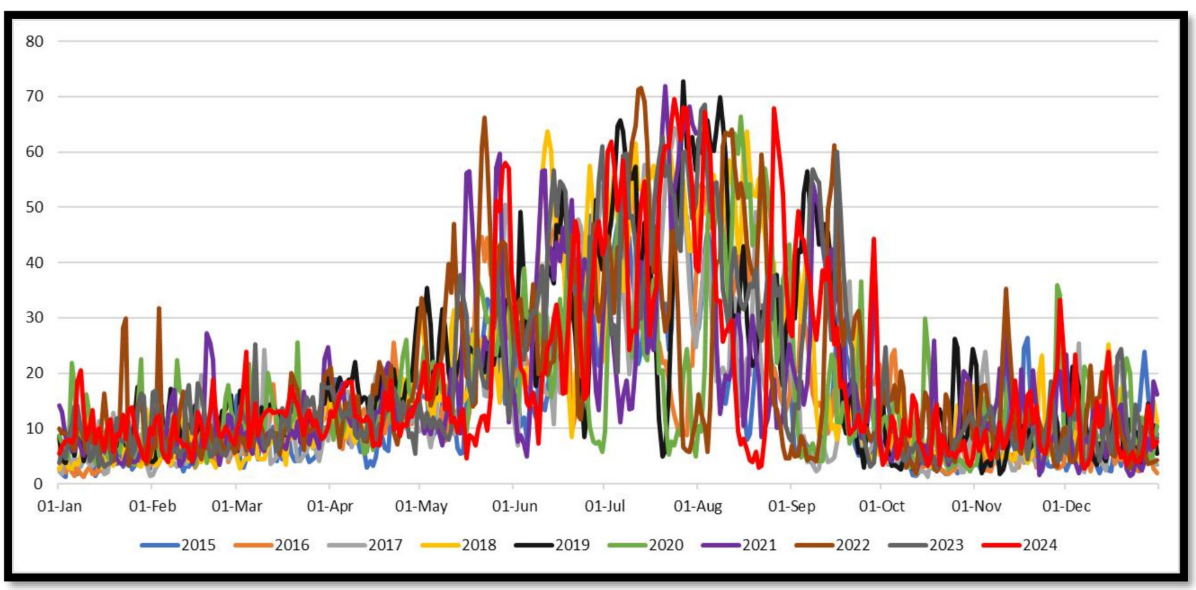

Figure 158: Daily Wind Energy in MUs

The wind energy generation in Maharashtra demonstrates clear **seasonal variability**:

- **High Generation in Monsoon**:

  A significant increase in wind energy generation is consistently observed during the **monsoon season (mid-June to September)**.

- **Dip in Winter and Summer**:

  Wind generation drops during **winter (December–February)** and **early summer (March–May)**.

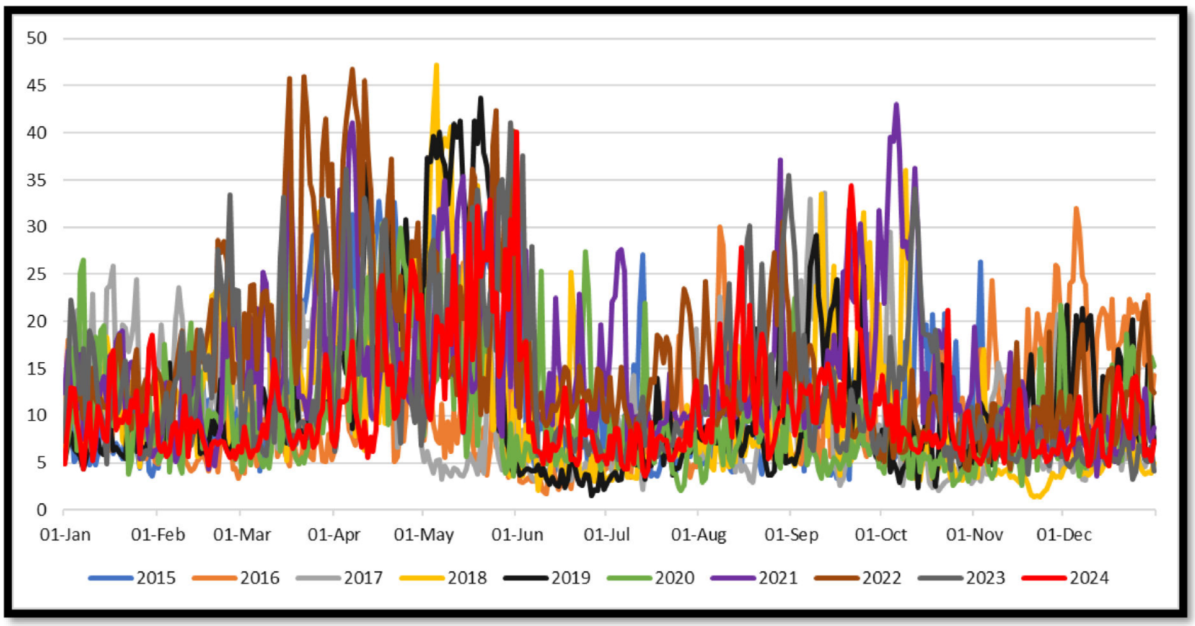

Figure 159: Daily Hydro Energy in MUs

Hydro energy drawal shows major peaks during **summer (March–May)** and **post-monsoon (August–September)**. Hydro usage tends to drop during the **core monsoon months (June–July)**.

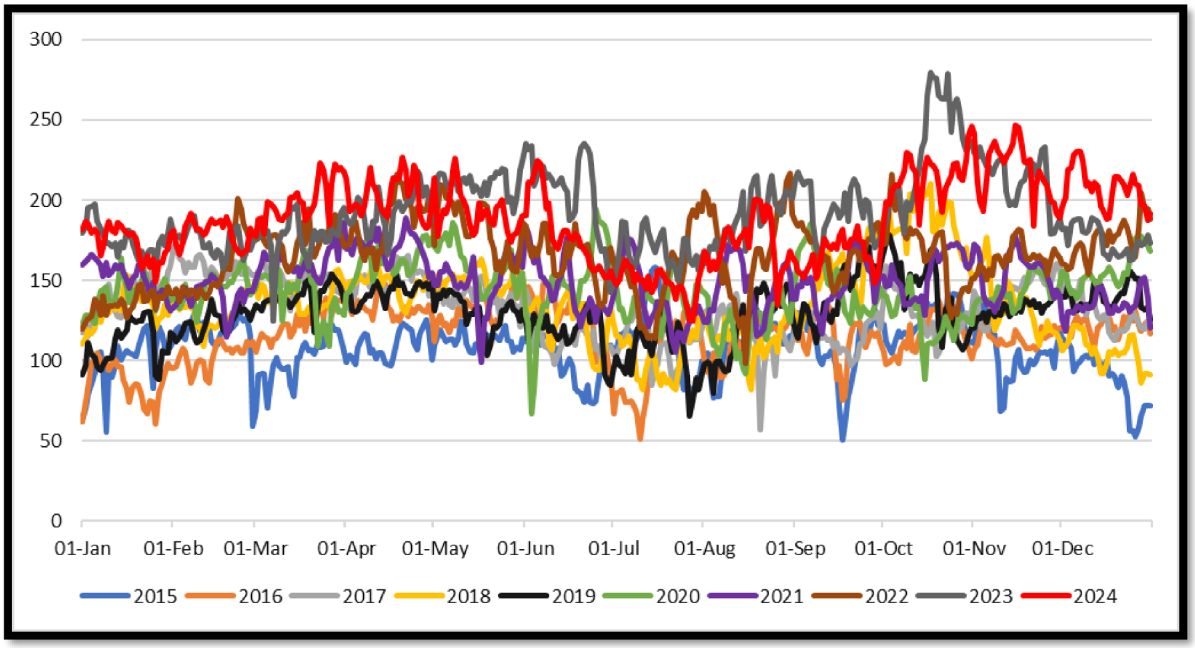

Figure 160: Daily ISTS Energy in MUs

ISTS drawal has increased in Q2 (summer) and Q4 (post-monsoon & early winter).

14. Monthly Energy Consumption in Solar & Non-Solar Hours for the year 2022, 2023 and 2024

14.1 Introduction

This chapter illustrates the monthly energy consumption patterns in solar and non-solar hours for the years 2022, 2023, and 2024 using **15 minutes time block data**. For assessing energy consumption patterns, time blocks 28–72 are considered as solar hours, while time blocks 73–96 and 1–27 are considered as non-solar hours.

14.2 Monthly Energy Consumption in Solar & non-solar Hrs (2022-2024)

Table 14: Monthly Energy Consumption in Solar & non-solar Hrs in 2022

2022 (Energy Consumption in MUs)					
Months	**Monthly Energy Consumption in 2022**	**Energy Consumed in Solar Hrs (28 to 72 TB)**	**Energy Consumed in Non-Solar Hrs (73 to 96 TB & 1 to 27 TB)**	**% of Energy in Solar Hrs w.r.t Monthly Energy**	**% of Energy in Non-Solar Hrs w.r.t Monthly Energy**
JAN	14166.06	7423.50	6742.56	52.40%	47.60%
FEB	15254.98	7764.02	7490.97	50.89%	49.11%
MAR	16903.59	8364.79	8538.80	49.49%	50.51%
APR	17189.03	8349.98	8839.05	48.58%	51.42%
MAY	17281.71	8278.51	9003.20	47.90%	52.10%
JUN	15227.72	7363.09	7864.63	48.35%	51.65%
JUL	13239.72	6444.78	6794.93	48.68%	51.32%
AUG	13766.29	6715.60	7050.68	48.78%	51.22%
SEP	13284.68	6485.96	6798.72	48.82%	51.18%
OCT	13377.66	6518.73	6858.94	48.73%	51.27%
NOV	14765.33	7518.93	7246.40	50.92%	49.08%
DEC	15897.44	8196.22	7701.22	51.56%	48.44%

Table 15: Monthly Energy Consumption in Solar & non-solar Hrs in 2023

2023 (Energy Consumption in MUs)					
Months	**Monthly Energy Consumption in 2023**	**Energy Consumed in Solar Hrs (28 to 72 TB)**	**Energy Consumed Non-Solar Hrs (73 to 96 TB & 1 to 27 TB)**	**% of Energy in Solar Hrs w.r.t Monthly Energy**	**% of Energy in Non-Solar Hrs w.r.t Monthly Energy**
JAN	15769.58	8186.21	7583.36	51.91%	48.09%
FEB	15254.94	7763.97	7490.97	50.89%	49.11%
MAR	16911.24	8452.40	8458.84	49.98%	50.02%
APR	16938.69	8258.98	8679.71	48.76%	51.24%
MAY	17662.20	8433.68	9228.53	47.75%	52.25%
JUN	17037.68	8175.65	8862.03	47.99%	52.01%
JUL	14643.41	7170.87	7472.54	48.97%	51.03%
AUG	16094.03	7972.00	8122.03	49.53%	50.47%
SEP	15398.48	7572.19	7826.29	49.17%	50.83%
OCT	17615.41	8642.66	8972.75	49.06%	50.94%
NOV	16254.28	8108.66	8145.61	49.89%	50.11%
DEC	15639.88	7958.84	7681.04	50.89%	49.11%

Table 16: Monthly Energy Consumption in Solar & non-solar Hrs in 2024

2024 (Energy Consumption in MUs)					
Months	**Monthly Energy Consumption in 2024**	**Energy Consumed in Solar Hrs (28 to 72 TB)**	**Energy Consumed in Non-Solar Hrs (73 to 96 TB & 1 to 27 TB)**	**% of Energy in Solar Hrs w.r.t Monthly Energy**	**% of Energy in Non-Solar Hrs w.r.t Monthly Energy**
JAN	16513.70	8453.49	8060.21	51.19%	48.81%
FEB	16214.99	8177.16	8037.83	50.43%	49.57%
MAR	17936.95	8795.94	9141.01	49.04%	50.96%
APR	17904.30	8599.6	9304.7	48.03%	51.97%
MAY	18253.61	8637.32	9616.29	47.32%	52.68%
JUN	16095.84	7646.5	8449.34	47.51%	52.49%
JUL	15057.40	7265.5	7791.9	48.25%	51.75%
AUG	15186.28	7340.83	7845.45	48.34%	51.66%
SEP	15008.07	7286	7722.07	48.55%	51.45%
OCT	16437.69	7943.98	8493.71	48.33%	51.67%

2024 (Energy Consumption in MUs)					
Month s	**Monthly Energy Consumption in 2024**	**Energy Consumed in Solar Hrs (28 to 72 TB)**	**Energy Consumed in Non-Solar Hrs (73 to 96 TB & 1 to 27 TB)**	**% of Energy in Solar Hrs w.r.t Monthly Energy**	**% of Energy in Non-Solar Hrs w.r.t Monthly Energy**
NOV	16256.63	8172	8084.63	50.27%	49.73%
DEC	17092.34	8779.32	8313.02	51.36%	48.64%

Table 17: Monthly Energy Consumption in MUs in 2022, 2023 and 2024

Months	Monthly Energy Consumption in 2022	Monthly Energy Consumption in 2023	Monthly Energy Consumption in 2024
JAN	14166.06	15769.58	16513.70
FEB	15254.98	15254.94	16214.99
MAR	16903.59	16911.24	17936.95
APR	17189.03	16938.69	17904.30
MAY	17281.71	17662.20	18253.61
JUN	15227.72	17037.68	16095.84
JUL	13239.72	14643.41	15057.40
AUG	13766.29	16094.03	15186.28
SEP	13284.68	15398.48	15008.07
OCT	13377.66	17615.41	16437.69
NOV	14765.33	16254.28	16256.63
DEC	15897.44	15639.88	17092.34

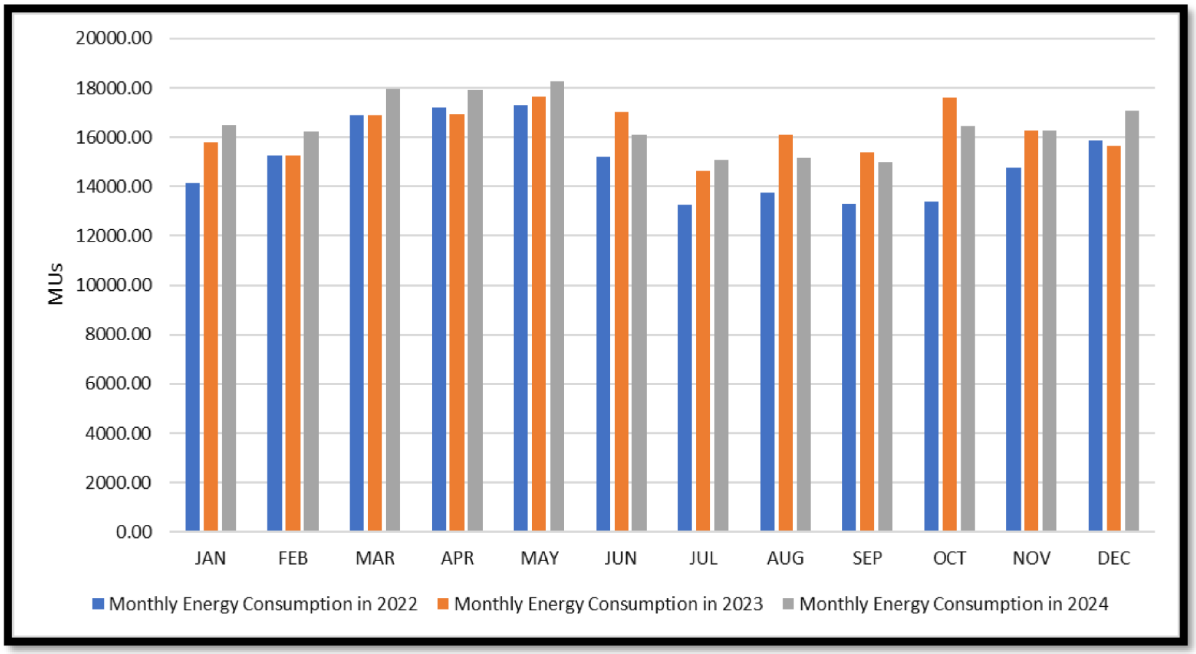

Figure 161: Monthly Energy Consumption in the year 2022,2023 & 2024

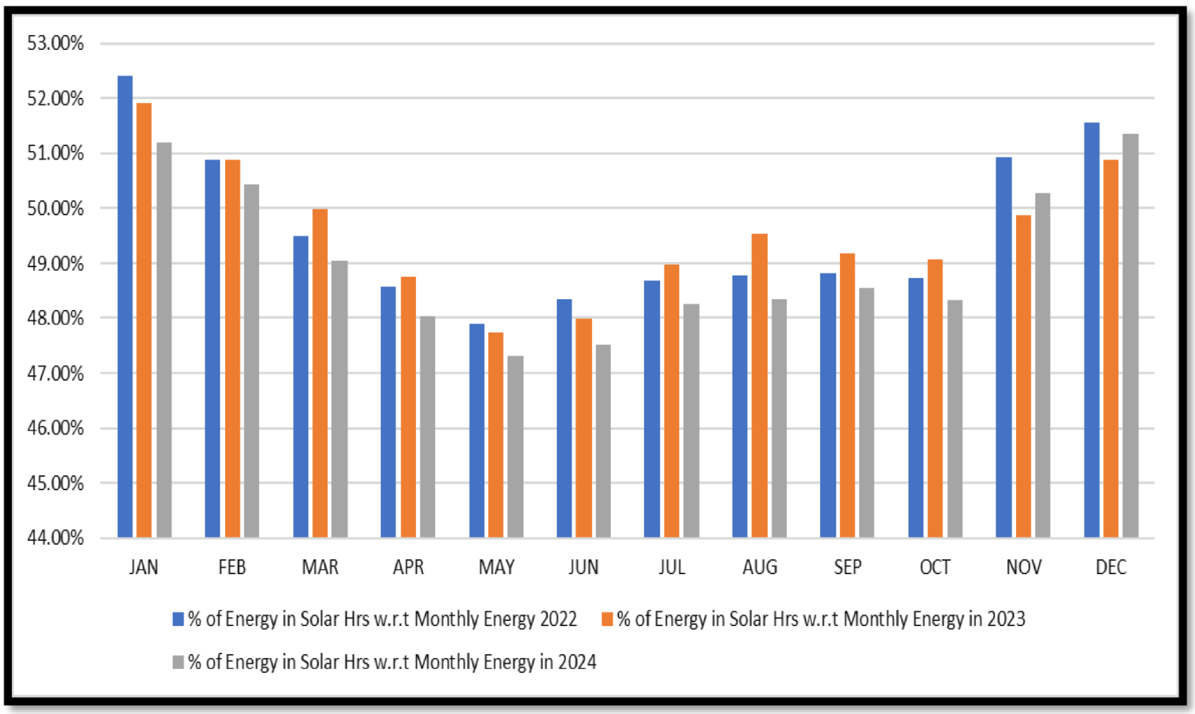

Figure 162: Percentage of Energy in Solar Hrs w.r.t. Monthly Energy (2022-2024)

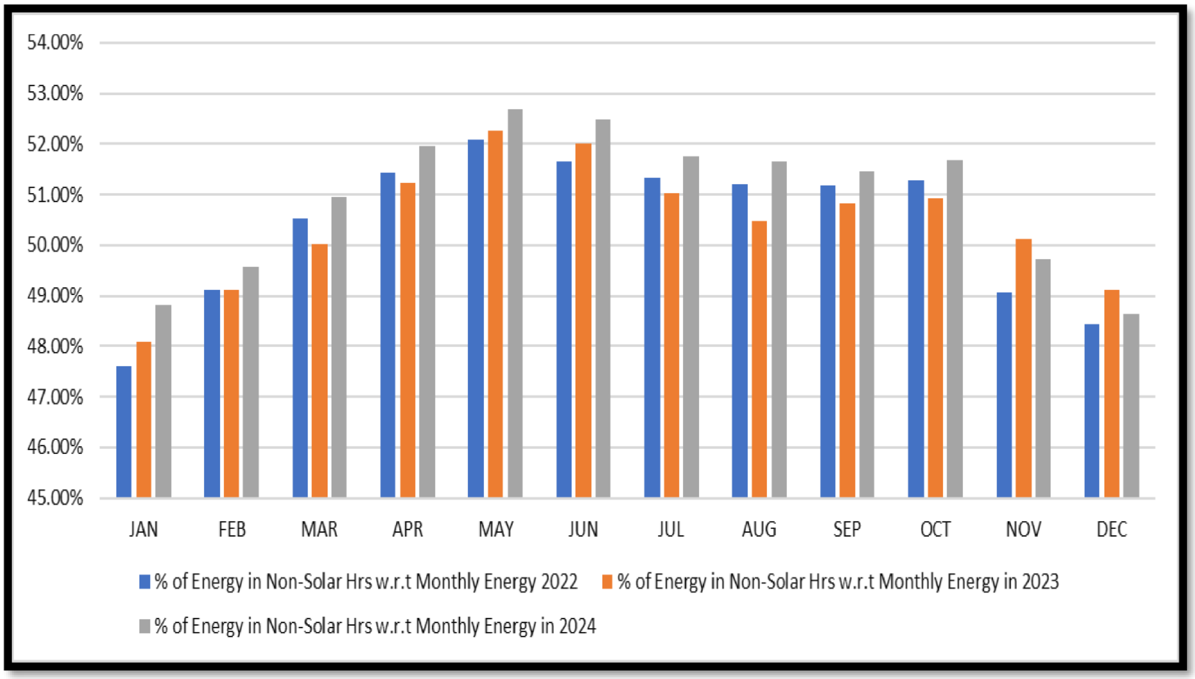

Figure 163: Percentage of Energy in Non-Solar Hrs w.r.t. Monthly Energy (2022-2024)

Key Observations:

- Total annual energy consumption steadily increased across the three years:
  - 2022: 180,398 MUs (Monthly Avg. ~15,033 MUs)
  - 2023: 195,220 MUs (Monthly Avg. ~16,268 MUs)
  - 2024: 197,958 MUs (Monthly Avg. ~16,496 MUs)
- This indicates a year-on-year demand growth of ~6–8% between 2022 and 2023, and a smaller but continued rise (~1–2%) from 2023 to 2024.
- Energy Consumption in solar hours crossing 50% in winter months (Jan, Feb, Nov, Dec) for 2022,2023 and 2024, indicating that approximately half of total energy demand is now consistently met during solar hours.
- Summer months (Apr–Jun): Increased energy consumption in non-solar hours (>51%).

15. Year-wise Share of MSPGCL Generation in Total State & MSEDCL Energy

This chapter presents illustrates the energy generation trends by Maharashtra State Power Generation Company Limited (MSPGCL) over the period from 2015 to 2024. The focus is on assessing the MSPGCL generation share in Maharashtra State Electricity Distribution Company Limited (MSEDCL) and the total state energy requirements.

15.1 Energy Generation Overview of MSPGCL (2015–2024)

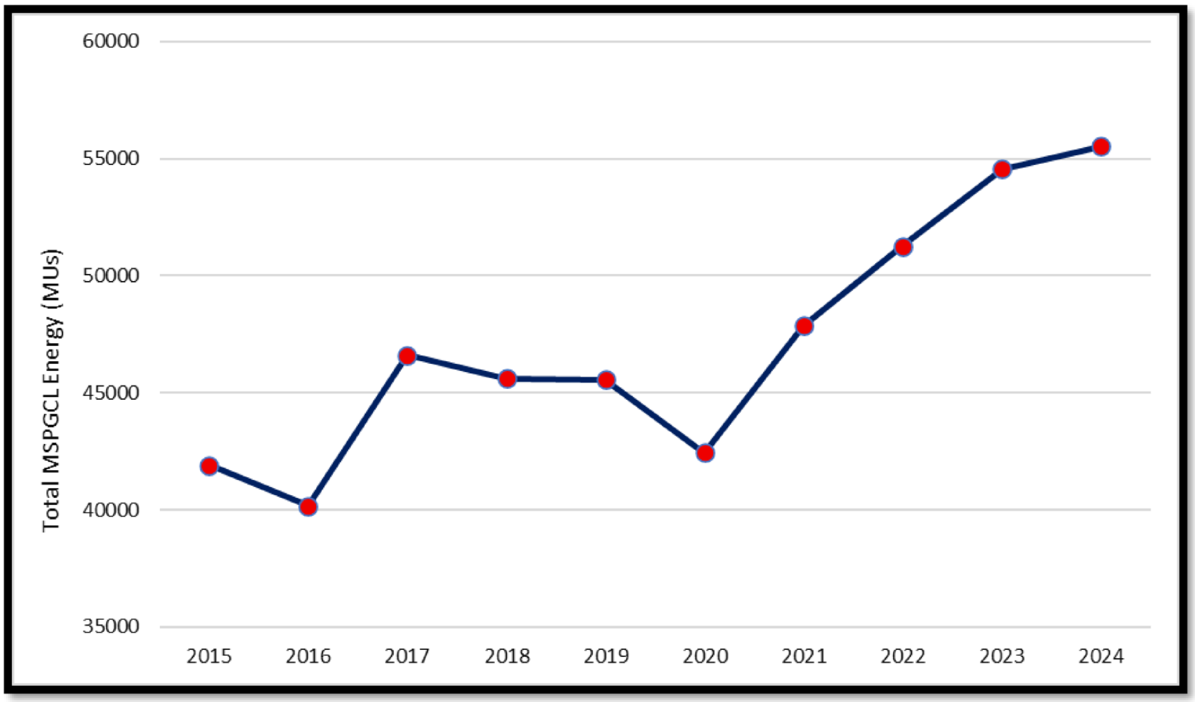

Figure 164: Total Energy (MUs) Generated by MSPGCL per year

- ❖ MSPGCL generated **41,908 MUs**, increasing to a peak generation of **55,536 MUs** in 2024, which corresponds to a **32.51% increase** in absolute terms.
- ❖ The **minimum generation** during this period was observed in **2016** at **40,166.322 MUs**, while the **maximum** of **55,536.083 MUs** was recorded in **2024**.
- ❖ Post-2020, the energy generation has consistently increased, demonstrating a **Compound Annual Growth Rate (CAGR) of 6.95%**.

15.2 Share of MSPGCL Generation in Total State Energy

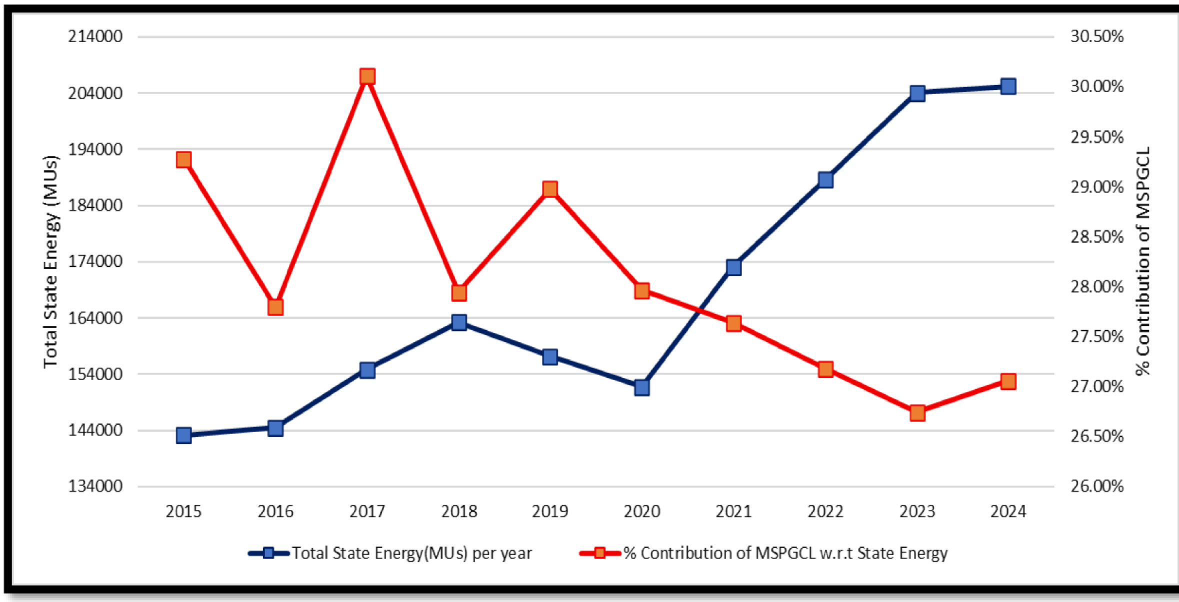

Figure 165: Total State Energy (MUs) and % share of MSPGCL in total State Energy

- **Maximum Contribution**: In **2017**, MSPGCL contributed **30.11%** of the total state energy requirement.
- **Minimum Contribution**: In **2023**, this contribution dropped to **26.74%**, the lowest in the decade.
- **Average Contribution (2015–2024)**: The average contribution of MSPGCL to total state energy stands at **28.07%**.

15.3 Share of MSPGCL Generation in Total MSEDCL Energy

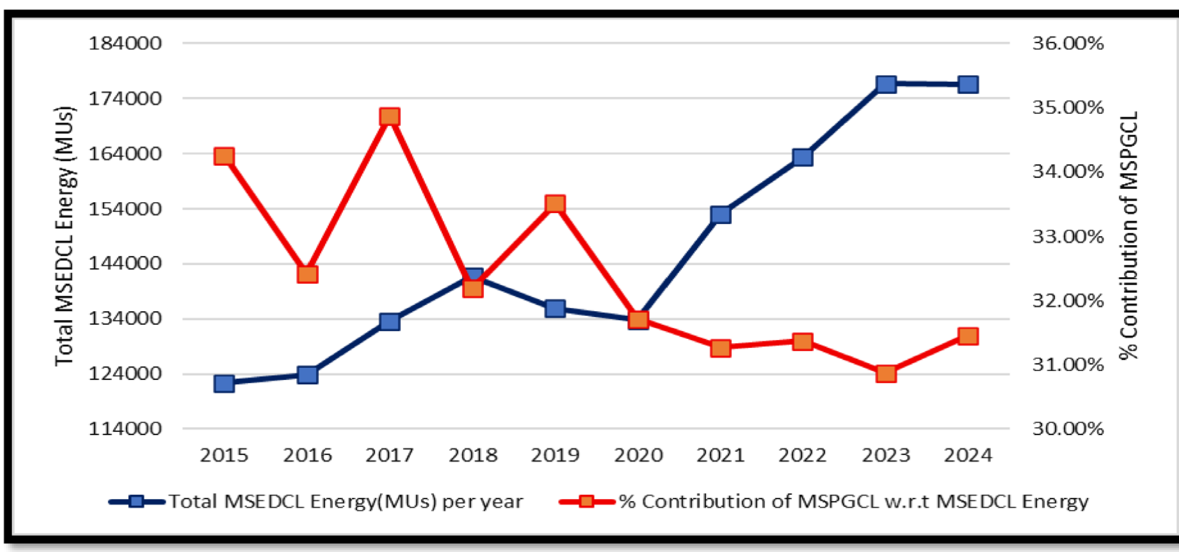

Figure 166:Total MSEDCL Energy (MUs) and % share of MSPGCL in total MSEDCL Energy

- **Maximum Contribution**: Again in **2017**, MSPGCL accounted for **34.88%** of MSEDCL's total energy supply.
- **Minimum Contribution**: The lowest was recorded in **2023**, at **30.88%**.
- **Average Contribution (2015–2024)**: The average contribution to MSEDCL's supply is **32.39%**.
- MSPGCL has consistently contributed a share of generation—**~28%** and **~32%** respectively.

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16. Thermal Energy Generation Profiles of Captive Power Producers (CPP) / Independent Power Producers (IPP) (2015–2024)

This chapter analyses the trends in energy generation by Captive Power Producers (CPP) and Independent Power Producers (IPP) in Maharashtra from 2015 to 2024. The analysis focuses on annual generation in Million Units (MUs) and the share of CPP/IPP to both Maharashtra State Electricity Distribution Company Limited (MSEDCL) and the overall state energy supply.

In addition, **the captive injection into the grid is only considered here** and not captive consumption by customer.

16.1 Energy Generation Overview (2015–2024)

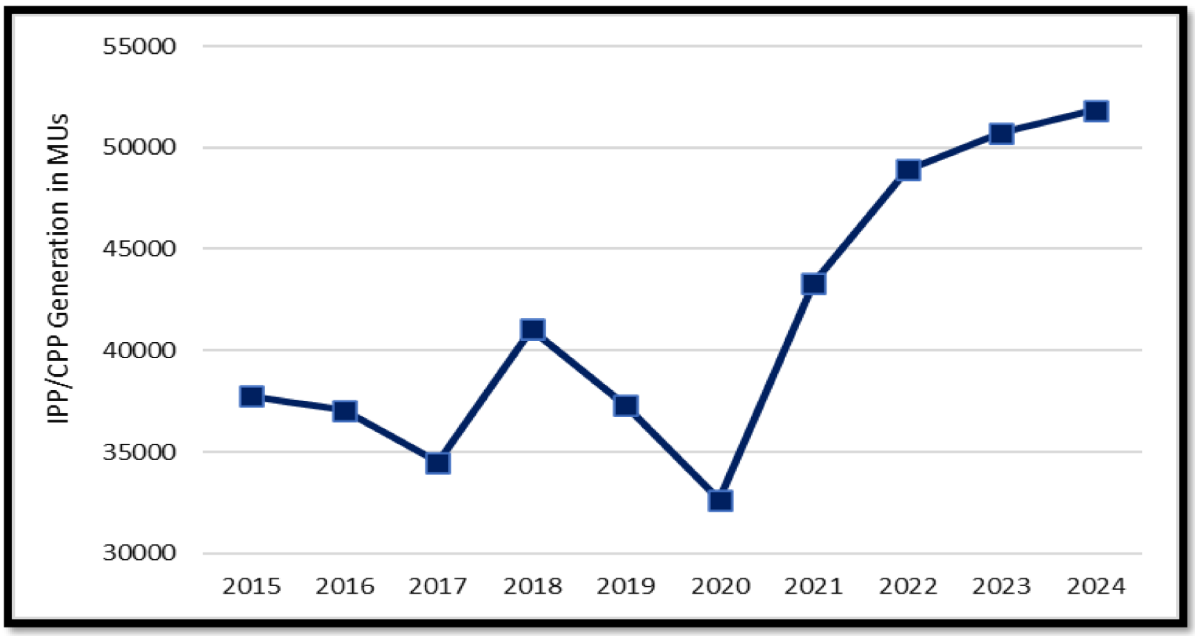

Figure 167: Total Energy Generated by IPP/CPP Thermal (in MUs) per year

The total energy generated by CPPs/IPPs has increased from **37,744 MUs** to **51,829 MUs** marking an **overall growth of 37.33%** over the decade.

- **Minimum generation** was recorded in **2020**, at **32,635 MUs**.
- **Maximum generation** occurred in **2024**, at **51,829 MUs**.

16.2 Share of CPP/IPP Thermal Generation in Total State Energy

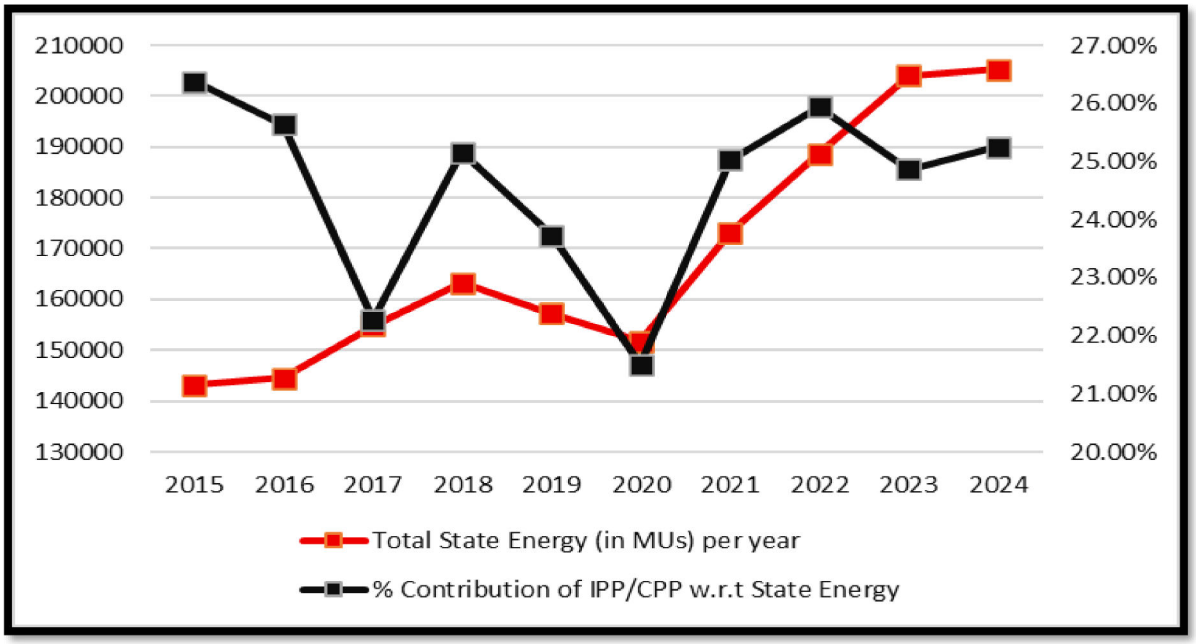

Figure 168: Percentage share of IPP/CPP Thermal in Total State Energy

- **Maximum Contribution**: In **2015**, CPP/IPP accounted for **26.37%** of the total state energy.
- **Minimum Contribution**: The lowest was observed in **2020**, at **21.50%**.
- **Average Contribution (2015–2024)**: The average contribution over the decade was approximately **24.29%**.

16.3 Share of CPP/IPP Thermal Generation in Total State Energy

- **Maximum Contribution**: In **2015**, CPP/IPP contributed **30.85%** of MSEDCL's energy.
- **Minimum Contribution**: In **2020**, the contribution dropped to **24.38%**.
- **Average Contribution (2015–2024)**: The average contribution to MSEDCL energy is **28.21%**.

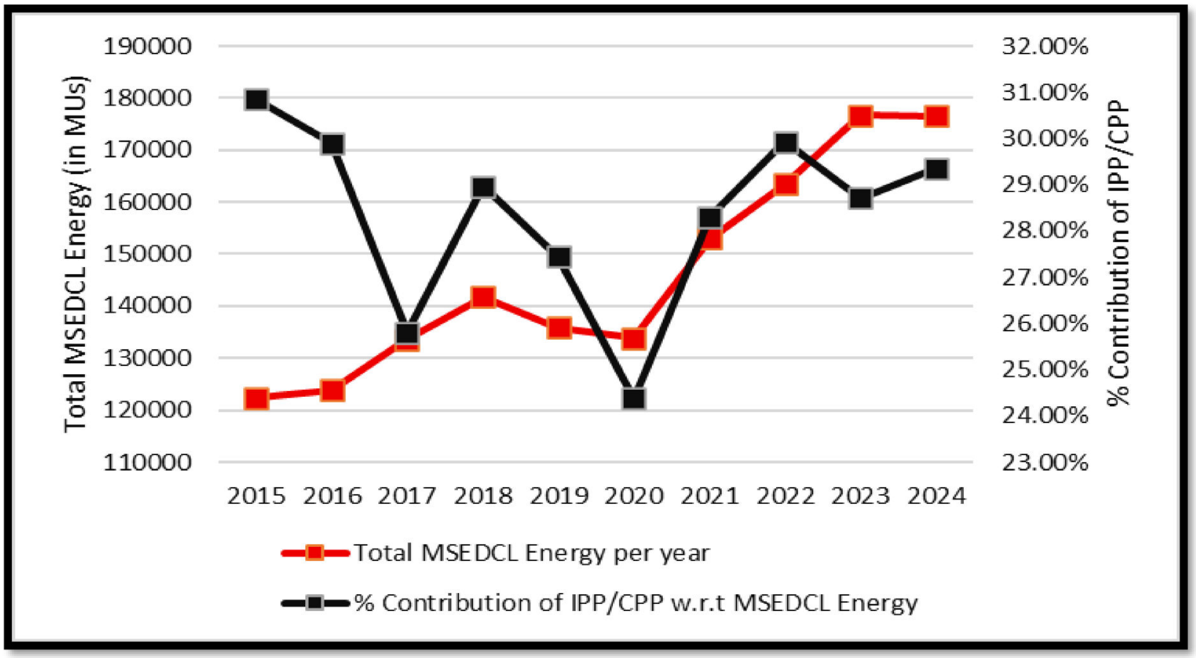

Figure 169: Percentage Share of IPP/CPP Thermal in MSEDCL Energy

Consistent Contributions: On average, CPP/IPP has contributed over **24%** to state energy and **28%** to MSEDCL energy.

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17. Solar and Wind Time Duration Curves

17.1 Solar Generation Duration Curve (2015–2024)

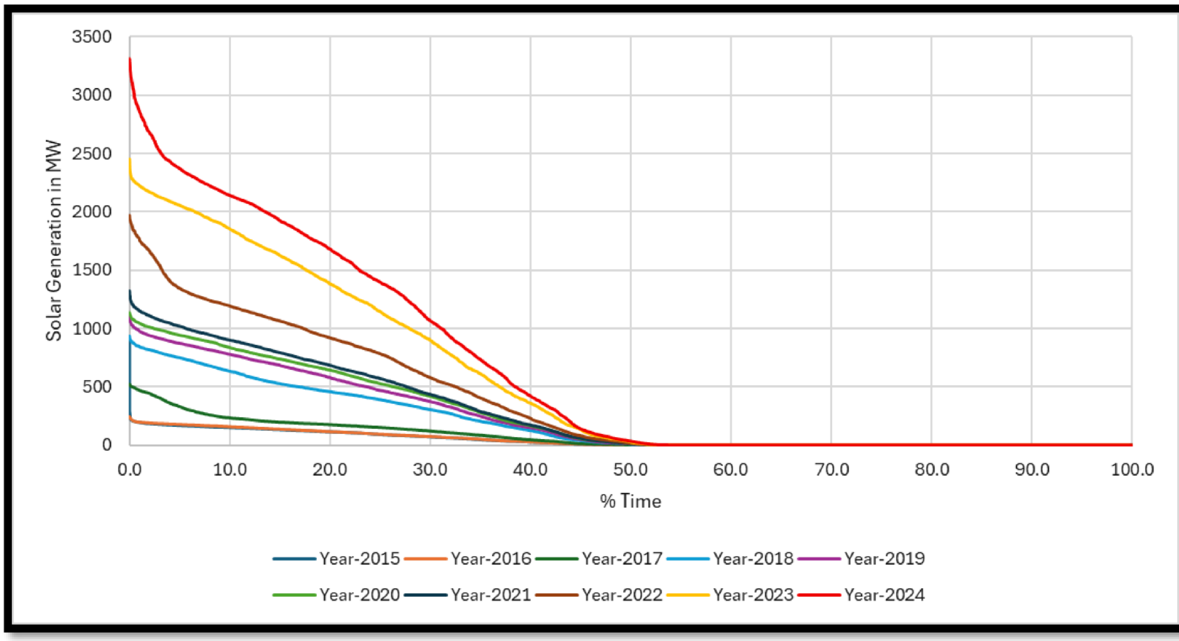

Figure 170: Solar Generation Duration Curves (2015-24)

Figure 170 shows Solar generation duration curves for each year from 2015 to 2024. The overall generation values are increasing over the years, indicating an upward trend in solar power capacity. Peak generation has increased from 910 MW in 2015 to 3313 MW in 2024, reflecting a 264% rise in solar energy capacity.

Table 18: Solar Generation Time Duration Curve Statistics (2015-2024)

Solar Generation (MW)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
≥ 500 MW	0.01 %	0.00 %	0.29 %	16.9 1%	23.77 %	26.32 %	27.69 %	32.65 %	37.00 %	38.50 %
≥ 1000 MW	0.00 %	0.00 %	0.00 %	0.00 %	0.64 %	2.44%	5.67%	17.35 %	28.03 %	31.15 %
≥ 1500 MW	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00%	0.00%	3.28%	17.68 %	22.93 %

Solar Generation (MW)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
≥ 2000 MW	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00%	0.00%	0.00%	6.59%	13.59 %
≥ 2500 MW	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00%	0.00%	0.00%	0.00%	3.18%
≥ 3000 MW	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00%	0.00%	0.00%	0.00%	0.49%

In 2015, the share of solar generation above 500 MW was almost negligible at 0.01%; however, by 2024 it had risen to 38.5%, demonstrating a significant expansion in installed capacity.

The steady rise in solar generation above 500 MW to over one-third of the time in 2024 implies that solar has become a important contributor to meeting daytime demand, thereby reducing reliance on conventional sources in solar hours. The emergence and growth of higher capacity thresholds, particularly above 1000 MW and 1500 MW, indicate a stronger load contribution from solar, which enhances energy security but also necessitates greater flexibility in conventional generation to manage variability. The sharp increase in generation above 2000 MW and the appearance of 2500 MW and 3000 MW levels in 2024 illustrate the system's transition towards high solar penetration during peak hours.

17.2 Wind Generation Duration Curve (2015–2024)

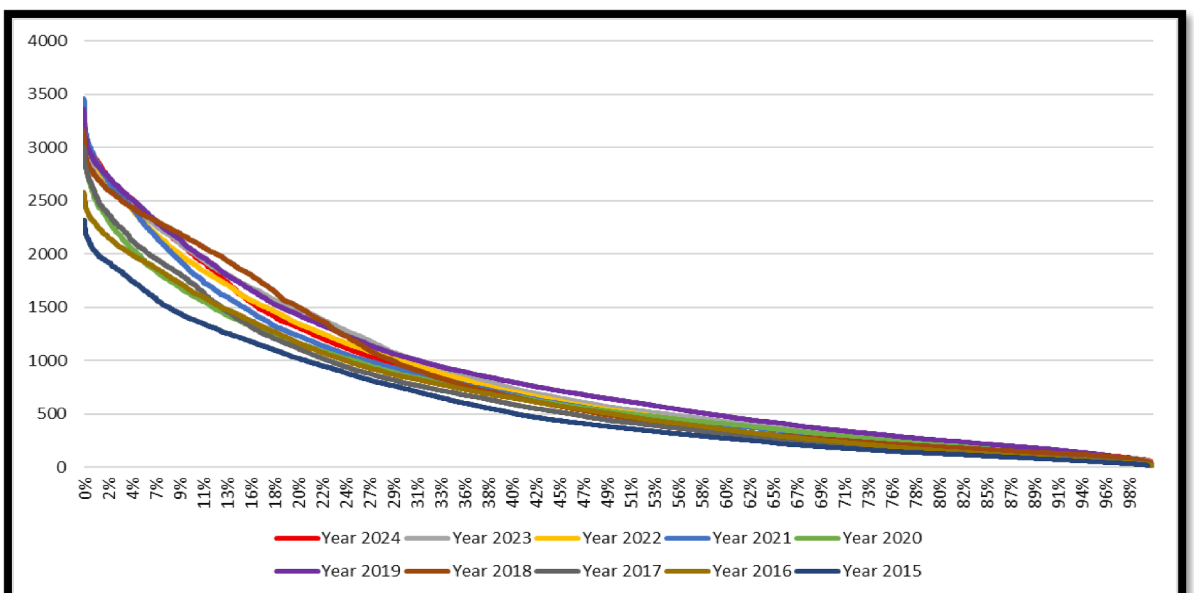

Figure 171: Wind Generation Duration Curves (2015-24)

This table shows the percentage of time the wind generation remained **above specific thresholds** (500 MW, 1000 MW, etc.) for each year:

Table 19: Wind Generation Time Duration Curve Statistics (2015-2024)

Wind Generation (MW)	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
≥ 500 MW	40.5 %	49.5 %	45.7 %	48.6 %	58.6 %	51.2 %	51.0 %	52.1 %	54.5 %	51.7 %
≥ 1000 MW	20.8 %	24.5 %	22.9 %	28.9 %	31.4 %	25.2 %	26.5 %	29.9 %	31.2 %	27.8 %
≥ 1500 MW	7.9%	12.8 %	12.9 %	20.1 %	18.5 %	12.0 %	15.0 %	17.1 %	19.6 %	16.3 %
≥ 2000 MW	1.2%	4.4%	6.1%	12.4 %	10.6 %	5.0%	8.3%	9.0%	10.4 %	10.2 %
≥ 2500 MW	0.0%	0.08 %	1.3%	3.5%	4.6%	1.1%	3.8%	3.8%	3.6%	4.6%
≥ 3000 MW	0.0%	0.0%	0.01 %	0.07 %	0.3%	0.1%	0.57 %	0.49 %	0.27 %	0.42 %

The consistent availability of generation above 500 MW, peaking at 54.5% in 2023, shows that wind has become a contributor to the energy mix, supporting base and mid-level demand. However, the variation in the share of wind generation above 1000 MW (20–31%) introduces variability that must be managed through flexible thermal generation, hydro support.

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18. Quarter-wise Wind and Solar Generation Profiles

This chapter illustrates the quarter-wise behaviour of daily peak Wind and Solar generation. For each quarter, the maximum daily generation is identified and analysed over the ten-year period from 2015 to 2024 to understand trends in renewable generation.

18.1 Quarter-wise behaviour of daily peak Solar Generation

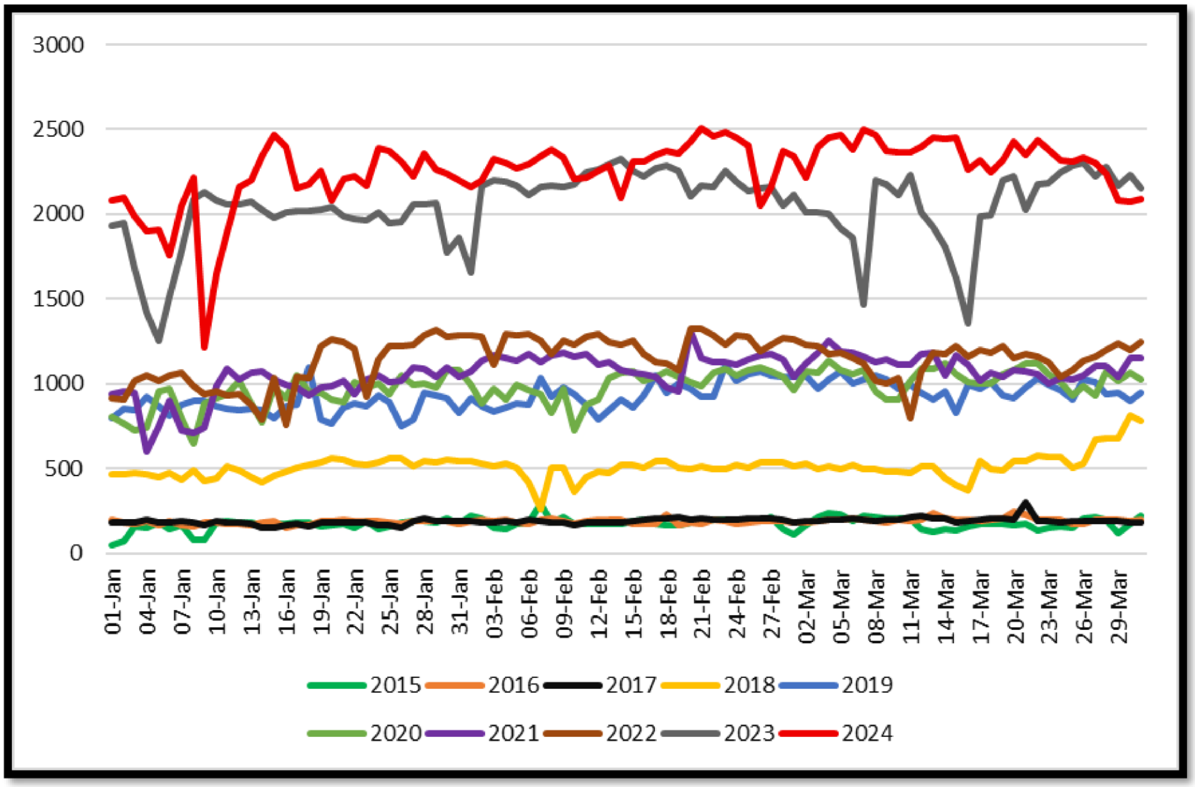

Figure 172: Daily Maximum Solar Generation-Q1[Jan – March]

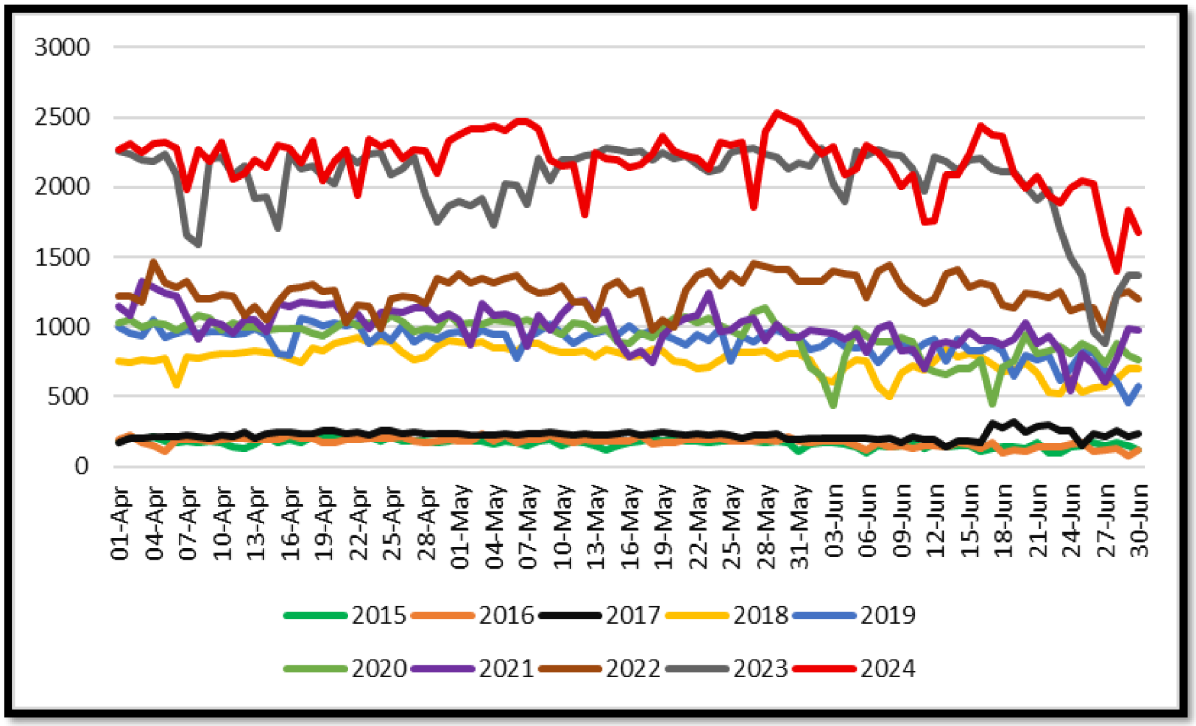

Figure 173: Daily Maximum Solar Generation-Q2 [Apr – June]

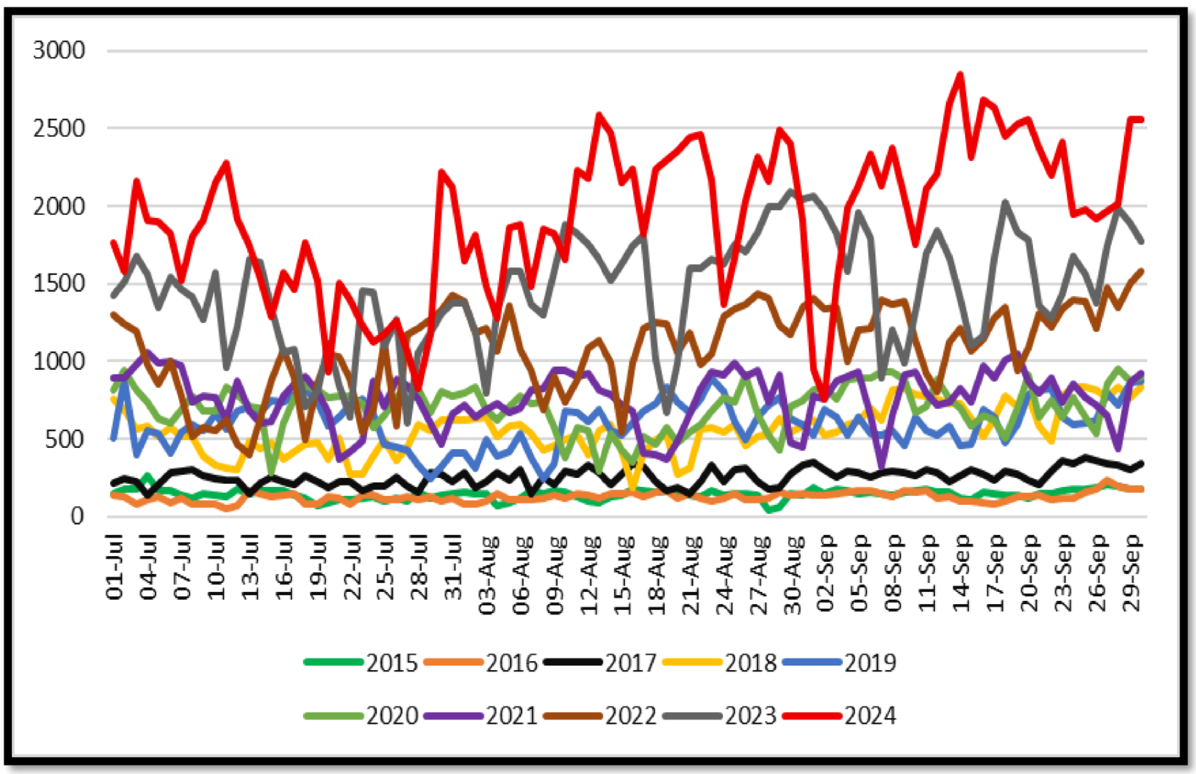

Figure 174: Daily Maximum Solar Generation-Q3 [Jul – Sep]

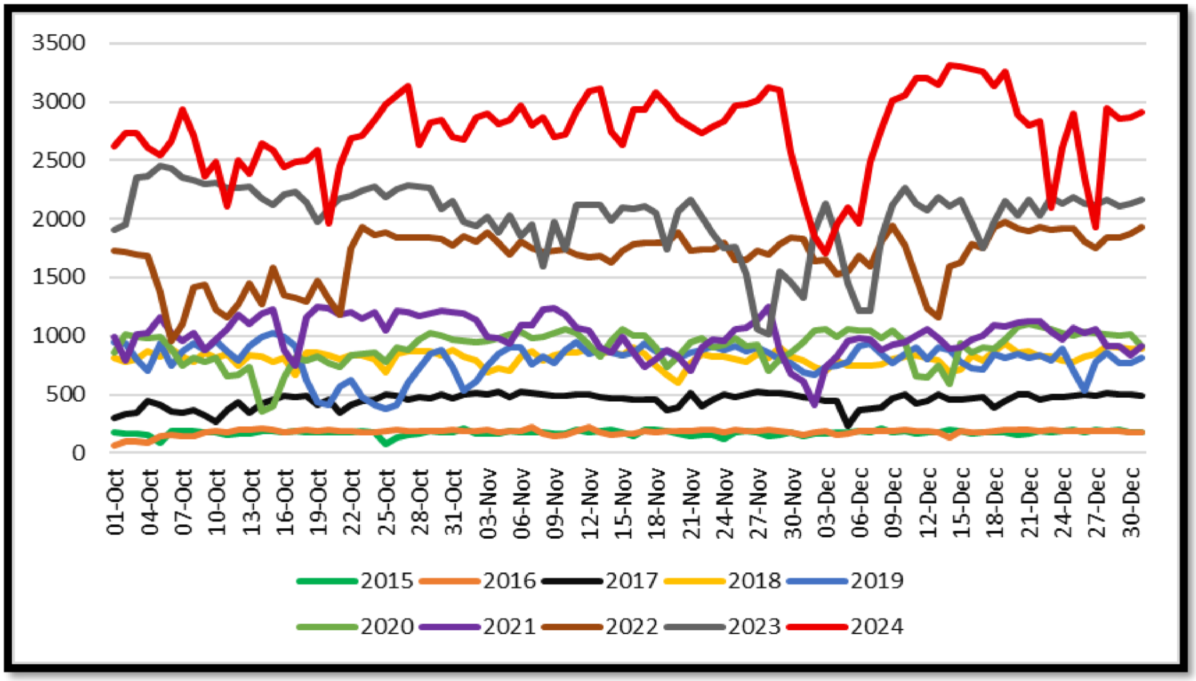

Figure 175: Daily Maximum Solar Generation-Q4 [Oct – Dec]

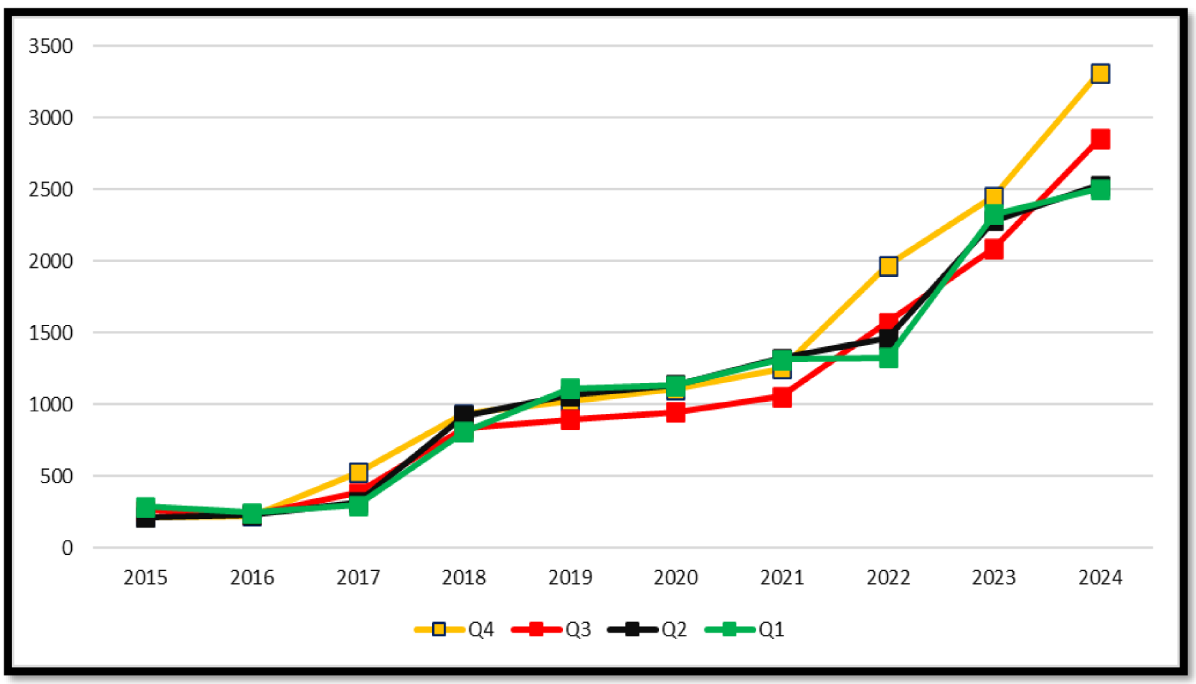

Figure 176: Year wise Maximum Solar Generation in Q1 to Q4

It is observed that **maximum solar generation** has increased across all quarters from 2015 to 2024, reflecting substantial growth in solar capacity and utilization:

- In **Q1**, the maximum solar generation increased from **290 MW in 2015** to **2505 MW in 2024**.
- In **Q2**, it rose from **216 MW in 2015** to **2531 MW in 2024**.
- In **Q3**, the generation climbed from **261 MW in 2015** to **2851 MW in 2024**.
- In **Q4**, the highest seasonal growth was observed, with maximum solar generation increasing from **215 MW in 2015** to **3313 MW in 2024**.

18.2 Quarter-wise behaviour of Daily Peak Wind Generation

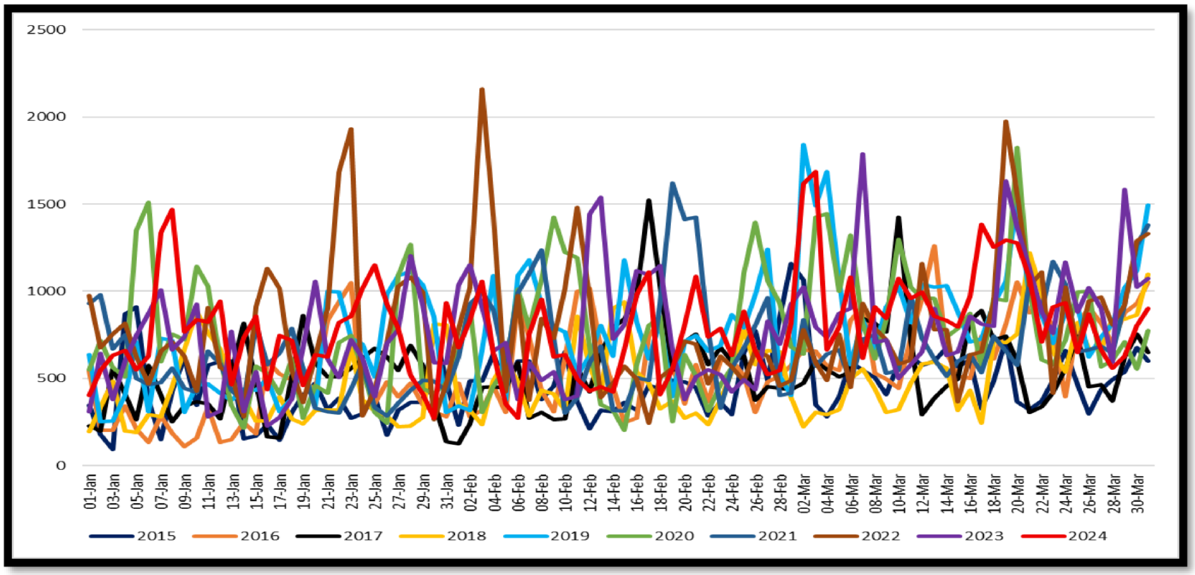

Figure 177: Daily Maximum Wind Generation -Q1

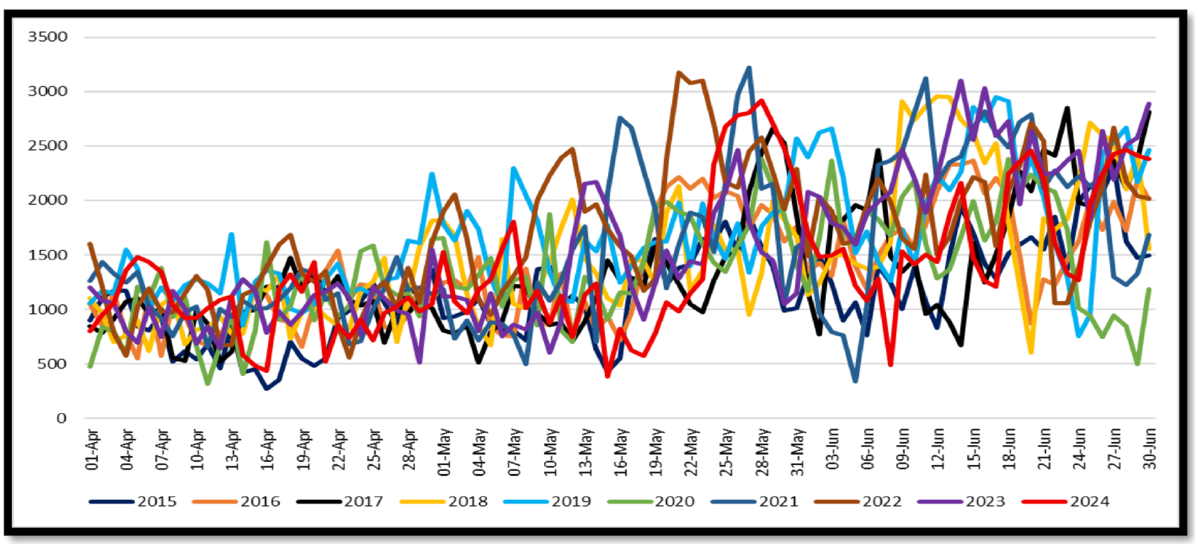

Figure 178: Daily Maximum Wind Generation -Q2

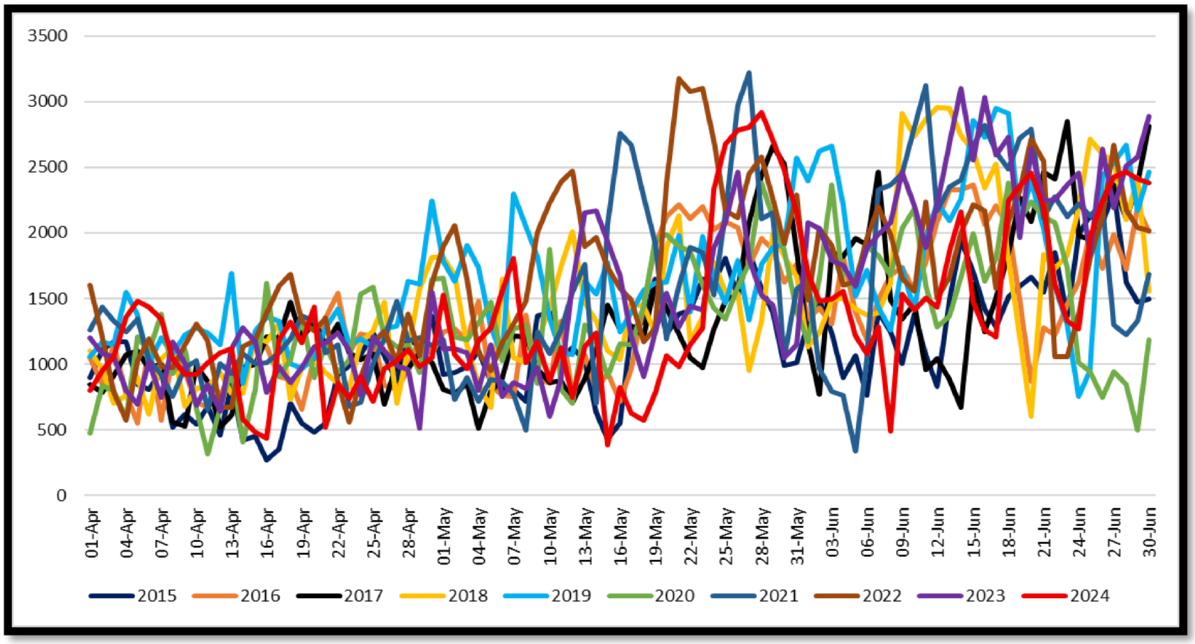

Figure 179: Daily Maximum Wind Generation -Q2

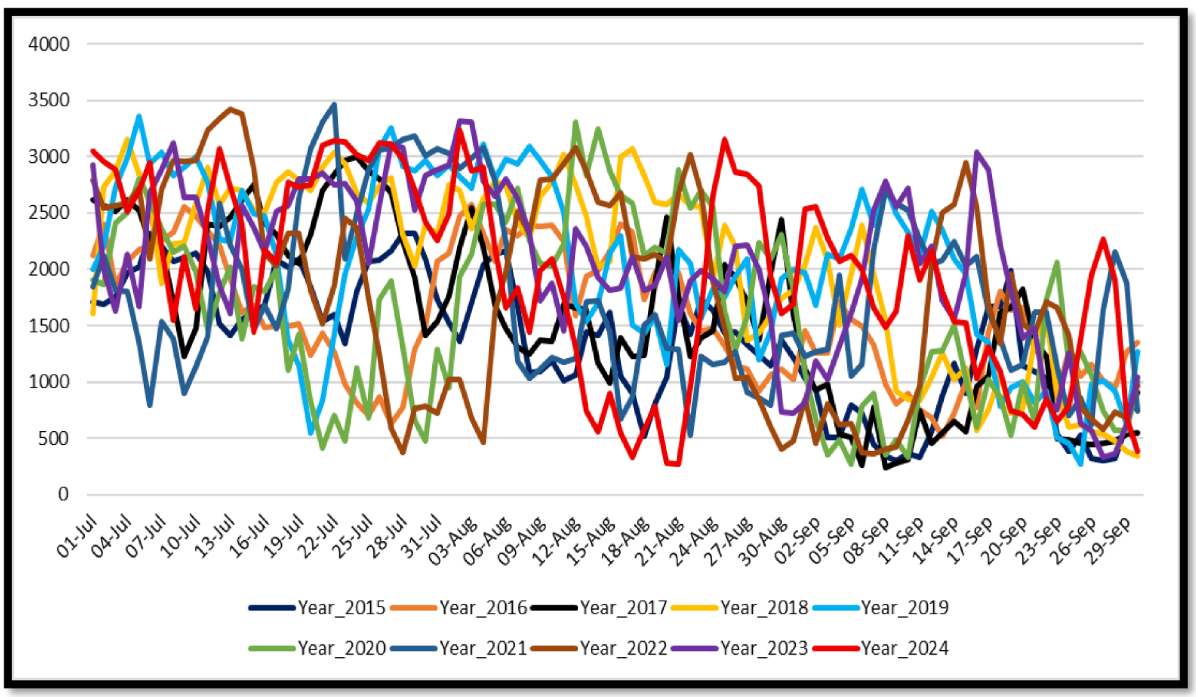

Figure 180: Daily Maximum Wind Generation -Q3

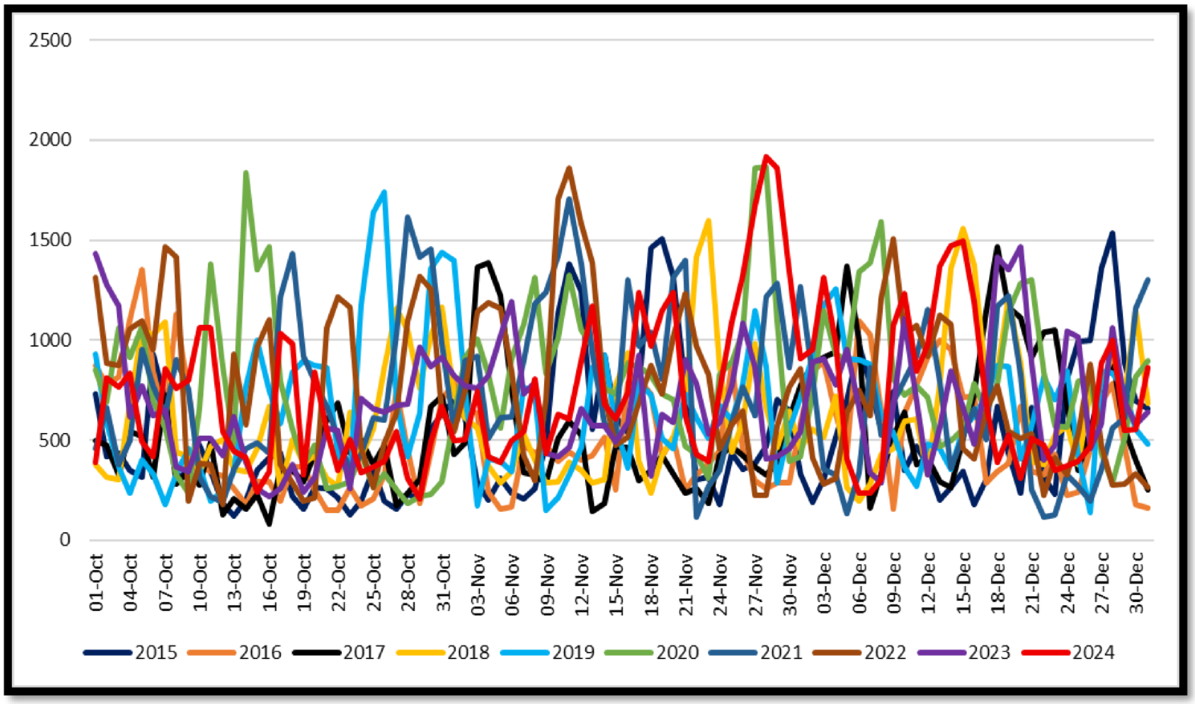

Figure 181: Daily Maximum Wind Generation -Q4

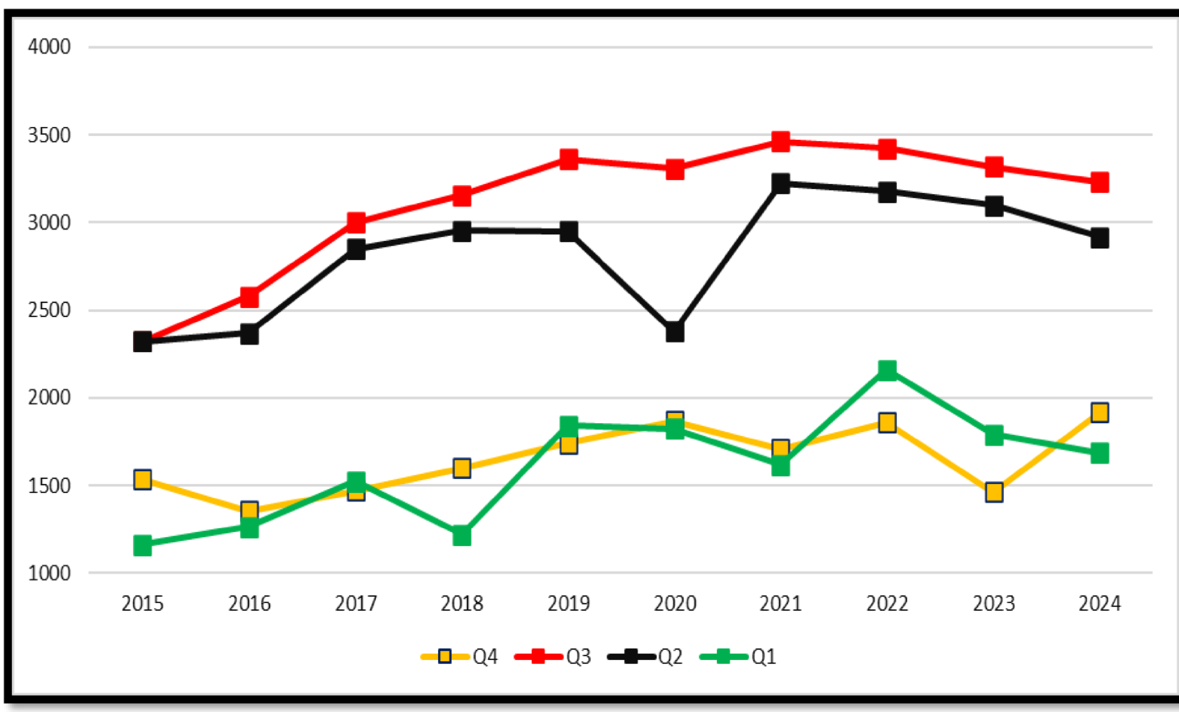

Figure 182: Year wise Maximum Wind Generation in Q1 to Q4

- In **Q1**, the maximum wind generation rose from **1161 MW in 2015** to **1687 MW in 2024**.
- In **Q2**, it increased from **2320 MW in 2015** to **2916 MW in 2024**.
- In **Q3**, the generation further rose from **2320 MW in 2015** to **3332 MW in 2024**, showing the highest seasonal peak among all quarters.
- In **Q4**, the maximum wind generation increased from **1533 MW in 2015** to **1917 MW in 2024.**

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19. Inter-State Transmission System Drawal (Under-Drawal / Over-Drawal)

19.1. Introduction

This chapter presents the Inter-State Transmission System (ISTS) Drawal patterns, focusing on Under-Drawal (UD) and Over-Drawal (OD) trends from 2015 to 2024. The UD and OD are calculated as the difference between central sector receipt (*refer Appendix-A (1.2)*) and central sector share; if receipt is higher than share, it is over-drawal, otherwise it is under-drawal. Positive values on the demand curve indicate over-drawal (OD), while negative values indicate under-drawal (UD).

- Commercial operation of the DSM framework in the state of Maharashtra, following directives from the Maharashtra Electricity Regulatory Commission (MERC), commenced on October 11, 2021.
- The volume limit of 250 MW was a threshold used in Maharashtra for setting deviation limits.

19.2 Under-drawal and Over-drawal behaviour – Time Duration Curves

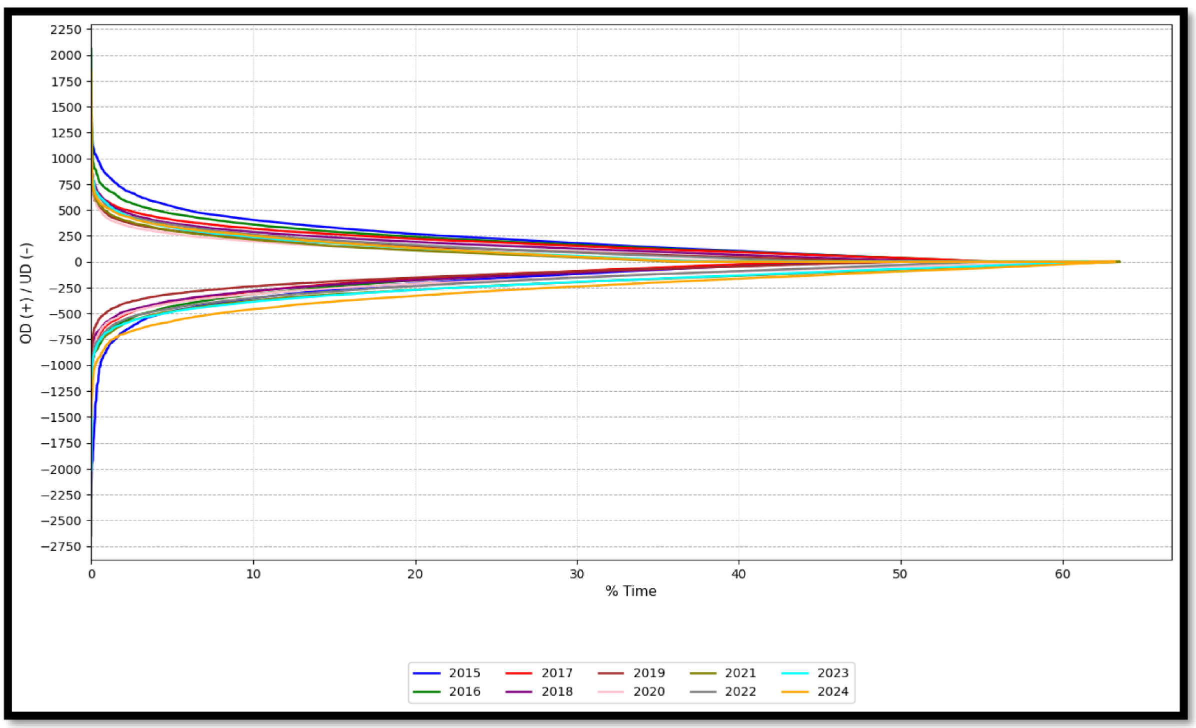

Figure 183: ISTS Drawal [UD/OD] 2015-2024

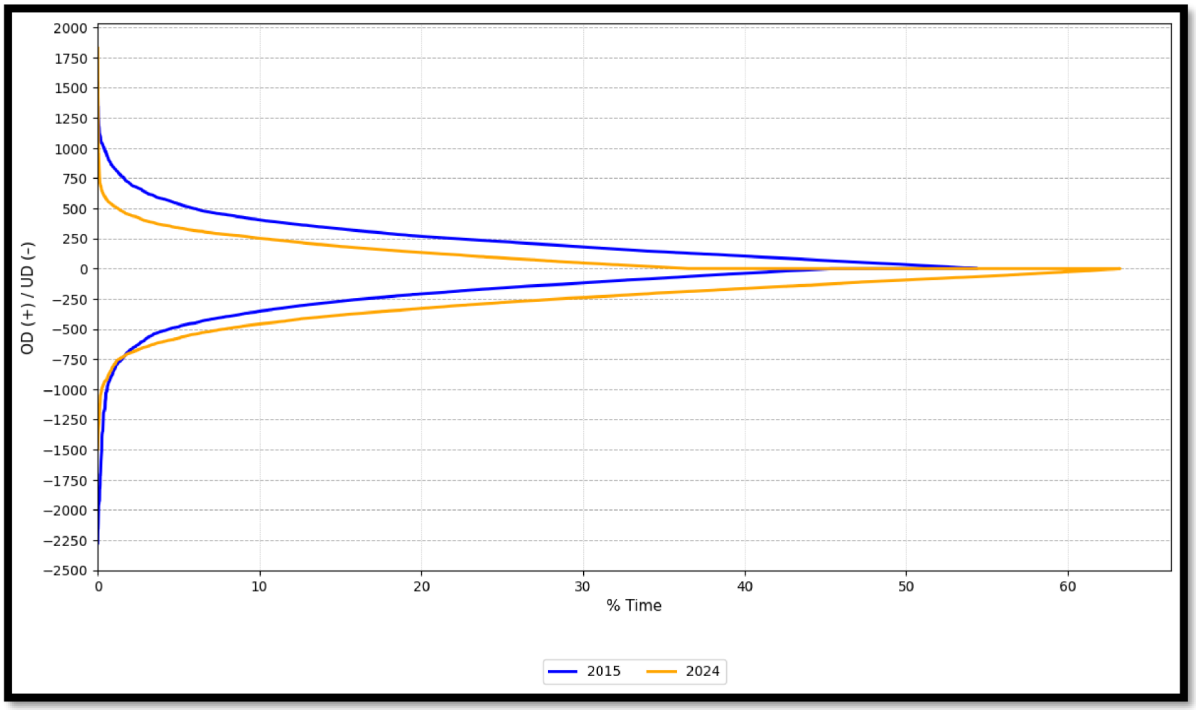

Figure 184: ISTS Drawal [UD/OD] for 2015 and 2024

In 2015, OD/UD data is available for **364 days**, whereas in 2024 the data covers **366 days**; this difference in data availability causes the 2024 duration curve to extend beyond 60% time compared to 2015.

Based on the time duration curve for ISTS DRAWAL [UD/OD] from 2015-2024, it has been observed that:

1. Year 2015 shows the highest over-drawal (OD) values overall.
2. Year 2024 demonstrates the highest under-drawal (UD) pattern across most of the time duration.
3. The convergence of all curves toward zero indicates that for a significant portion of time, the grid operates close to scheduled values across all years.

Table 20: Year-wise Time Share of OD/UD within ±250 MW Band

Year	Total Time Blocks available	Blocks within ±250 MW	% Time within ±250 MW
2015	8,736	5,385	**61.64%**
2016	8,784	5,865	**66.77%**
2017	8,760	6,217	**70.97%**
2018	8,760	6,474	**73.90%**
2019	8,760	7,234	**82.58%**
2020	8,784	6,879	**78.31%**
2021	8,760	6,096	**69.59%**
2022	8,760	6,189	**70.65%**
2023	8,760	5,956	**67.99%**
2024	8,783	5,384	**61.30%**

The system stayed within the ±250 MW OD/UD band for **~62%–83% of the time**, with the **best performance in 2019** and relatively lower containment in **2015 and 2024**.

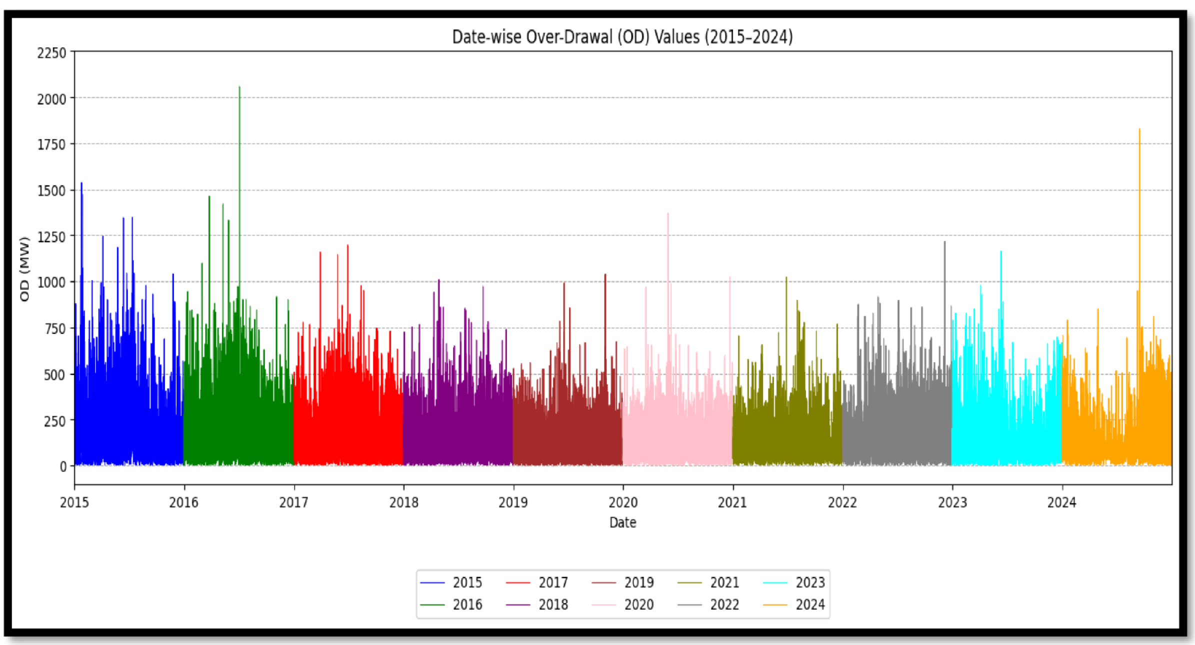

Figure 185: Date-wise Over-drawal scenario (2015-2024)

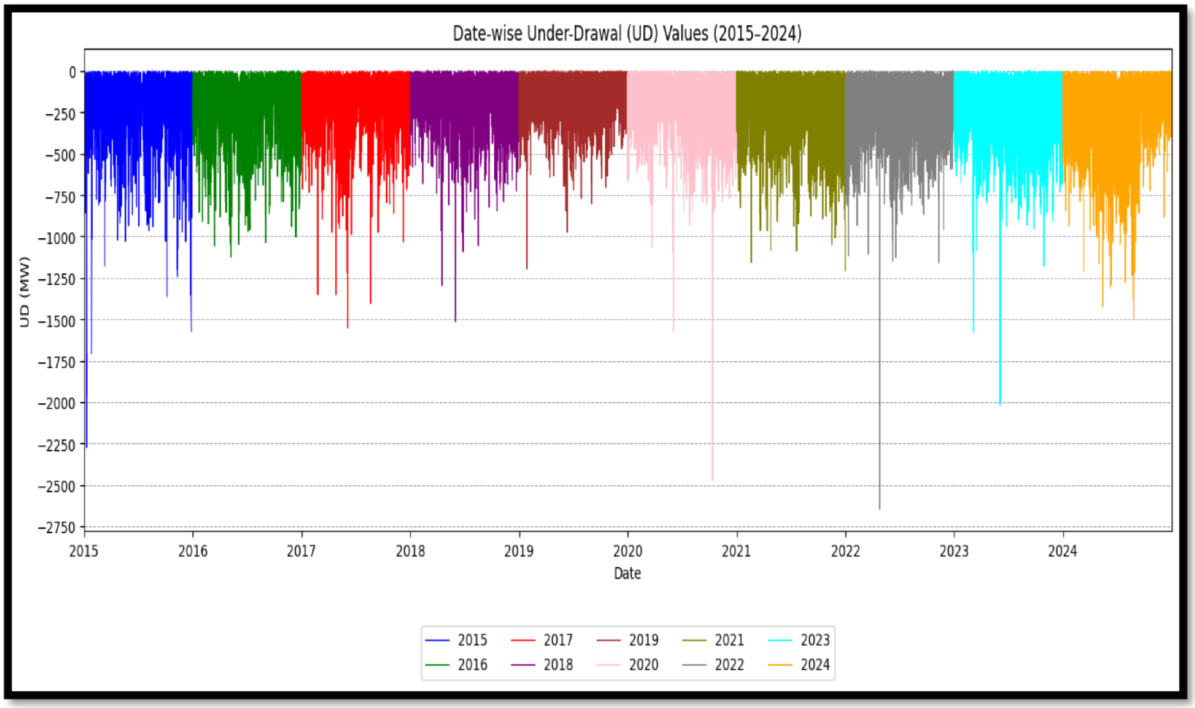

Figure 186: Date-wise Under-drawal scenario (2015-2024)

These above two charts (Figure 185 & 186) present the **date-wise behaviour of over-drawal (OD) and under-drawal (UD)** of the Maharashtra power system from **2015 to 2024**. The OD chart highlights periods when the state drew power in excess of its scheduled share, while the UD chart shows instances of drawal below the schedule.

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District-wise Energy Consumption (2022-2024)

20. District-wise Energy Consumption (2022-2024)

20.1 Introduction

This chapter provides a comprehensive district-wise analysis of energy consumption across all 36 districts of Maharashtra State for the period 2022–2024. The analysis is carried out using intrastate energy consumption expressed in million units (MUs) and includes district-wise comparative visualizations, growth rate analysis for 2022–2023 and 2023–2024, and the percentage contribution of each district to the total state energy consumption for the respective years. The analysis focuses on the five highest and five lowest energy-consuming districts and examines their consumption patterns and growth.

20.2 District wise energy consumption (2022-2024)

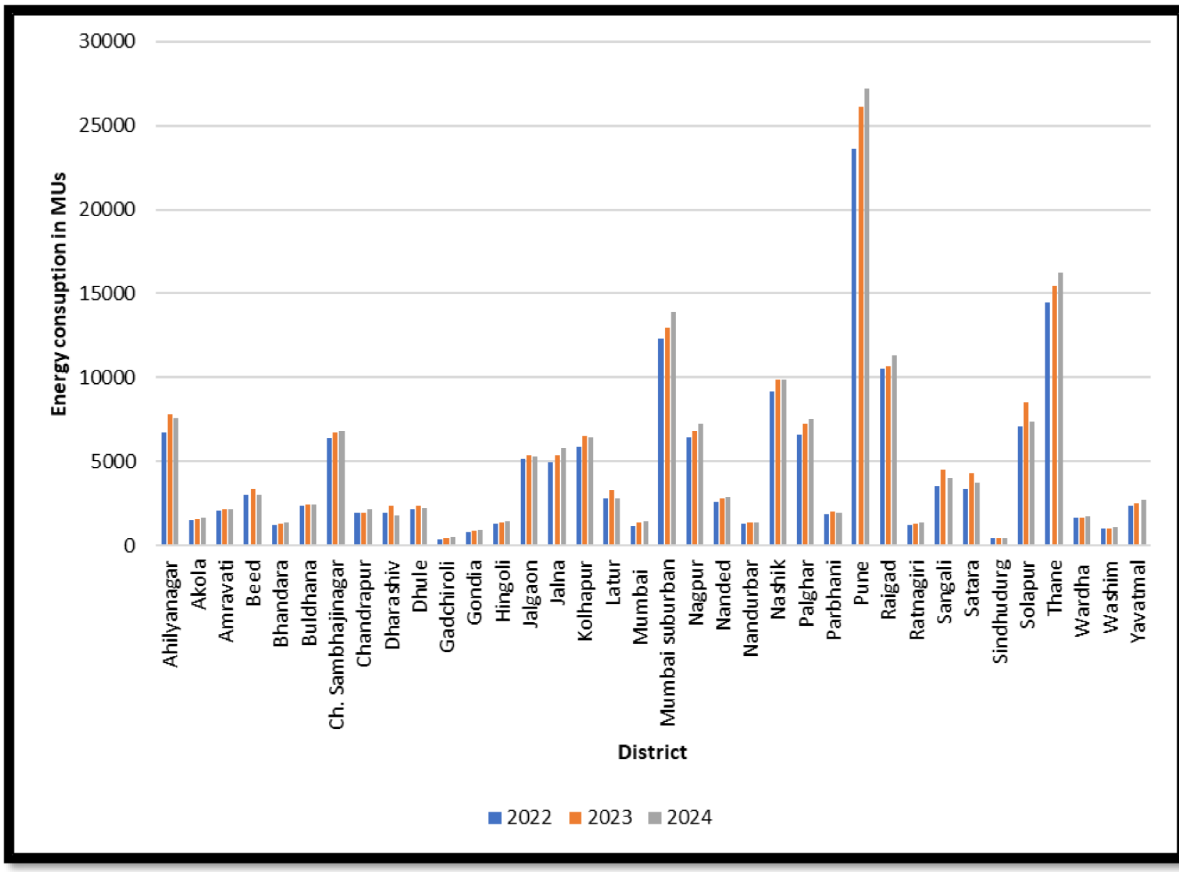


Figure 187: District wise energy consumption comparison (2022-2024)

Observations:

The above plot illustrates a district-wise comparison of energy consumption (in MUs) across 36 districts over a three-year period from 2022 to 2024. The table below gives statistical insights.

Table 21: District-wise energy consumption for 36 districts for the year 2022 to 2024

District	Energy consumption in MUs for 2022	Energy consumption in MUs for 2023	Energy consumption in MUs for 2024
Ahilyanagar	6761.05	7799.74	7554.33
Akola	1509.86	1598.06	1671.79
Amravati	2038.40	2153.69	2160.76
Beed	2999.44	3374.95	2995.23
Bhandara	1189.07	1262.18	1378.73
Buldhana	2331.55	2418.86	2412.24
Ch. Sambhajinagar	6402.35	6715.13	6791.09
Chandrapur	1901.95	1959.89	2113.42
Dharashiv	1915.83	2327.41	1820.69
Dhule	2166.22	2358.14	2225.80
Gadchiroli	367.94	433.95	472.52
Gondia	817.03	874.88	952.01
Hingoli	1277.31	1356.35	1430.73
Jalgaon	5180.14	5373.75	5296.85
Jalna	4946.40	5397.79	5830.91
Kolhapur	5874.66	6520.42	6439.01
Latur	2791.62	3290.51	2776.34
Mumbai	1166.95	1333.21	1408.08
Mumbai suburban	12322.31	12969.74	13902.86
Nagpur	6474.19	6789.41	7249.87
Nanded	2571.84	2785.62	2881.26
Nandurbar	1296.37	1381.79	1364.62
Nashik	9134.16	9846.54	9867.62
Palghar	6591.47	7241.94	7484.63
Parbhani	1891.24	1987.84	1910.18
Pune	23620.60	26121.44	27217.59
Raigad	10523.96	10689.99	11342.04
Ratnagiri	1190.42	1263.55	1324.15
Sangli	3515.31	4475.98	3994.05
Satara	3390.00	4319.15	3708.36
Sindhudurg	409.70	442.36	452.89
Solapur	7116.50	8504.65	7370.39
Thane	14491.85	15466.46	16256.59
Wardha	1615.04	1666.59	1719.90
Washim	984.02	984.58	1052.04

District	Energy consumption in MUs for 2022	Energy consumption in MUs for 2023	Energy consumption in MUs for 2024
Yavatmal	2372.27	2517.75	2695.96

20.2.1 Heat Map Showing Energy Consumption (MUs) for the Ten Highest Energy-Consuming Districts (2022–2024)

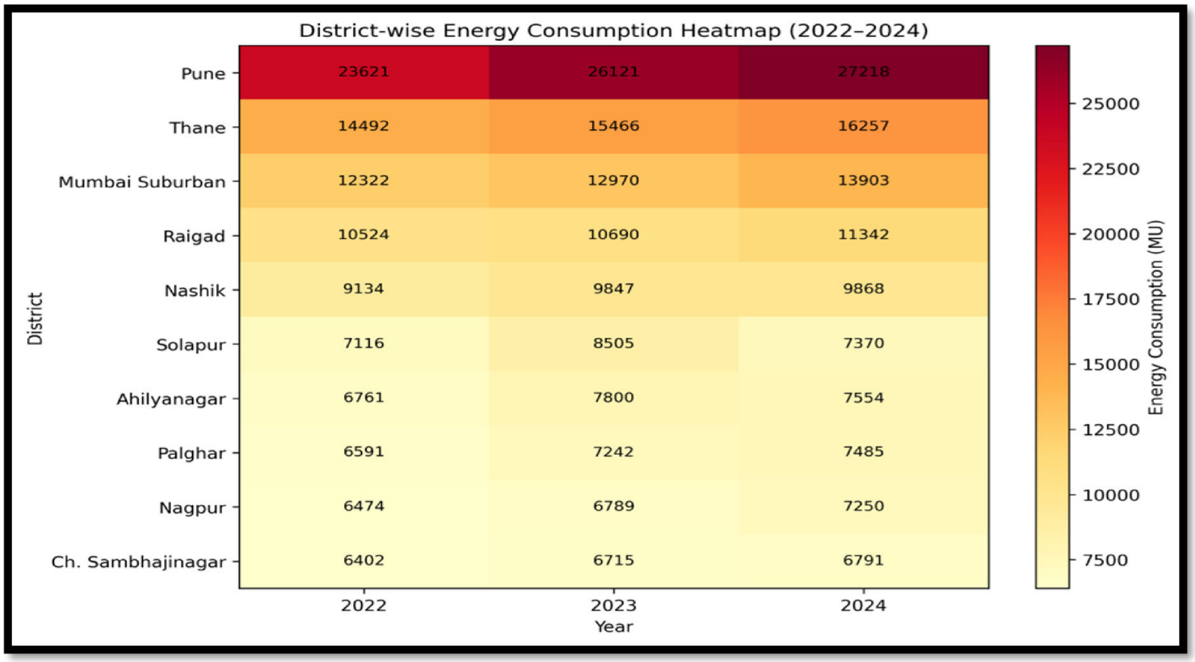


Figure 188: Energy consumption in MUs for 10 highest energy consuming districts (2022-2024)

The above heat map illustrates the energy consumption of 10 highest energy consuming districts over the period 2022–2024.

20.2.2 Percentage Growth rate of Energy Consumption in MUs for 2022-2023

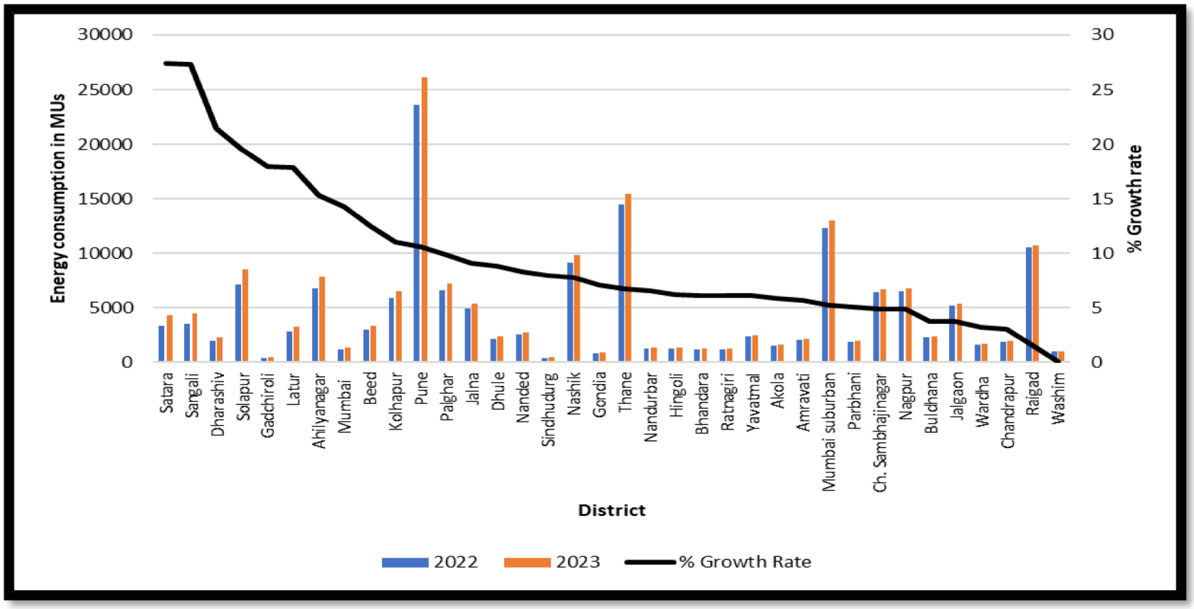


Figure 189: Energy consumption Growth Rate 2022-2023

Observations:

The above plot illustrates the percentage growth rate across 36 districts from 2022 to 2023. The table below gives statistical insights.

Table 22: Energy consumption Growth rate for 36 districts for 2022-2023

District	Energy consumption in MUs for 2022	Energy consumption in MUs for 2023	% Growth Rate
Ahilyanagar	6761.05	7799.74	15.36
Akola	1509.86	1598.06	5.84
Amravati	2038.40	2153.69	5.66
Beed	2999.44	3374.95	12.52
Bhandara	1189.07	1262.18	6.15
Buldhana	2331.55	2418.86	3.74
Ch. Sambhajinagar	6402.35	6715.13	4.89
Chandrapur	1901.95	1959.89	3.05
Dharashiv	1915.83	2327.41	21.48
Dhule	2166.22	2358.14	8.86
Gadchiroli	367.94	433.95	17.94
Gondia	817.03	874.88	7.08
Hingoli	1277.31	1356.35	6.19
Jalgaon	5180.14	5373.75	3.74

District	Energy consumption in MUs for 2022	Energy consumption in MUs for 2023	% Growth Rate
Jalna	4946.40	5397.79	9.13
Kolhapur	5874.66	6520.42	10.99
Latur	2791.62	3290.51	17.87
Mumbai	1166.95	1333.21	14.25
Mumbai suburban	12322.31	12969.74	5.25
Nagpur	6474.19	6789.41	4.87
Nanded	2571.84	2785.62	8.31
Nandurbar	1296.37	1381.79	6.59
Nashik	9134.16	9846.54	7.8
Palghar	6591.47	7241.94	9.87
Parbhani	1891.24	1987.84	5.11
Pune	23620.60	26121.44	10.59
Raigad	10523.96	10689.99	1.58
Ratnagiri	1190.42	1263.55	6.14
Sangli	3515.31	4475.98	27.33
Satara	3390.00	4319.15	0
Sindhudurg	409.70	442.36	7.97
Solapur	7116.50	8504.65	19.51
Thane	14491.85	15466.46	6.73
Wardha	1615.04	1666.59	3.19
Washim	984.02	984.58	0.06
Yavatmal	2372.27	2517.75	6.13

20.2.3 Percentage Growth rate of Energy Consumption in MUs for 2023-2024

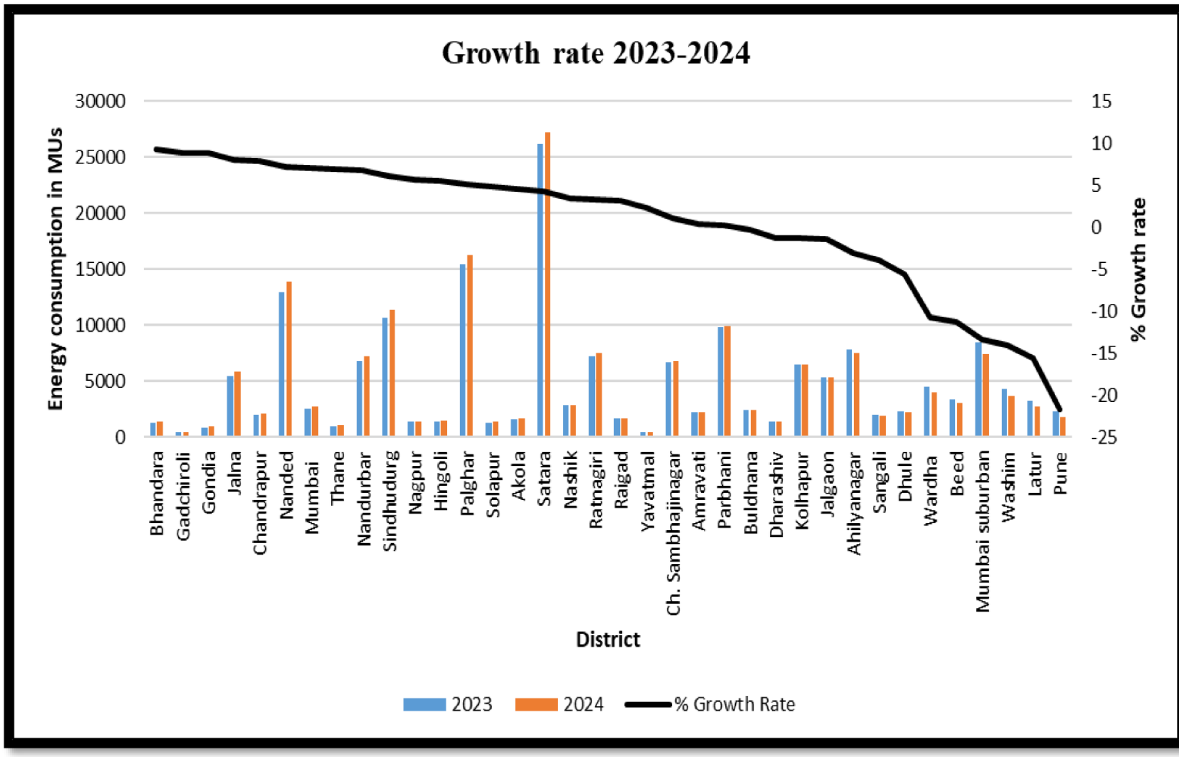


Figure 190: Energy consumption Growth rate 2023-2024

Observations:

The above plot illustrates the percentage growth rate across 36 districts from 2023 to 2024. The table below gives statistical insights.

Table 23: Energy consumption Growth rate for 36 districts for 2023-2024

District	2023	2024	% Growth Rate
Ahilyanagar	7799.74	7554.33	-3.15
Akola	1598.06	1671.79	4.61
Amravati	2153.69	2160.76	0.33
Beed	3374.95	2995.23	-11.25
Bhandara	1262.18	1378.73	9.23
Buldhana	2418.86	2412.24	-0.27
Ch. Sambhajinagar	6715.13	6791.09	1.13
Chandrapur	1959.89	2113.42	7.83

District	2023	2024	% Growth Rate
Dharashiv	1381.79	1364.62	-1.24
Dhule	2358.14	2225.80	-5.61
Gadchiroli	433.95	472.52	8.89
Gondia	874.88	952.01	8.82
Hingoli	1356.35	1430.73	5.48
Jalgaon	5373.75	5296.85	-1.43
Jalna	5397.79	5830.91	8.02
Kolhapur	6520.42	6439.01	-1.25
Latur	3290.51	2776.34	-15.63
Mumbai	2517.75	2695.96	7.08
Mumbai suburban	8504.65	7370.39	-13.34
Nagpur	1333.21	1408.08	5.62
Nanded	12969.74	13902.86	7.19
Nandurbar	6789.41	7249.87	6.78
Nashik	2785.62	2881.26	3.43
Palghar	15466.46	16256.59	5.11
Parbhani	9846.54	9867.62	0.21
Pune	2327.41	1820.69	-21.77
Raigad	1666.59	1719.90	3.2
Ratnagiri	7241.94	7484.63	3.35
Sangli	1987.84	1910.18	-3.91
Satara	26121.44	27217.59	4.2
Sindhudurg	10689.99	11342.04	6.1
Solapur	1263.55	1324.15	4.8
Thane	984.58	1052.04	6.85
Wardha	4475.98	3994.05	-10.77
Washim	4319.15	3708.36	-14.14
Yavatmal	442.36	452.89	2.38

20.2.4 Radar chart showing district-wise energy consumption growth rate (2022-2023 & 2023-2024)

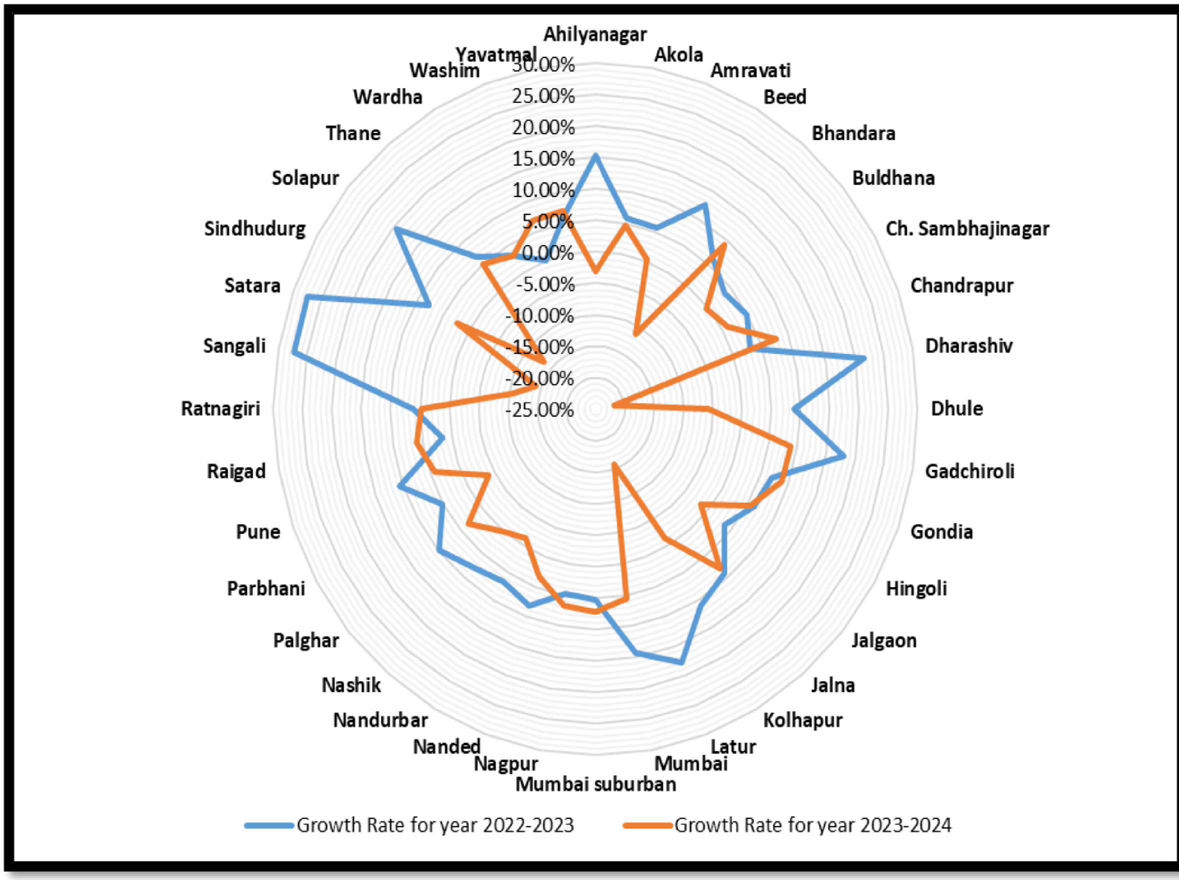


Figure 191: Radar chart showing district-wise energy consumption growth rate (2022-2023 & 2023-2024)

Observations:

The above radar plot illustrates the difference in energy consumption growth rates between 2022–2023 and 2023–2024 across 36 districts. The table below gives statistical insights.

Table 24: Percentage Growth Rates 2022-2023 & 2023-2024

District	Growth Rate for year 2022-2023	Growth Rate for year 2023-2024
Ahilyanagar	15.36%	-3.15%
Akola	5.84%	4.61%
Amravati	5.66%	0.33%
Beed	12.52%	-11.25%
Bhandara	6.15%	9.23%
Buldhana	3.74%	-0.27%
Ch. Sambhajinagar	4.89%	1.13%

District	Growth Rate for year 2022-2023	Growth Rate for year 2023-2024
Chandrapur	3.05%	7.83%
Dharashiv	21.48%	-21.77%
Dhule	8.86%	-5.61%
Gadchiroli	17.94%	8.89%
Gondia	7.08%	8.82%
Hingoli	6.19%	5.48%
Jalgaon	3.74%	-1.43%
Jalna	9.13%	8.02%
Kolhapur	10.99%	-1.25%
Latur	17.87%	-15.63%
Mumbai	14.25%	5.62%
Mumbai suburban	5.25%	7.19%
Nagpur	4.87%	6.78%
Nanded	8.31%	3.43%
Nandurbar	6.59%	-1.24%
Nashik	7.80%	0.21%
Palghar	9.87%	3.35%
Parbhani	5.11%	-3.91%
Pune	10.59%	4.20%
Raigad	1.58%	6.10%
Ratnagiri	6.14%	4.80%
Sangli	27.33%	-10.77%
Satara	27.41%	-14.14%
Sindhudurg	7.97%	2.38%
Solapur	19.51%	-13.34%
Thane	6.73%	5.11%
Wardha	3.19%	3.20%
Washim	0.06%	6.85%
Yavatmal	6.13%	7.08%

20.2.5 District-wise % Energy contribution for 2022:

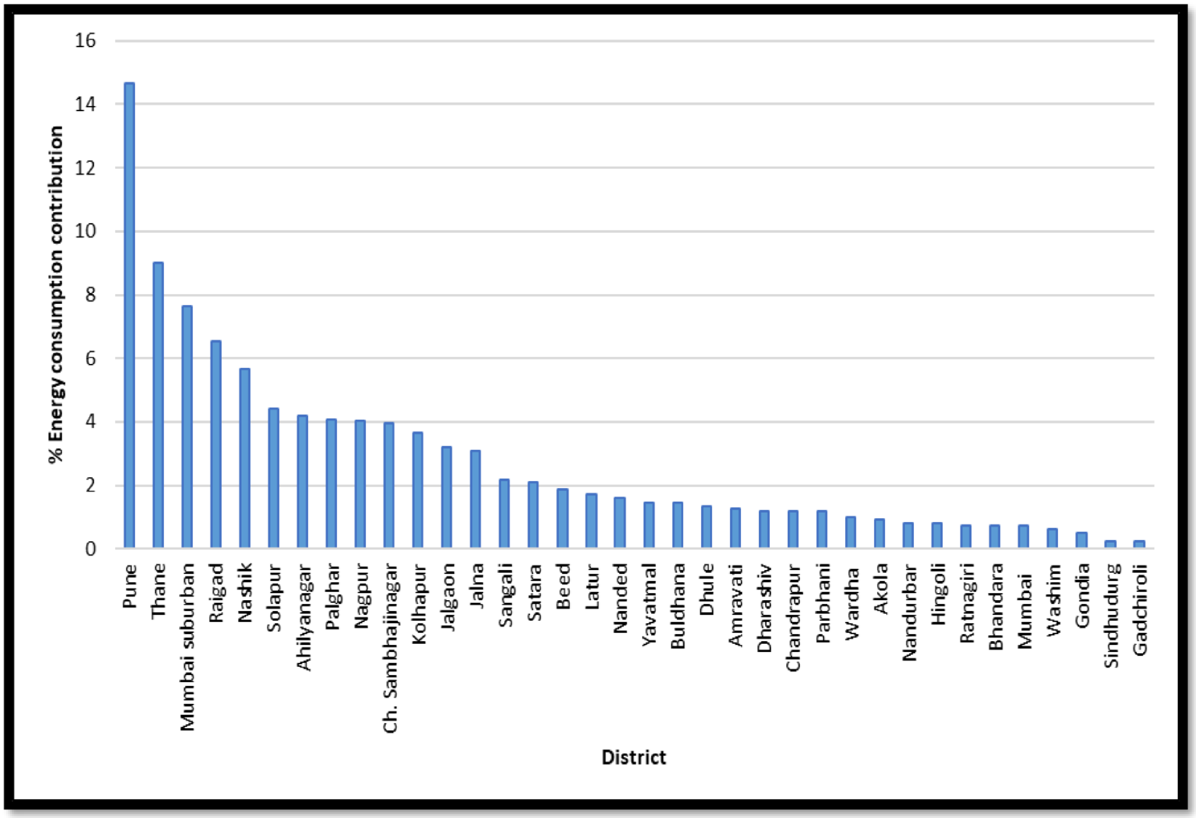


Figure 192: District wise % energy consumption contribution for 2022

Observations:

The above plot illustrates the district-wise % energy consumption contribution for 36 districts for year 2022. The table below gives statistical insights.

Total state energy consumption for year 2022: 161149.01 MUs

Table 25: District-wise % energy consumption contribution for 2022

District	District wise % energy consumption contribution for 2022
Pune	14.66
Thane	8.99
Mumbai suburban	7.65
Raigad	6.53
Nashik	5.67
Solapur	4.42

District	District wise % energy consumption contribution for 2022
Ahilyanagar	4.20
Palghar	4.09
Nagpur	4.02
Ch. Sambhajinagar	3.97
Kolhapur	3.65
Jalgaon	3.21
Jalna	3.07
Sangli	2.18
Satara	2.10
Beed	1.86
Latur	1.73
Nanded	1.60
Yavatmal	1.47
Buldhana	1.45
Dhule	1.34
Amravati	1.26
Dharashiv	1.19
Chandrapur	1.18
Parbhani	1.17
Wardha	1.00
Akola	0.94
Nandurbar	0.80
Hingoli	0.79
Ratnagiri	0.74
Bhandara	0.74
Mumbai	0.72
Washim	0.61
Gondia	0.51
Sindhudurg	0.25
Gadchiroli	0.23

20.2.6 District-wise % Energy contribution for 2023:

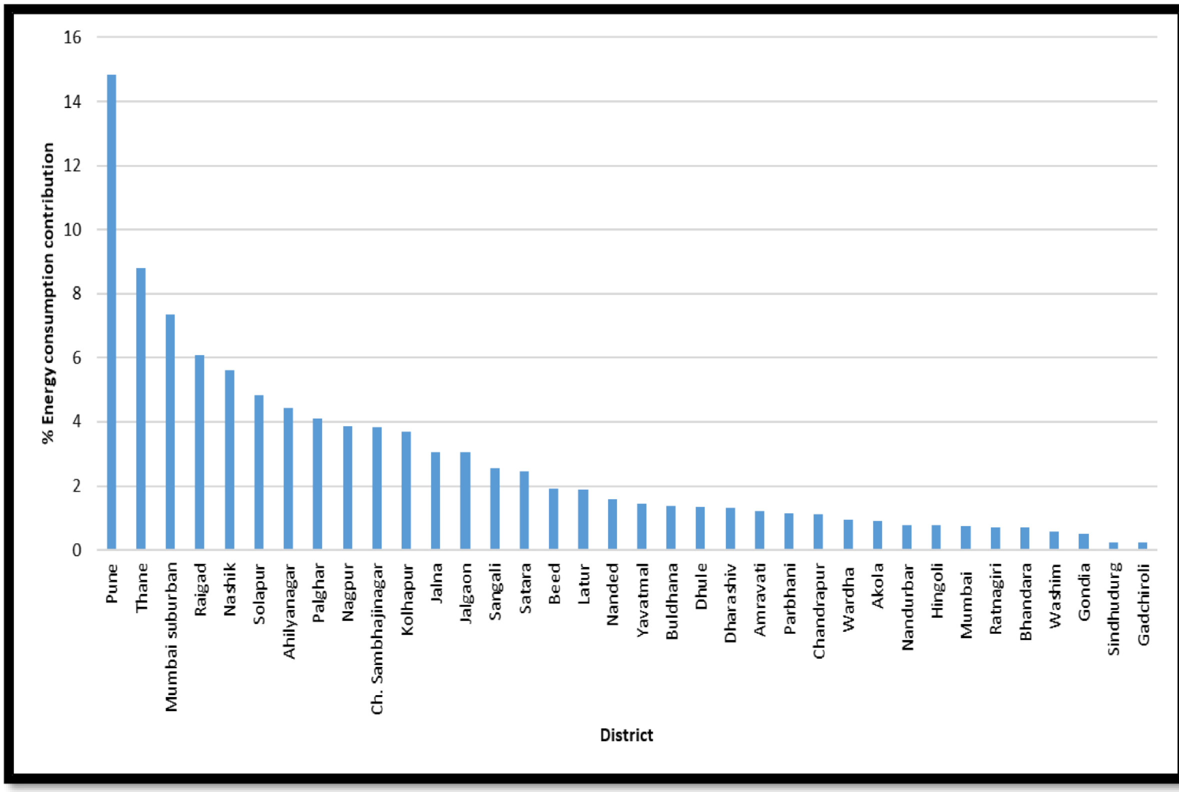


Figure 193: District wise % energy consumption contribution for 2023

Observations:

The above plot illustrates the district-wise % energy consumption contribution for 36 districts for year 2023. The table below gives statistical insights.

Total state energy consumption for year 2023: 176004.28 MUs

Table 26: District-wise % energy consumption contribution for 2023

District	District wise % energy consumption contribution for 2023
Pune	14.84
Thane	8.79
Mumbai suburban	7.37
Raigad	6.07
Nashik	5.59
Solapur	4.83
Ahilyanagar	4.43

District	District wise % energy consumption contribution for 2023
Palghar	4.11
Nagpur	3.86
Ch. Sambhajinagar	3.82
Kolhapur	3.70
Jalna	3.07
Jalgaon	3.05
Sangli	2.54
Satara	2.45
Beed	1.92
Latur	1.87
Nanded	1.58
Yavatmal	1.43
Buldhana	1.37
Dhule	1.34
Dharashiv	1.32
Amravati	1.22
Parbhani	1.13
Chandrapur	1.11
Wardha	0.95
Akola	0.91
Nandurbar	0.79
Hingoli	0.77
Mumbai	0.76
Ratnagiri	0.72
Bhandara	0.72
Washim	0.56
Gondia	0.50
Sindhudurg	0.25
Gadchiroli	0.25

20.2.7 District-wise % Energy Contribution in 2024:

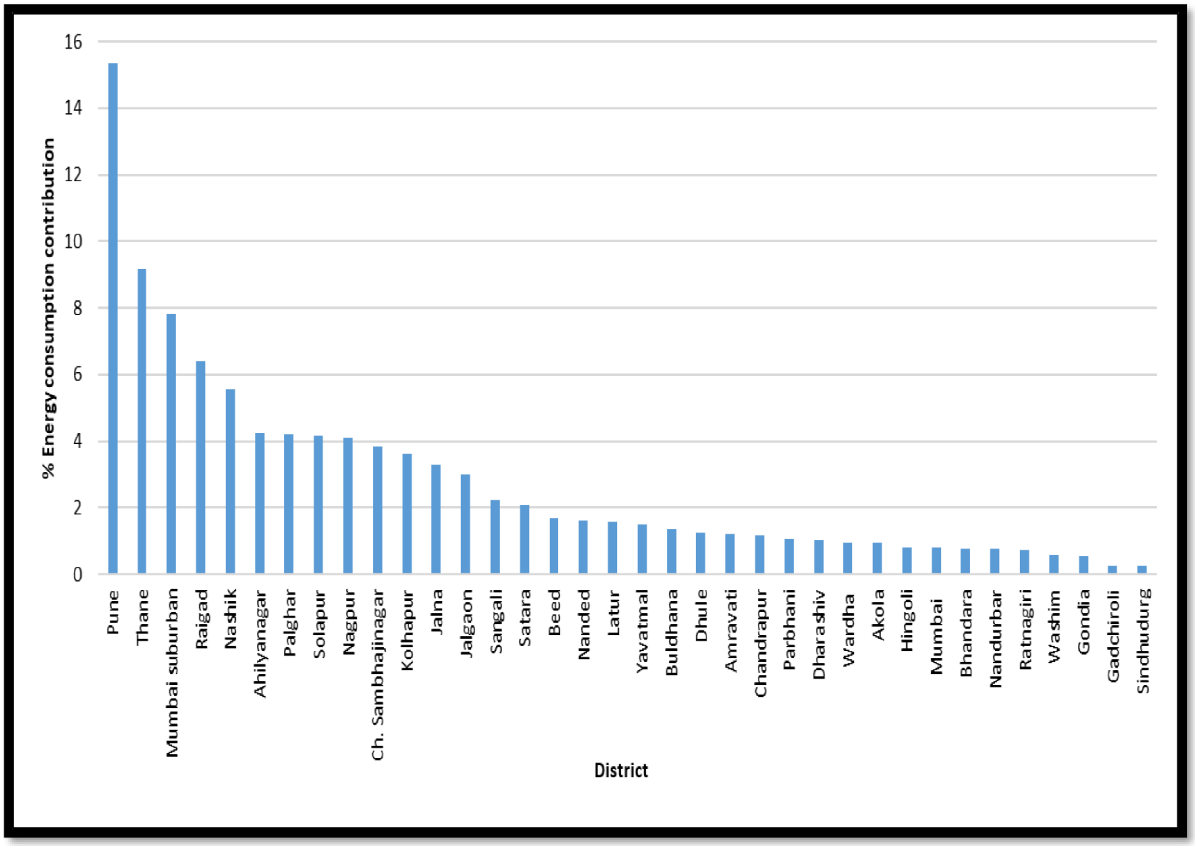


Figure 194: District wise % energy consumption contribution for 2024

Observations:

The above plot illustrates the district-wise % energy consumption contribution for 36 districts for year 2024. The table below gives statistical insights.

Total state energy consumption for year 2024: 177525.51 MUs

Table 27: District-wise % energy consumption contribution for 2024

District	District wise % energy consumption contribution for 2024
Pune	15.33
Thane	9.16
Mumbai suburban	7.83
Raigad	6.39
Nashik	5.56
Ahilyanagar	4.26
Palghar	4.22

District	District wise % energy consumption contribution for 2024
Solapur	4.15
Nagpur	4.08
Ch. Sambhajinagar	3.83
Kolhapur	3.63
Jalna	3.28
Jalgaon	2.98
Sangli	2.25
Satara	2.09
Beed	1.69
Nanded	1.62
Latur	1.56
Yavatmal	1.52
Buldhana	1.36
Dhule	1.25
Amravati	1.22
Chandrapur	1.19
Parbhani	1.08
Dharashiv	1.03
Wardha	0.97
Akola	0.94
Hingoli	0.81
Mumbai	0.79
Bhandara	0.78
Nandurbar	0.77
Ratnagiri	0.75
Washim	0.59
Gondia	0.54
Gadchiroli	0.27
Sindhudurg	0.26

20.2.8 Heat map showing contribution of 10 highest energy consuming districts in total state energy consumed (2022-2024)

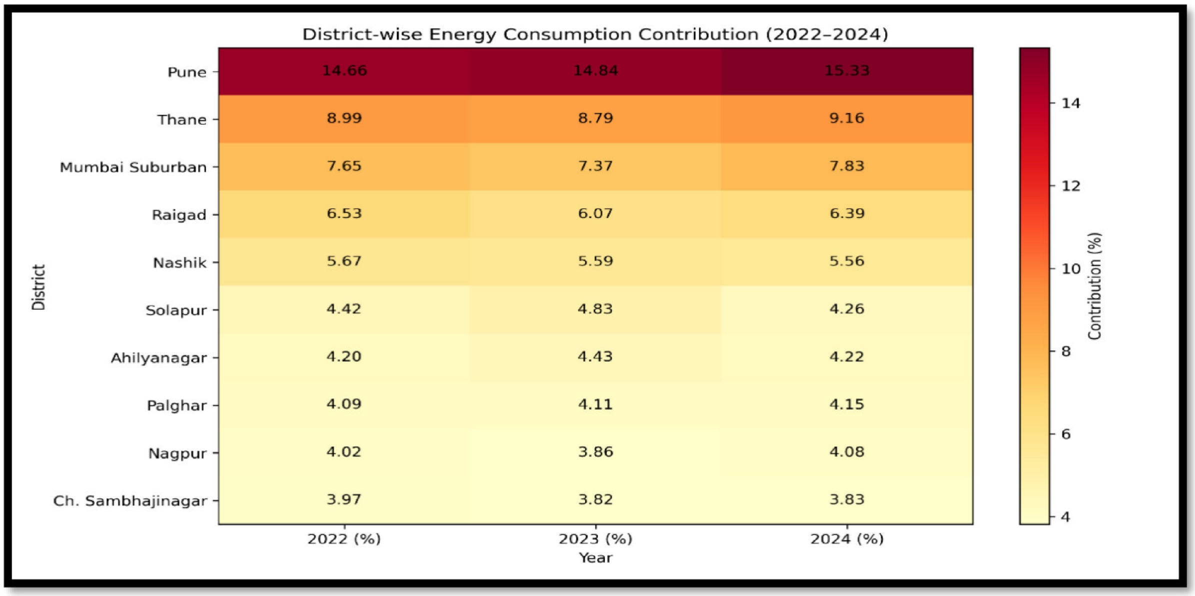


Figure 195: Heat map showing contribution of 10 highest energy consuming districts (2022-2024)

Observations:

The above heat map illustrates the percentage contribution of the 10 highest energy consuming districts to overall energy consumption over the period 2022–2024.

20.3 Five Districts with the highest energy consumption (2022-2024)

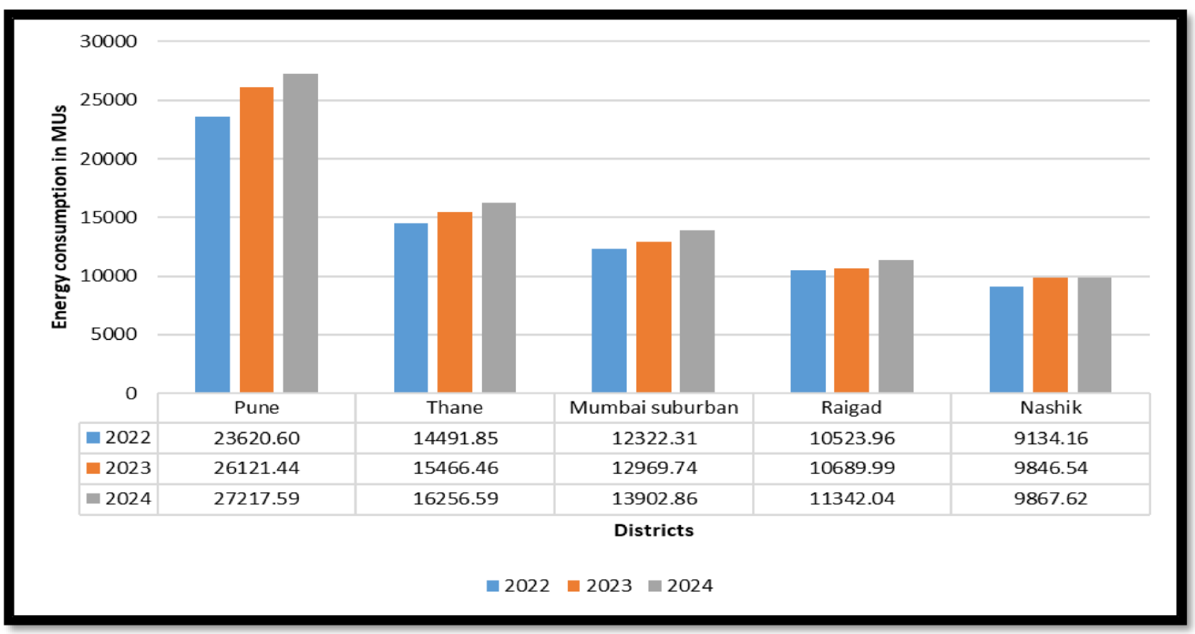


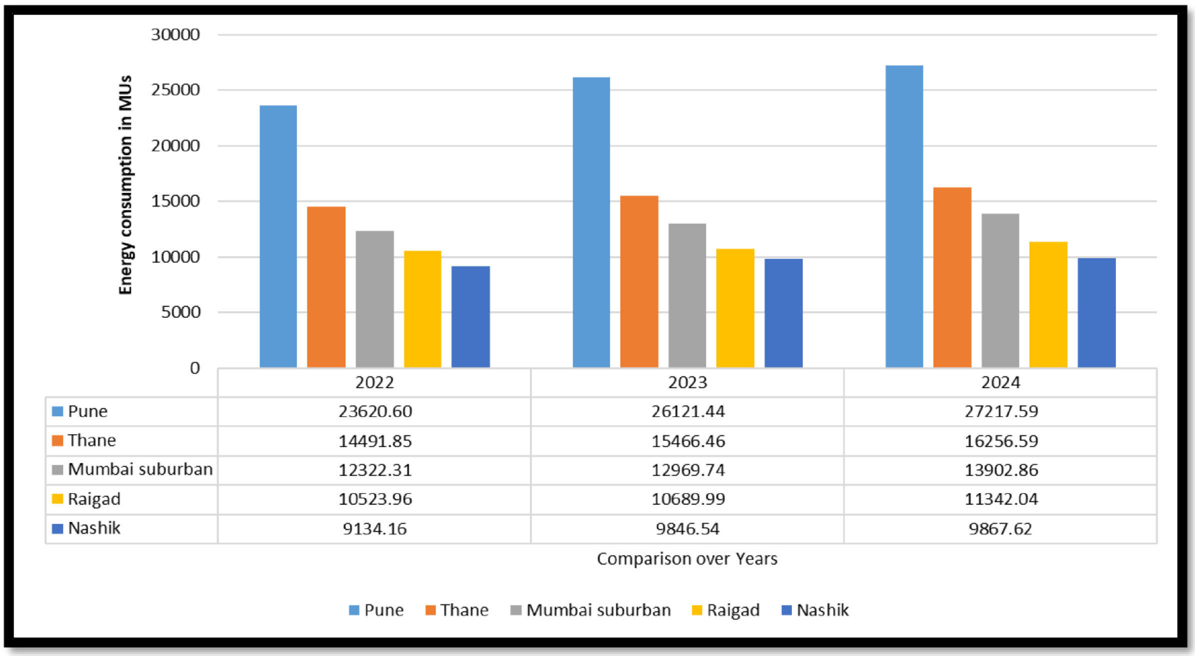
Figure 196: Comparison of Energy Consumption: Five Highest-Consuming Districts (2022–2024)

Summary:

The above plot illustrates yearly energy consumption (in MUs) for the five districts with the highest energy consumption during 2022–2024.

The districts are listed below:

1. Pune
2. Thane
3. Mumbai Suburban
4. Raigad
5. Nashik



	2022	2023	2024
Pune	23620.60	26121.44	27217.59
Thane	14491.85	15466.46	16256.59
Mumbai suburban	12322.31	12969.74	13902.86
Raigad	10523.96	10689.99	11342.04
Nashik	9134.16	9846.54	9867.62

Figure 197: Comparison of Energy Consumption: Five Highest-Consuming Districts (2022–2024)

Summary:

The above plot illustrates a district-wise comparison of energy consumption (in MU) for the five districts with the highest energy consumption over the period 2022–2024.

The districts are listed below:

1. Pune
2. Thane
3. Mumbai Suburban

4. Raigad
5. Nashik

20.3.1 Yearly energy consumption growth for Pune

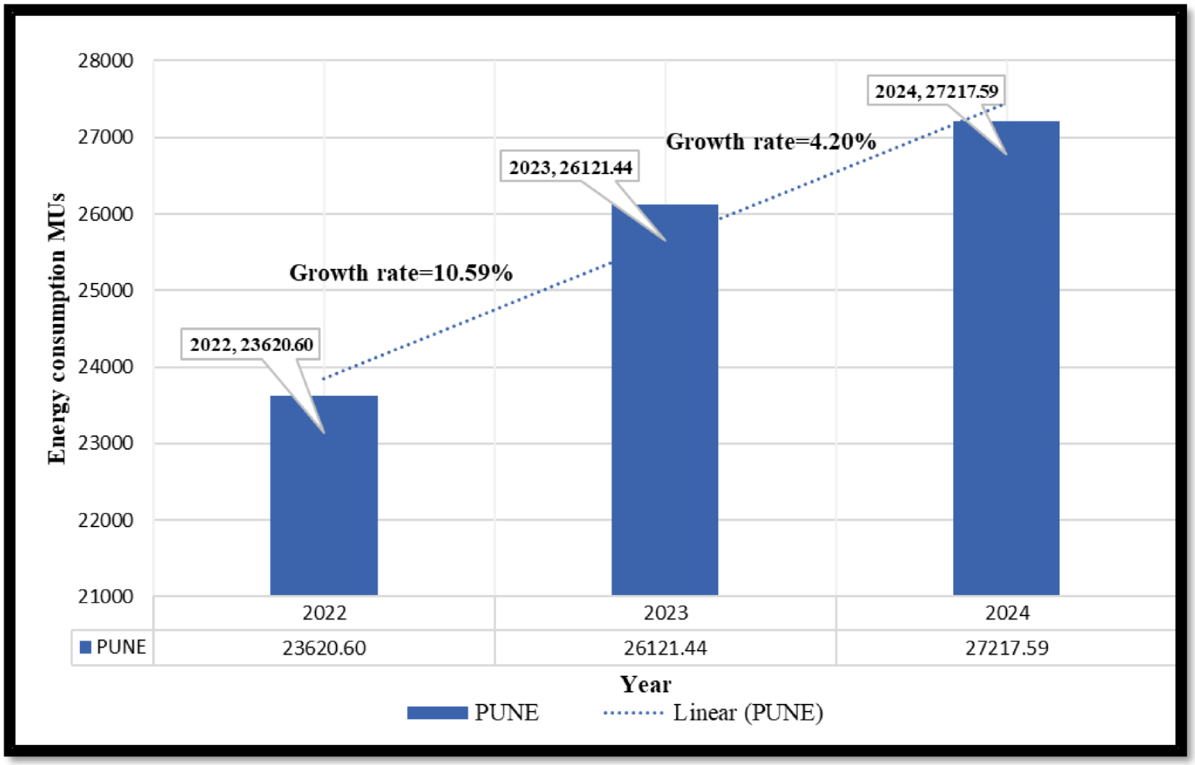


Figure 198: Yearly Energy consumption growth rate for Pune (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Pune and growth rate in energy consumption over the period 2022–2024.

20.3.2 Yearly energy consumption growth for Nashik

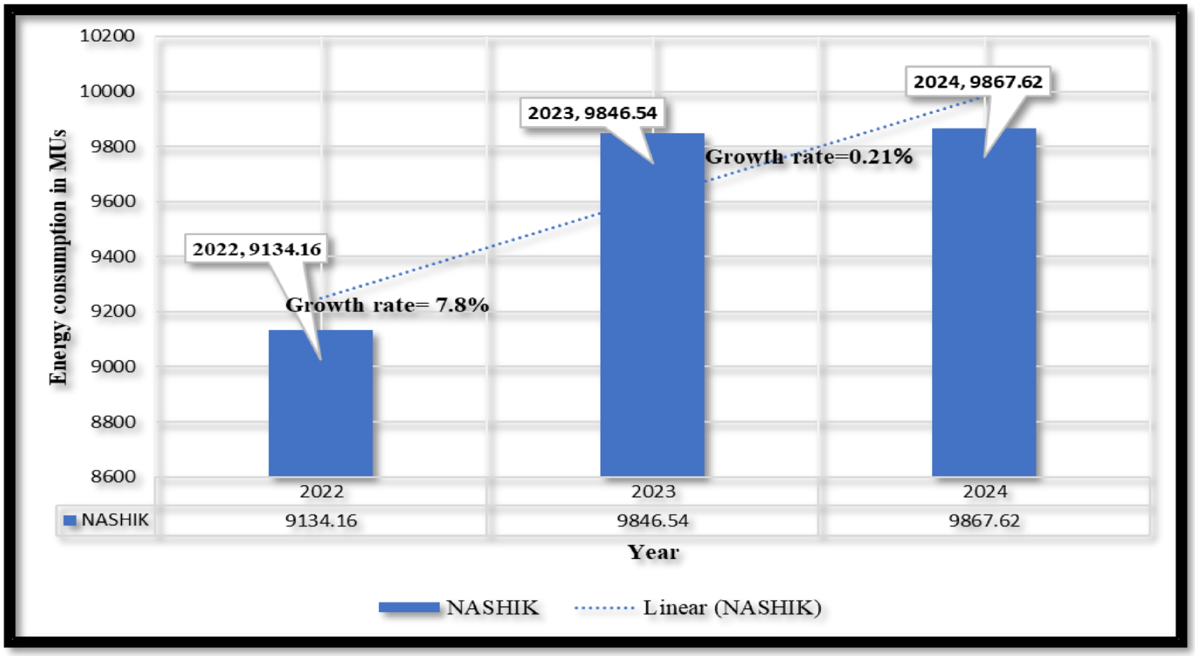


Figure 199: Yearly Energy Consumption growth rate for Nashik (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Nashik and growth rate in energy consumption over the period 2022–2024.

20.3.3 Yearly energy consumption growth for Thane

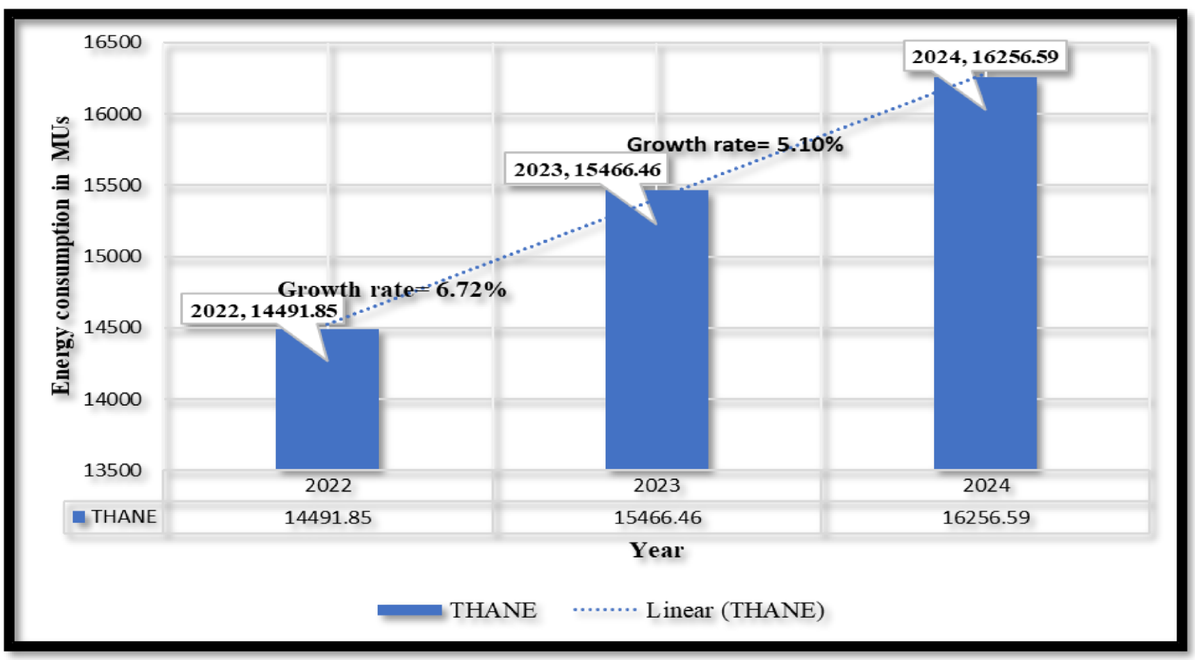


Figure 200: Yearly Energy Consumption growth rate for Thane (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Thane and growth rate in energy consumption over the period 2022–2024.

20.3.4 Yearly energy consumption growth for Mumbai suburban

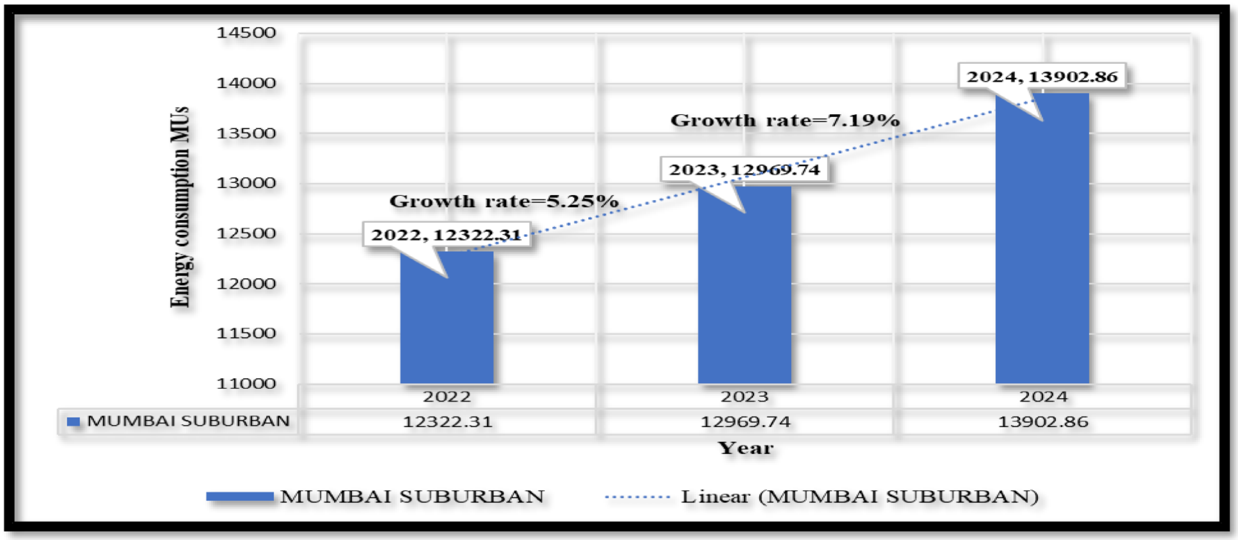


Figure 201: Yearly Energy Consumption growth rate for Mumbai suburban (2022–2024)

The above plot illustrates energy consumption (in MUs) for Mumbai suburban and growth rate in energy consumption over the period 2022–2024.

20.3.5 Yearly energy consumption growth for Raigad

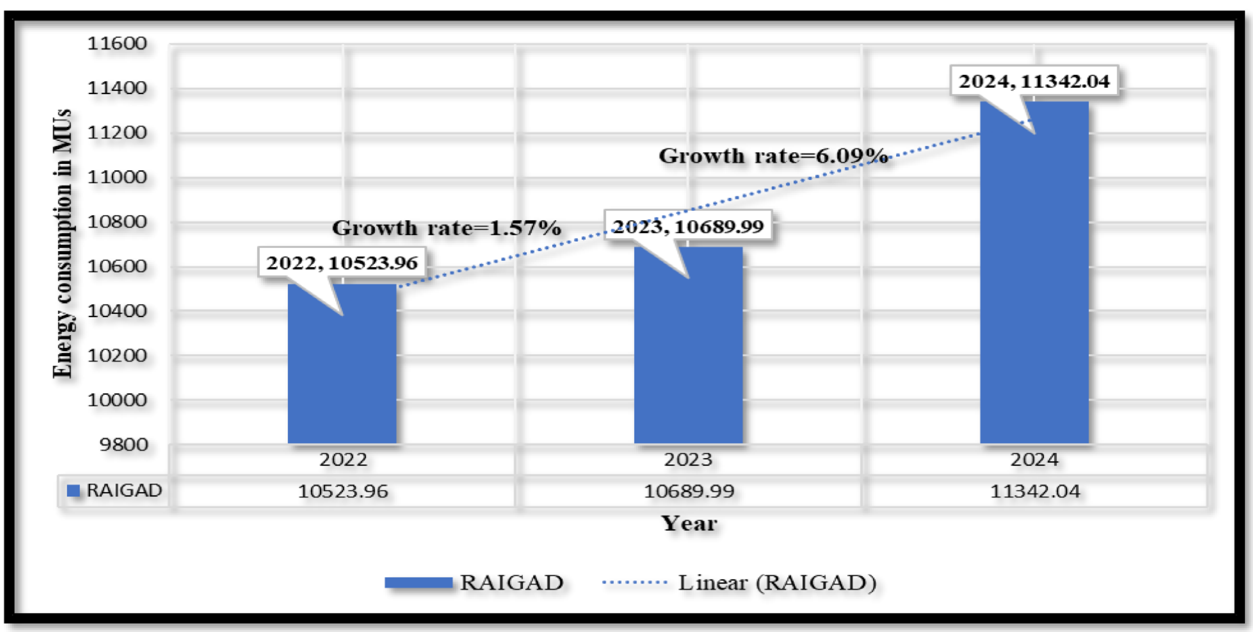


Figure 202: Yearly Energy Consumption growth rate for Raigad (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Raigad and growth rate in energy consumption over the period 2022–2024.

20.4 Five Districts with the Lowest Energy Consumption (2022–2024)

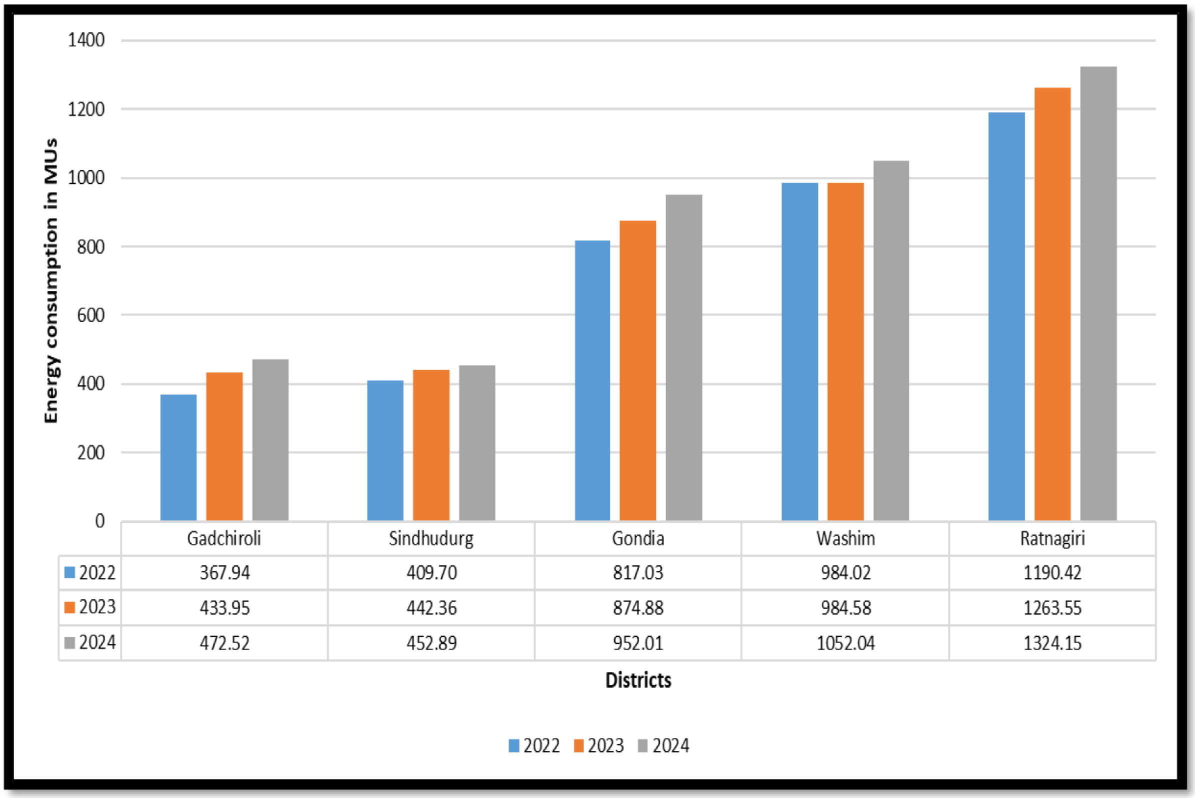


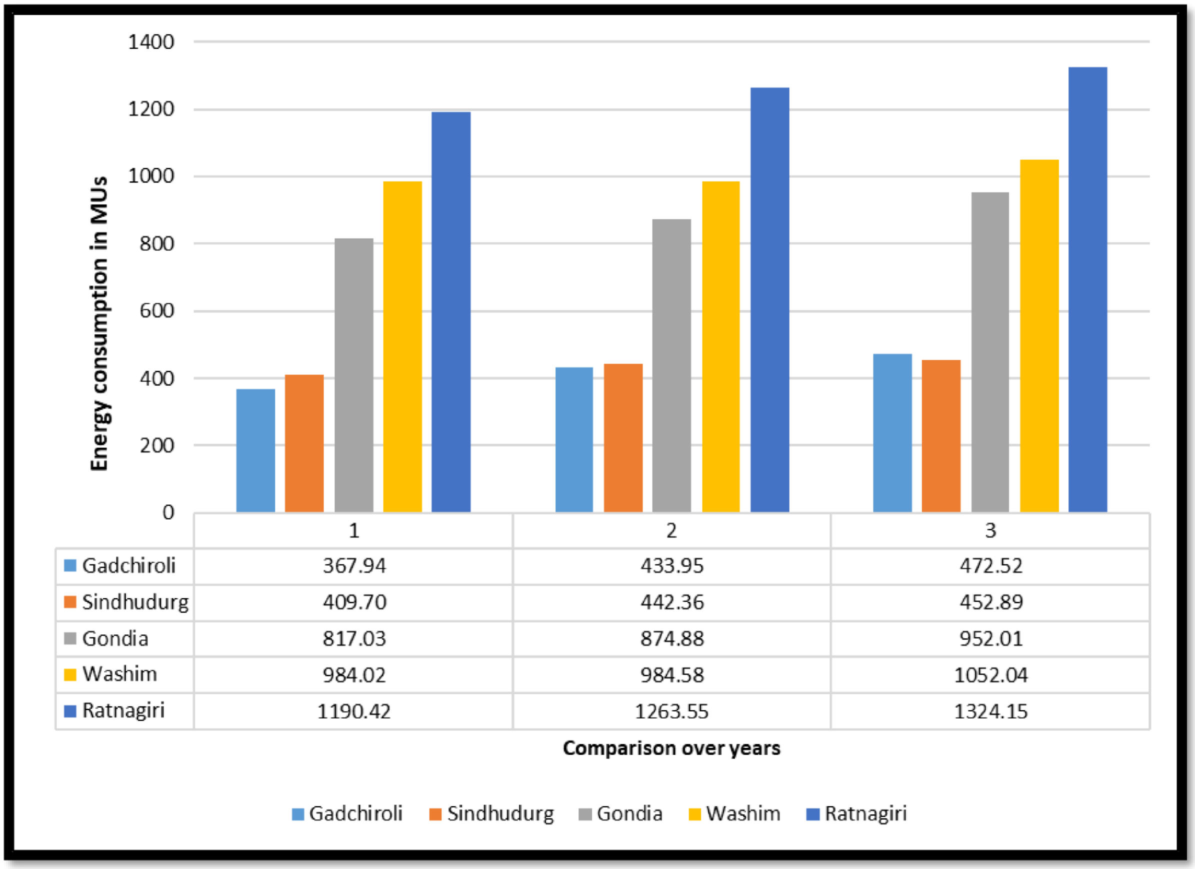
Figure 203: Comparison of Energy Consumption: Five Lowest-Consuming Districts (2022–2024)

Summary:

The above plot illustrates a district-wise comparison of energy consumption (in MUs) for the five districts with the lowest energy consumption over the period 2022–2024.

The districts are listed below:

1. Gadchiroli
2. Sindhudurg
3. Gondia
4. Washim
5. Ratnagiri



	1	2	3
Gadchiroli	367.94	433.95	472.52
Sindhudurg	409.70	442.36	452.89
Gondia	817.03	874.88	952.01
Washim	984.02	984.58	1052.04
Ratnagiri	1190.42	1263.55	1324.15

Figure 204: Comparison of Energy Consumption: Five Lowest-Consuming Districts (2022–2024)

Summary:

The above plot illustrates a district-wise comparison of energy consumption (in MUs) for the five districts with the lowest energy consumption over the period 2022–2024.

The districts are listed below:

6. Gadchiroli
7. Sindhudurg
8. Gondia
9. Washim
10. Ratnagiri

20.4.1 Yearly energy consumption growth for Gadchiroli

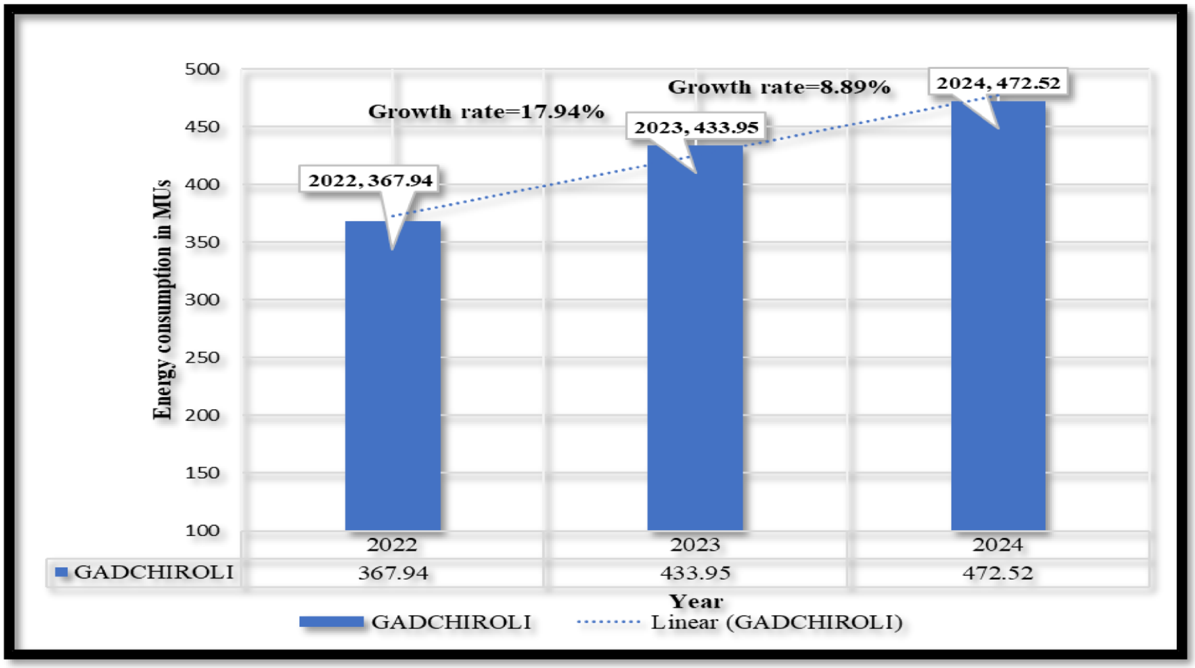


Figure 205: Yearly energy consumption growth for Gadchiroli (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Gadchiroli and growth rate in energy consumption over the period 2022–2024.

20.4.2 Yearly energy consumption growth for Sindhudurg

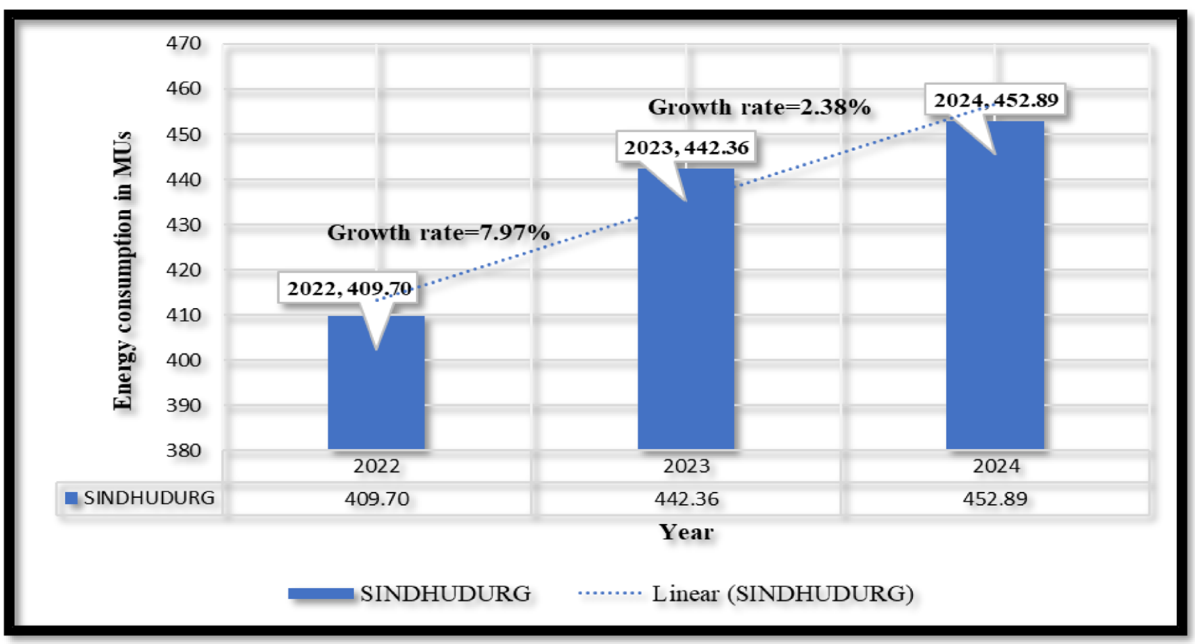


Figure 206: Yearly Energy Consumption growth rate for Sindhudurg (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Sindhudurg and growth rate in energy consumption over the period 2022–2024.

20.4.3 Yearly energy consumption growth for Gondia

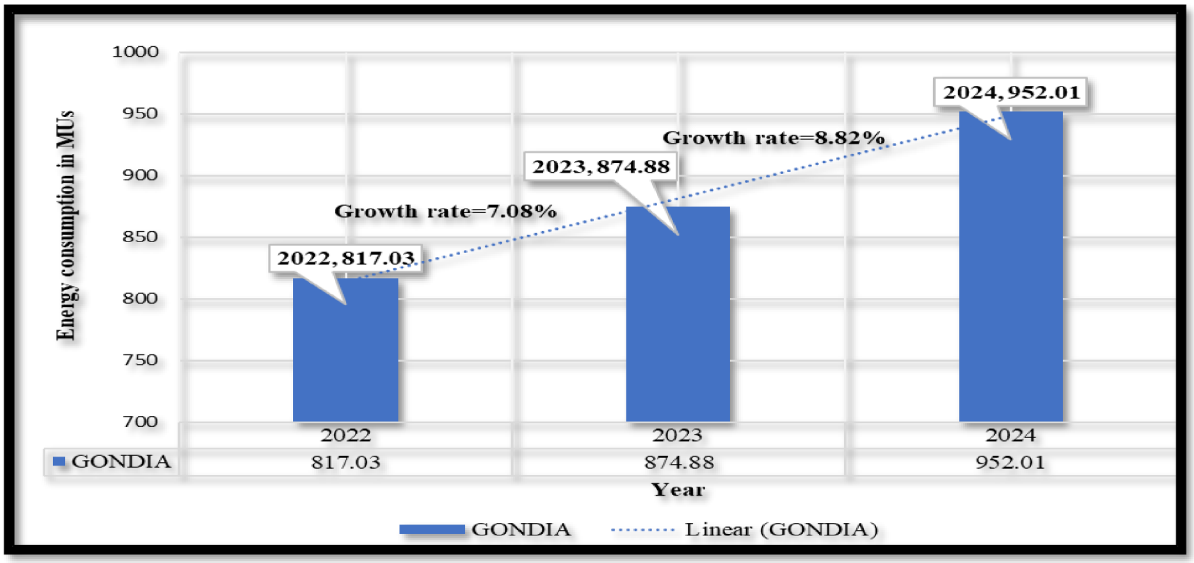


Figure 207: Yearly Energy Consumption growth rate for Gondia (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Gondia and growth rate in energy consumption over the period 2022–2024.

20.4.4 Yearly energy consumption growth for Washim

Figure 208: Yearly Energy Consumption growth rate for Washim (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Washim and growth rate in energy consumption over the period 2022–2024.

20.4.5 Yearly energy consumption growth for Ratnagiri

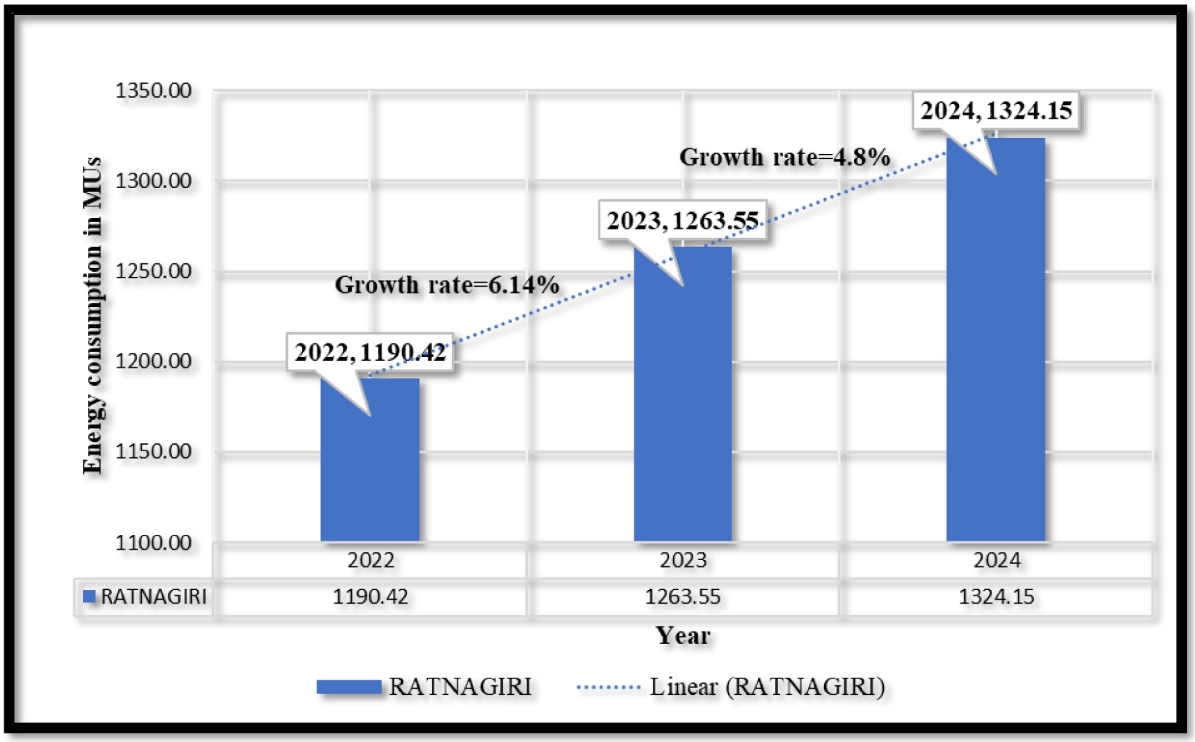


Figure 209: Yearly Energy Consumption growth rate for Ratnagiri (2022–2024)

Summary:

The above plot illustrates energy consumption (in MUs) for Ratnagiri and growth rate in energy consumption over the period 2022–2024.

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21. Region-wise Energy Consumption Behaviour (2022-2024)

21.1 Introduction

This chapter focuses on regional energy consumption behaviour for the period 2022–2024, where the 36 districts of Maharashtra State are grouped into regions. The details of the regional classification are provided below. The state is divided into five regions, and each region is further analyzed to identify the districts in terms of highest energy consumption (in MUs).

21.2 Regional Classification of Maharashtra

The state is divided into five regions purely based on geographical location. These regions group together neighbouring districts to simplify the analysis of electricity consumption.

The regions are:

- Western Maharashtra
- Konkan
- Marathwada
- Vidarbha
- North Maharashtra
- MMR Region (Excluding Ratnagiri and Sindhudurg districts from Konkan Region)

The table below outlines the districts falling under each of these regions. This classification serves as the foundational structure for **region-wise electricity consumption** behaviour across the **years 2022, 2023, and 2024**.

Region	**Districts**
Western Maharashtra	Pune, Solapur, Ahilyanagar, Kolhapur, Sangli, Satara
Konkan	Thane, Mumbai Suburban, Raigad, Ratnagiri, Mumbai, Sindhudurg, Palghar
Marathwada	Ch. Sambhajinagar, Jalna, Beed, Latur, Nanded, Dharashiv, Parbhani, Hingoli
Vidarbha	Nagpur, Washim, Buldhana, Amravati, Chandrapur, Wardha, Akola, Bhandara, Yavatmal, Gondia, Gadchiroli
North Maharashtra	Nashik, Jalgaon, Dhule, Nandurbar

21.2.1 Region-wise energy consumption comparison for State (2022-2024)

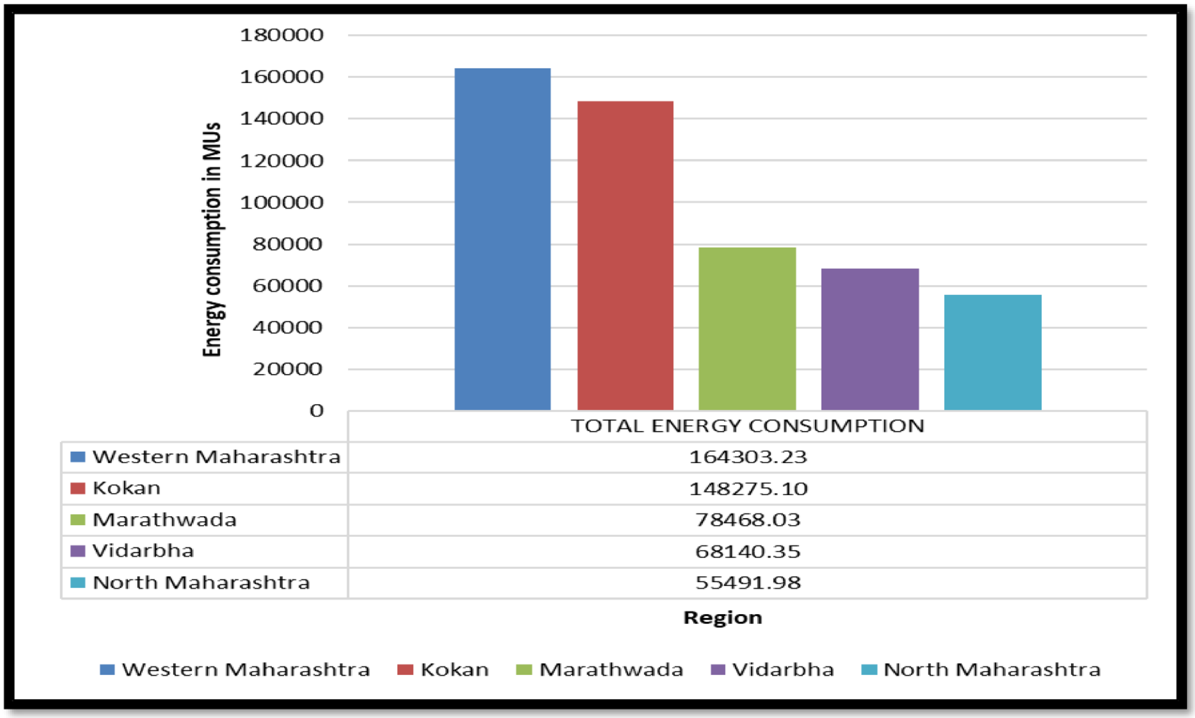


Figure 210: Region wise energy consumption for state (2022-2024)

Summary

The above plot shows region wise energy consumption in MUs for 2022-2024. The table below indicates the total energy consumption (in Million Units, MUs) by each major geographical region of Maharashtra over a period of 3 years (2022-2024).

Table 28: Region-wise Energy Consumption – Maharashtra

Region	**Energy Consumption (MUs)**
Western Maharashtra	164303.23
Konkan	148275.1
Marathwada	78468.03
Vidarbha	68140.35
North Maharashtra	55491.98
Total (State)	**513914.08**

21.2.2 Region wise % contribution for State

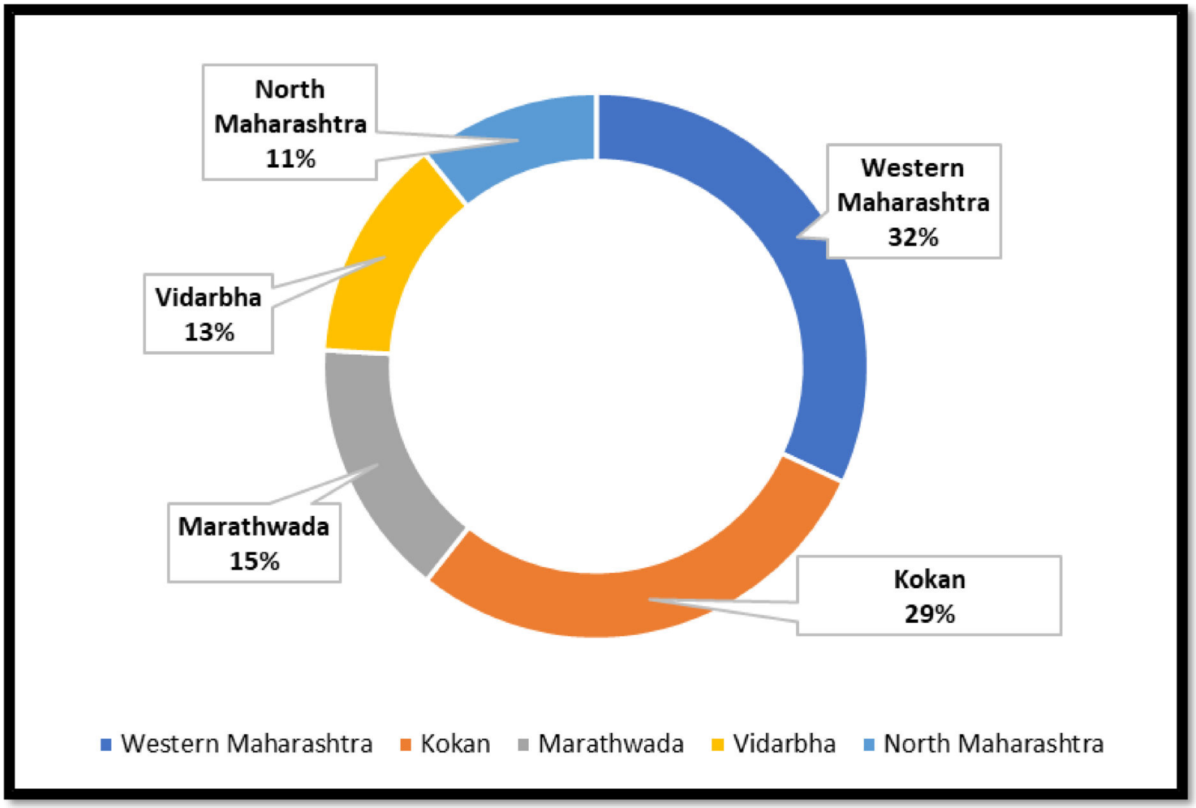


Figure 211: Region wise % contribution for State (2022-2024)

Summary

The above plot shows region wise % energy consumption in MUs for 2022-2024. The table below indicates the % energy consumption by each major geographical region of Maharashtra over a period of 3 years (2022-2024).

Table 29: Region-wise Energy Consumption – Maharashtra

Region	**Percentage (%)**
Western Maharashtra	32
Konkan	29
Marathwada	15
Vidarbha	13
North Maharashtra	11
First 2 Regions Total	**61**

21.3 Konkan Region

21.3.1 District-wise energy consumption comparison for Konkan region (2022-2024)

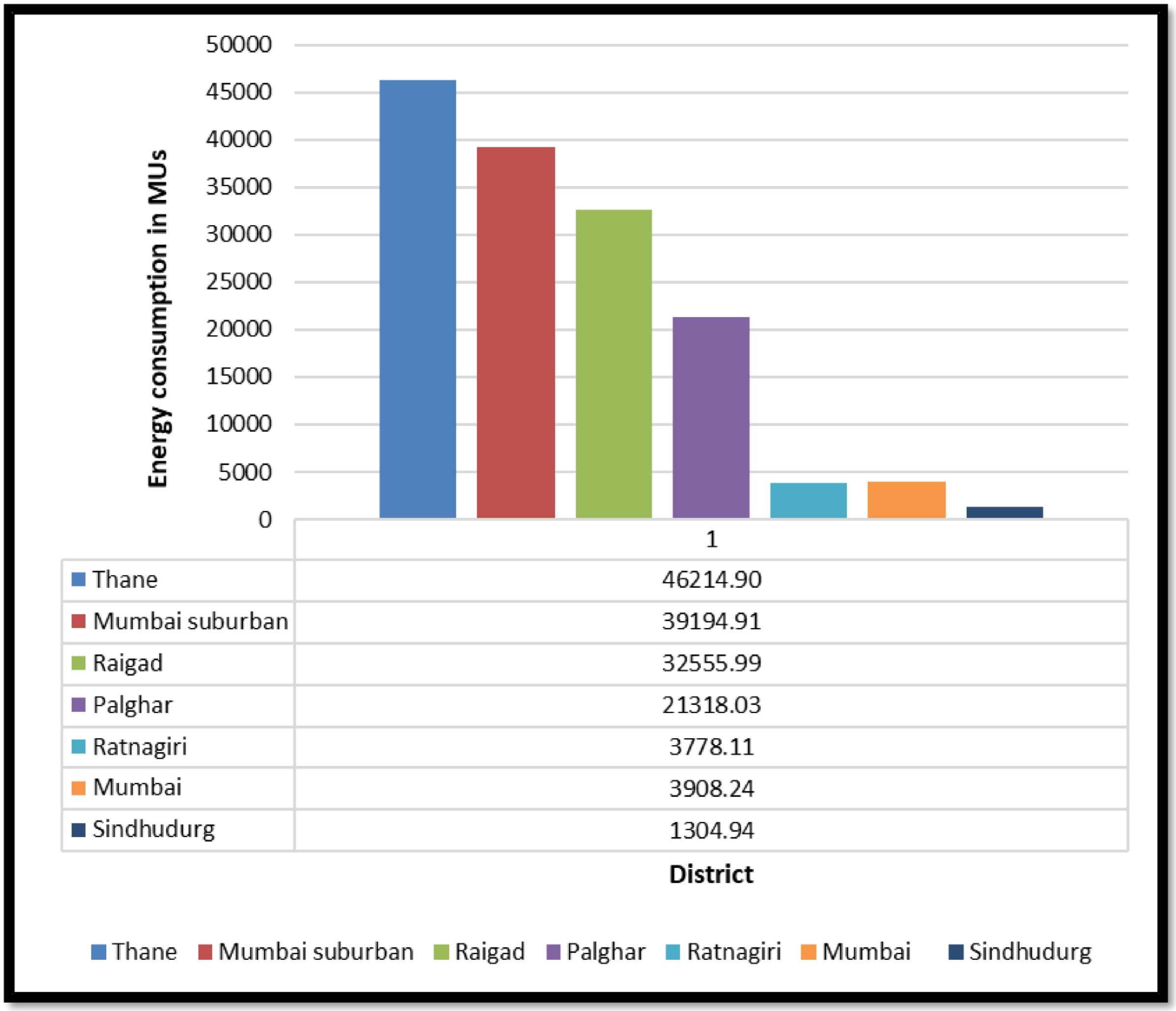


Figure 212: District-wise energy consumption comparison for Konkan region (2022-2024)

Summary

The above plot shows district wise energy consumption in MUs for Konkan region over a period of 2022-2024. The table below gives statistical insights.

Table 30: District-wise energy consumption for Konkan region

Region	District	Total Consumption in MUs
Konkan	Thane	46214.90
	Mumbai suburban	39194.91
	Raigad	32555.99

Region	District	Total Consumption in MUs
	Ratnagiri	3778.11
	Mumbai	3908.24
	Sindhudurg	1304.94
	Palghar	21318.03
	Total	147510.49

21.3.2 District wise % contribution for Konkan region (2022-2024)

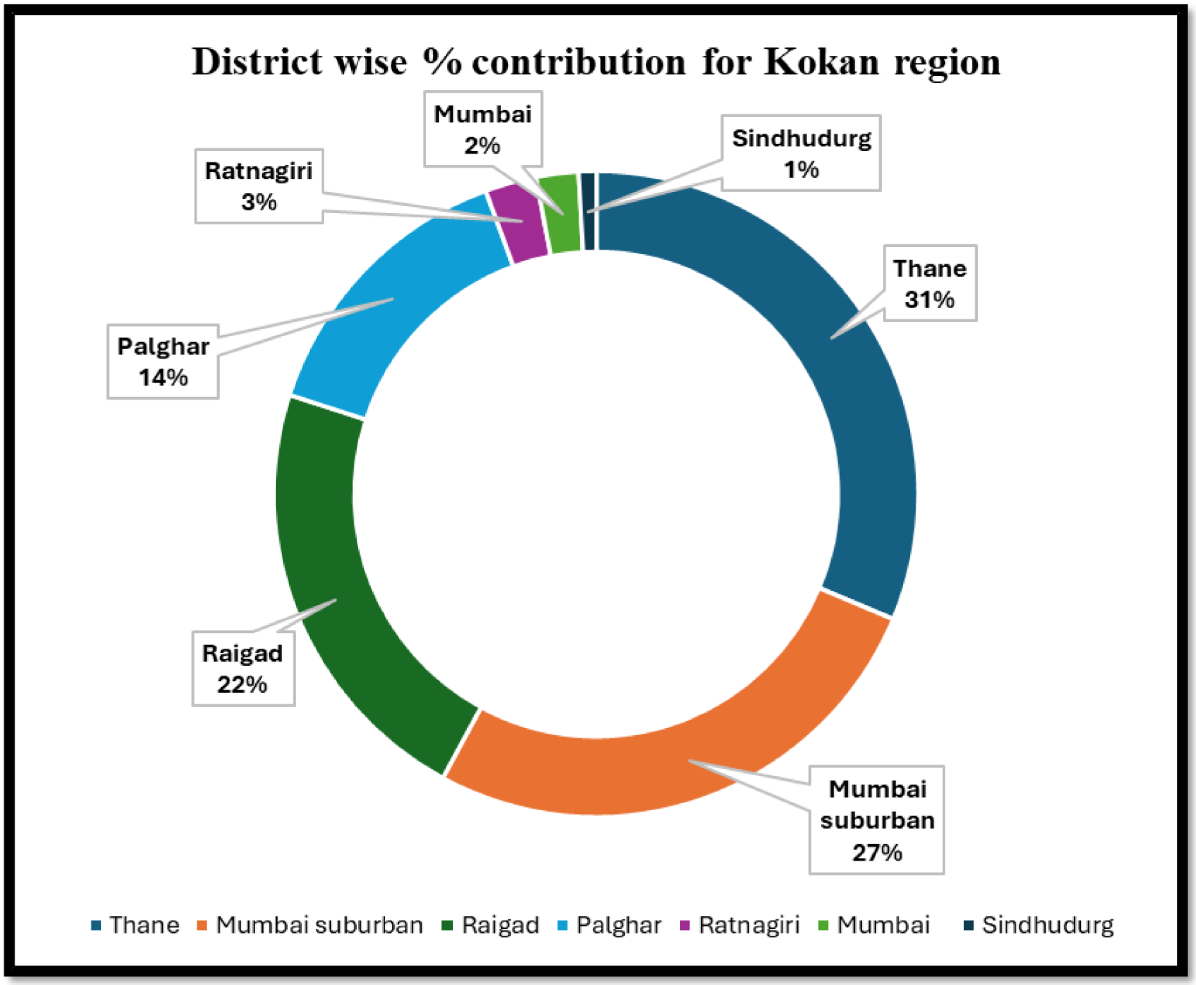


Figure 213: District wise % contribution for Konkan region (2022-2024)

Observations:

The plot shows % contribution of each district for Konkan region. The table below gives statistical insights.

Table 31: District-wise % energy consumption for Konkan region

District	Percentage (%)
Thane	31
Mumbai Suburban	27
Raigad	22
Mumbai City	2
Ratnagiri	3
Sindhudurg	1
Palghar	14
First 3 Districts Total	**80**

21.3.3 Monthly energy consumption comparison for Konkan region (2022-2024)

Figure 214: Monthly energy consumption comparison for Konkan region (2022-2024)

Summary

The above plot illustrates the comparison of Monthly energy consumption of Konkan region in MUs over years 2022 to 2024.

21.3.4 Σ Monthly energy consumption comparison for Konkan region (2022-2024)

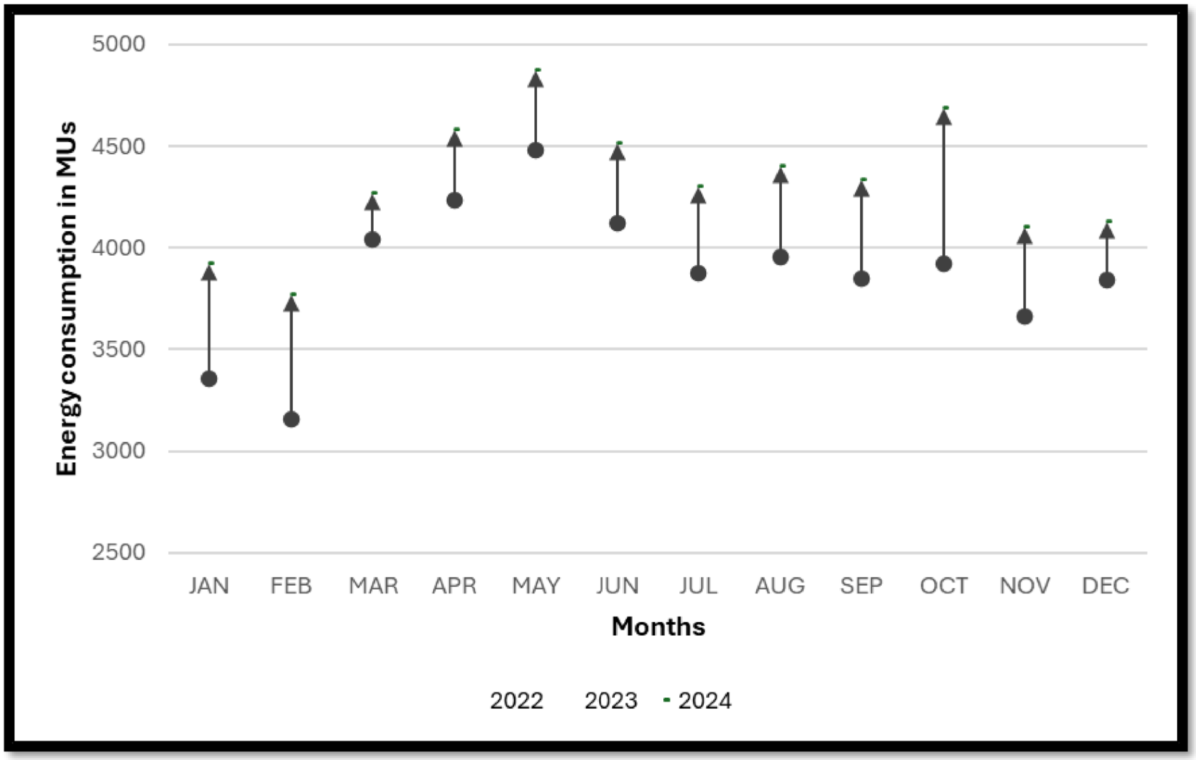


Figure 215: Σ Monthly energy consumption comparison for Konkan region (2022-2024)

Summary

The graph uses dots, line segment and triangles to show data points

▲: Represents energy consumption for 2024

|: The vertical line segment represents the trend for 2023

•: Indicates energy consumption for 2022

The above plot shows the variation in monthly energy consumption values (in MU) across the years 2022, 2023, and 2024.

21.4 Western Maharashtra Region

21.4.1 District-wise energy consumption comparison for Western Maharashtra region (2022-2024)

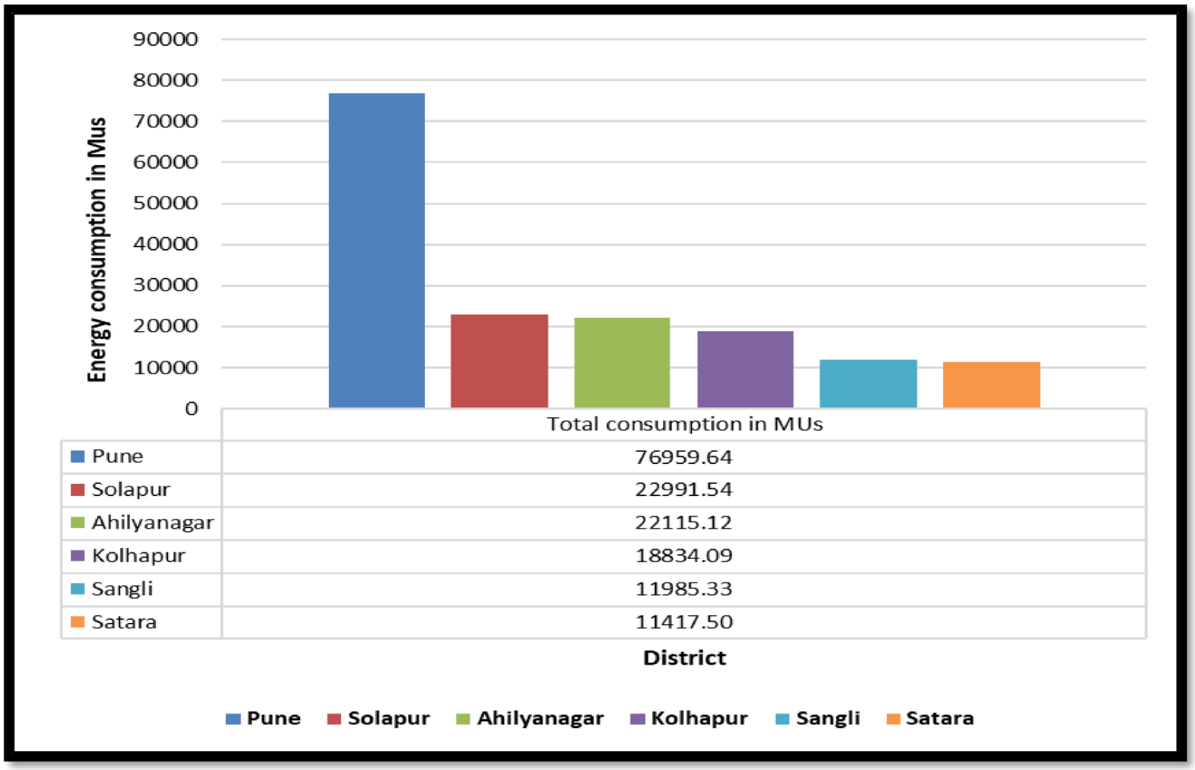


Figure 216: District-wise energy consumption comparison for Western Maharashtra region (2022-2024)

Summary

The above plot shows district wise energy consumption in MUs for Western Maharashtra region over a period of 2022-2024. The table below gives statistical insights.

Table 32: District-wise energy consumption for Western Maharashtra region

Region	District	Total Consumption in MUs
Western Maharashtra	Pune	76959.64
	Solapur	22991.54
	Ahilyanagar	22115.12
	Kolhapur	18834.08
	Sangli	11985.33
	Satara	11417.50
	Total	**164303.23**

21.4.2 District wise % contribution for Western Maharashtra region (2022-2024)

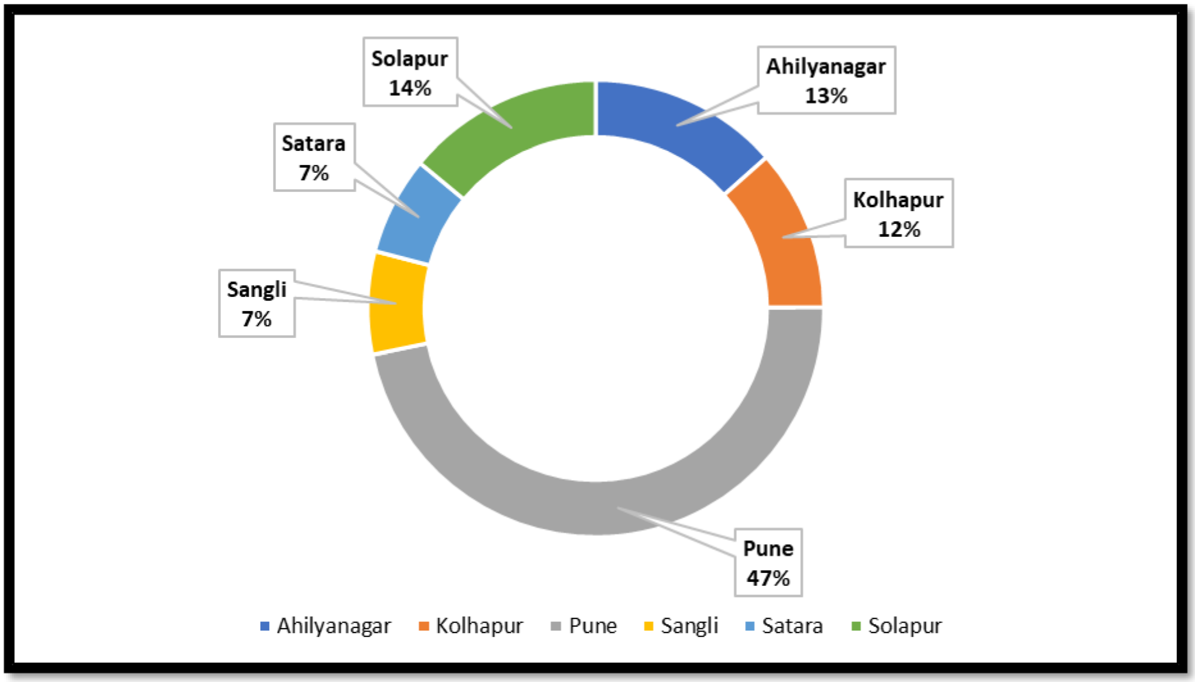


Figure 217: District wise % contribution for Western Maharashtra region (2022-2024)

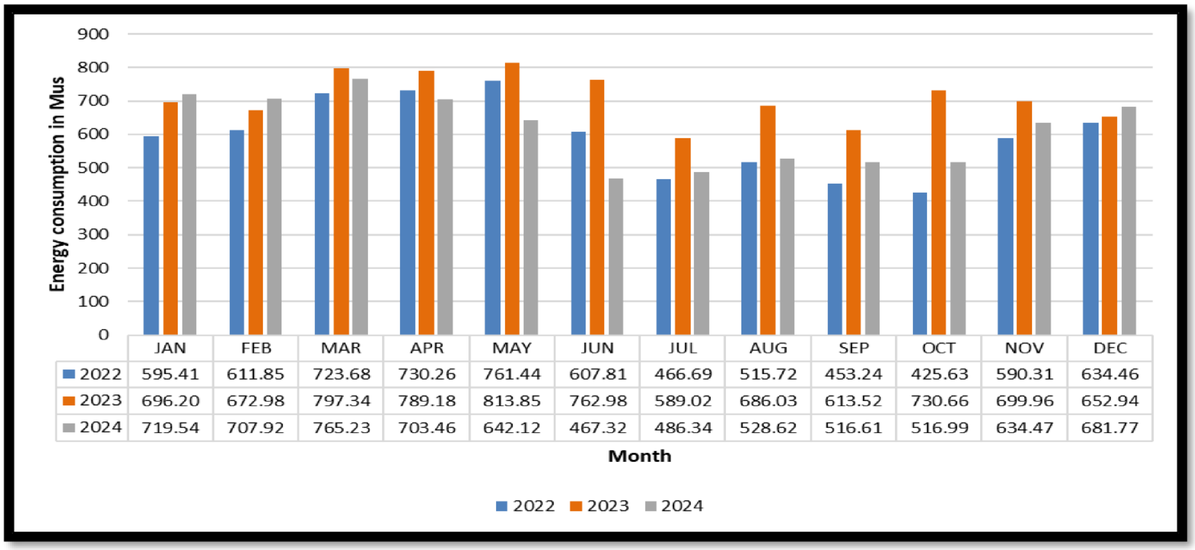
Observations:

The plot shows % contribution of each district for Western Maharashtra region. The table below gives statistical insights.

Table 33: District-wise % energy consumption for Western Maharashtra region

District	Percentage (%)
Pune	46.87
Solapur	14
Ahilyanagar	13.46
Kolhapur	11.46
Sangli	7.3
Satara	6.95
First 3 Districts Total	~74.33

21.4.3 Monthly energy consumption comparison for Western Maharashtra region (2022-2024)



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2022	595.41	611.85	723.68	730.26	761.44	607.81	466.69	515.72	453.24	425.63	590.31	634.46
2023	696.20	672.98	797.34	789.18	813.85	762.98	589.02	686.03	613.52	730.66	699.96	652.94
2024	719.54	707.92	765.23	703.46	642.12	467.32	486.34	528.62	516.61	516.99	634.47	681.77

Figure 218: Monthly energy consumption comparison for Western Maharashtra region (2022-2024)

Summary

The above plot illustrates the comparison of Monthly energy consumption of Western Maharashtra region in MUs over years 2022 to 2024.

21.4.4 ΣMonthly energy consumption comparison for Western Maharashtra region (2022-2024)

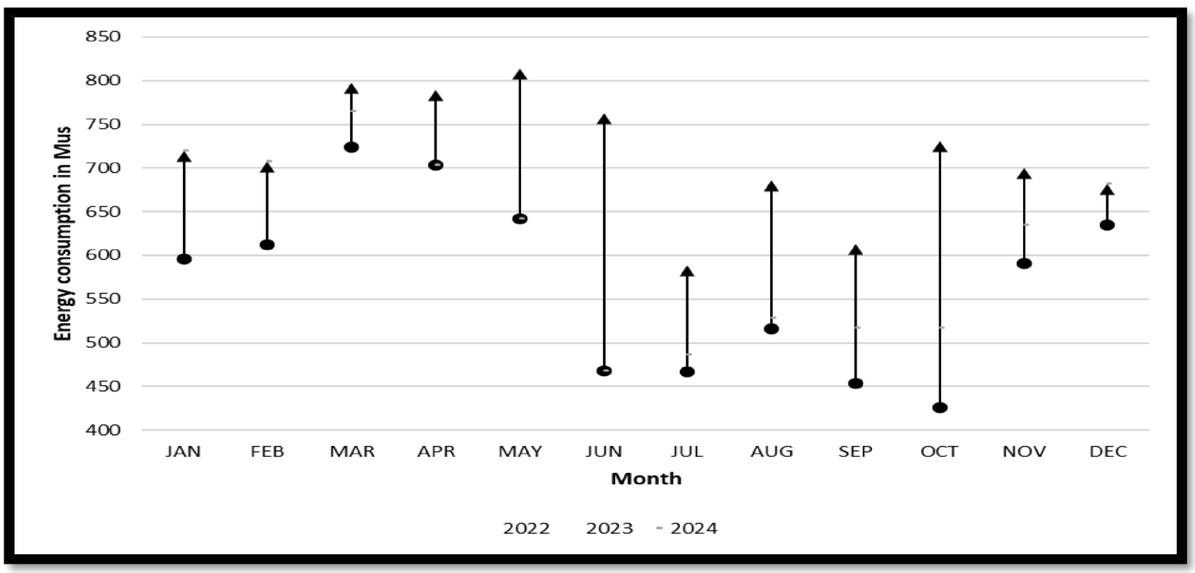


Figure 219: ΣMonthly energy consumption comparison for Western Maharashtra region (2022-2024)

Summary

The graph uses dots, line segment and triangles to show data points

▲: Represents energy consumption for 2024

|: The vertical line segment represents the trend for 2023

●: Indicates energy consumption for 2022

The above plot shows the variation in monthly energy consumption values (in MU) across the years 2022, 2023, and 2024.

21.5 Northern Maharashtra Region

21.5.1 District-wise energy consumption comparison for Northern Maharashtra region (2022-2024)

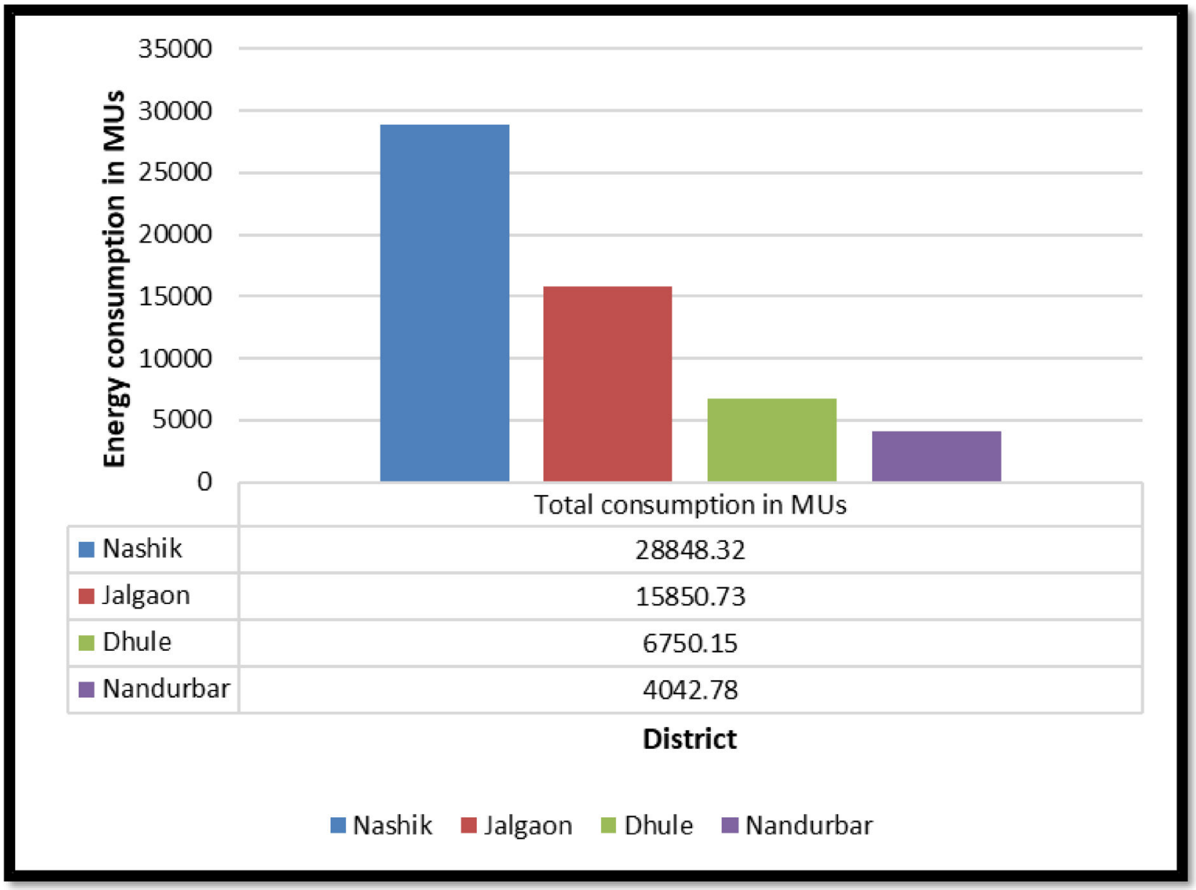


Figure 220: Monthly energy consumption comparison for Northern Maharashtra region (2022-2024)

Summary

The above plot shows district wise energy consumption in MUs for Northern Maharashtra region over a period of 2022-2024. The table below gives statistical insights.

Table 34: District-wise energy consumption for Northern Maharashtra region

Region	District	Total Consumption in MUs
North Maharashtra	Nashik	28848.32
	Jalgaon	15850.73
	Dhule	6750.15
	Nandurbar	4042.78
	Total	**55491.98**

21.5.2 District wise % contribution for Northern Maharashtra region (2022-2024)

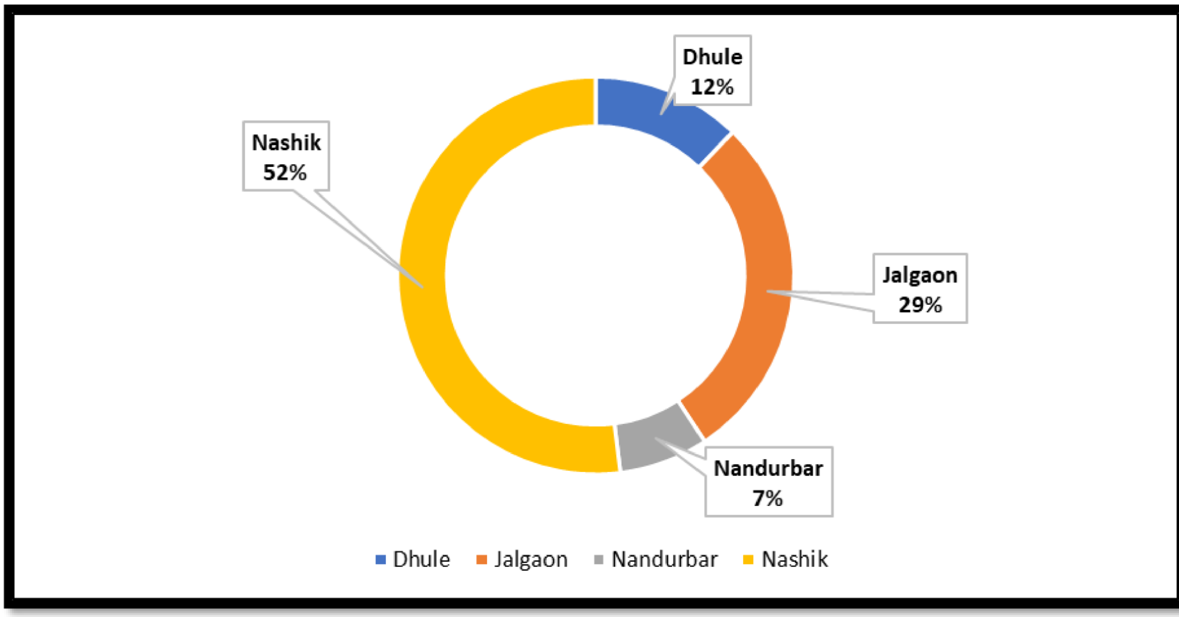


Figure 221: District wise % contribution for Northern Maharashtra region (2022-2024)

Observations:

The plot shows % contribution of each district for *Northern* Maharashtra region. The table below gives statistical insights.

Table 35: District-wise % energy consumption for Northern Maharashtra region

District	Percentage (%)
Nashik	51.9
Jalgaon	28.6
Dhule	12.2

Nandurbar	7.3
First 2 Districts Total	80.5

21.5.3 Monthly energy consumption comparison for Northern Maharashtra region (2022-2024)

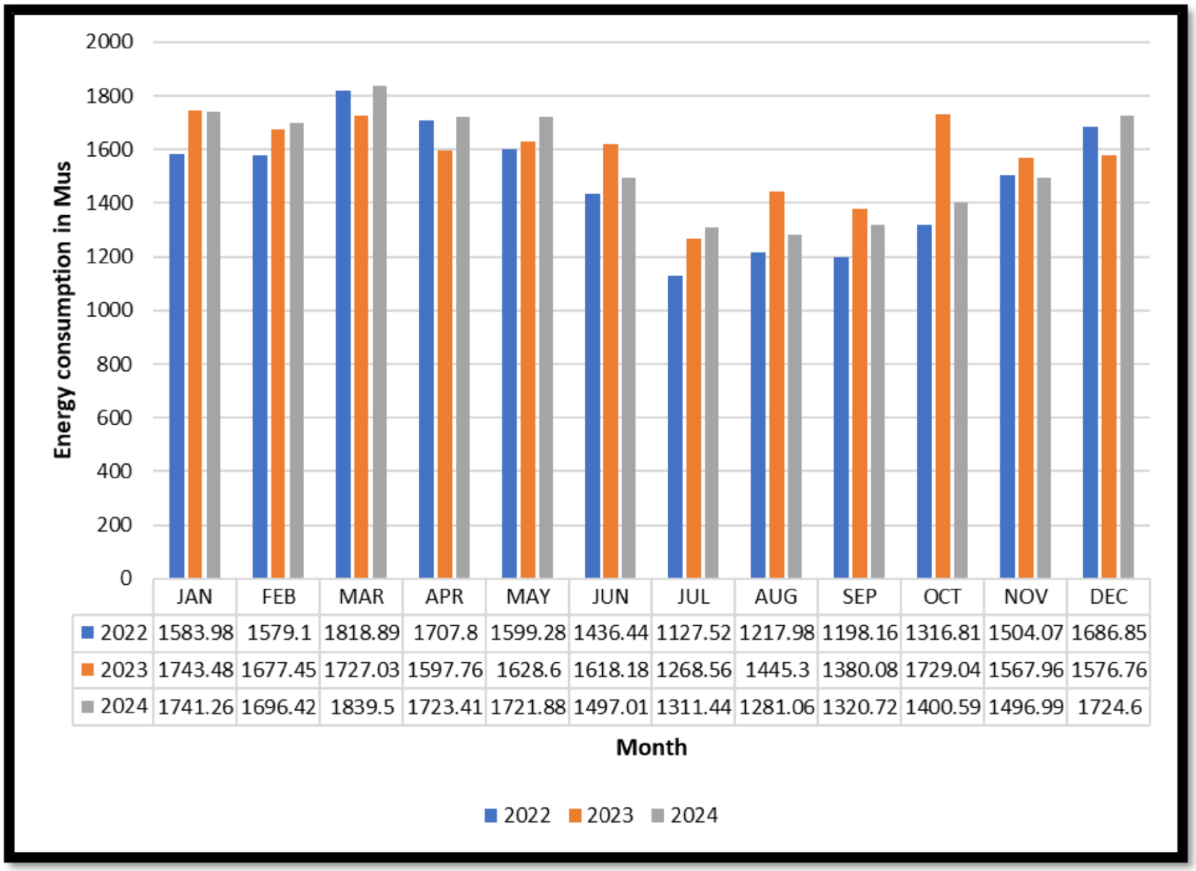


Figure 222: Monthly energy consumption comparison for Northern Maharashtra region (2022-2024)

Summary

The above plot illustrates the comparison of Monthly energy consumption of Northern Maharashtra region in MUs over years 2022 to 2024.

21.5.4 ΣMonthly energy consumption comparison for Northern Maharashtra region (2022-2024)

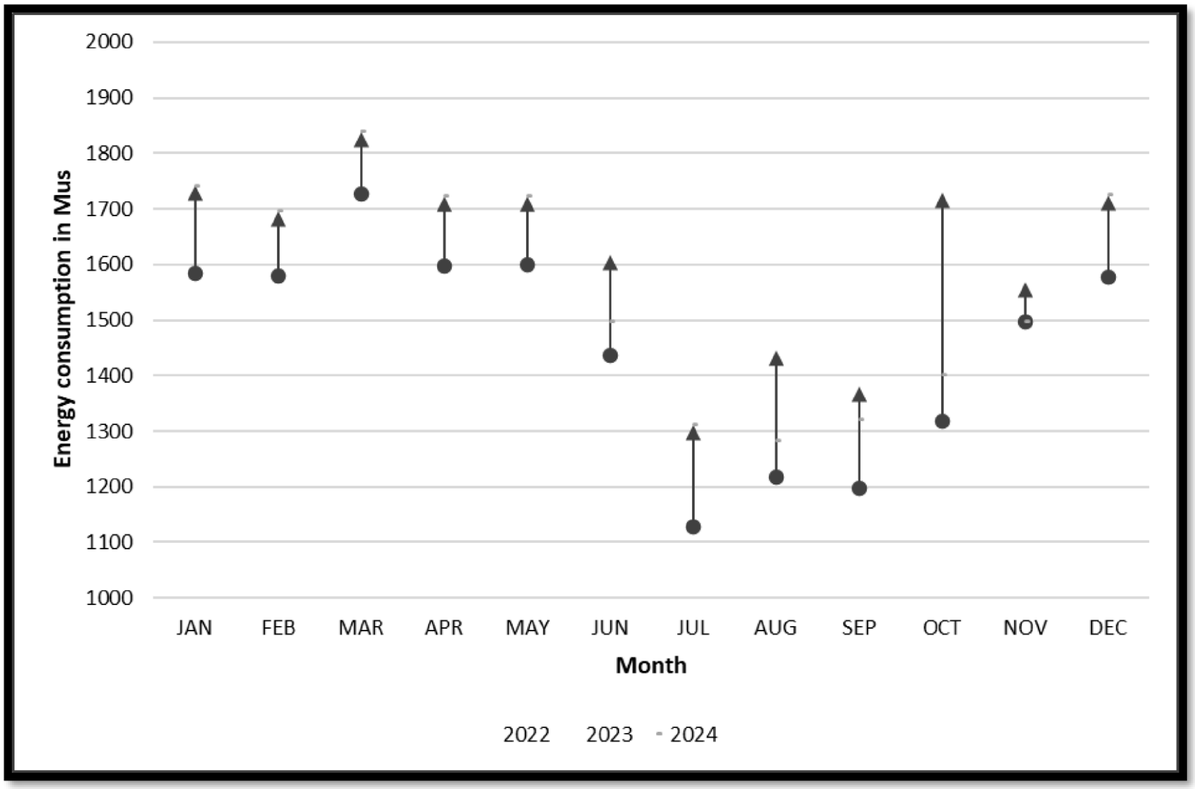


Figure 223: ΣMonthly energy consumption comparison for Northern Maharashtra region (2022-2024)

- The graph uses dots, line segment and triangles to show data points

▲: Represents energy consumption for 2024

|: The vertical line segment represents the trend for 2023

•: Indicates energy consumption for 2022

The above plot shows the variation in monthly energy consumption values (in MU) across the years 2022, 2023, and 2024.

21.6 Vidarbha Region

21.6.1 District-wise energy consumption comparison for Vidarbha region (2022-2024)

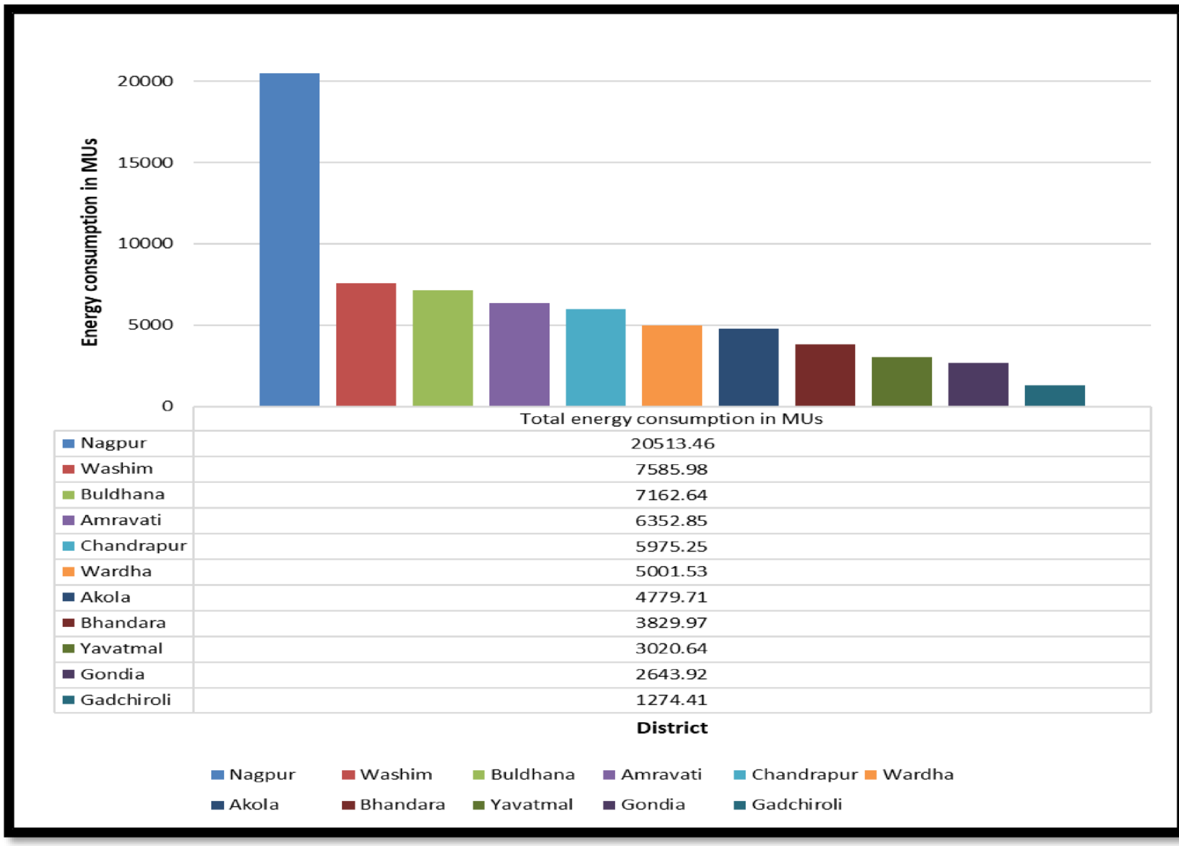


Figure 224: Monthly energy consumption comparison for Vidarbha region (2022-2024)

Summary

The above plot shows district wise energy consumption in MUs for Vidarbha region over a period of 2022-2024. The table below gives statistical insights.

Table 36: District-wise energy consumption for Vidarbha region

Region	District	Total Consumption in MUs
Vidarbha	Nagpur	20513.46
	Washim	7585.98
	Buldhana	7162.64
	Amravati	6352.85
	Chandrapur	5975.25
	Wardha	5001.53
	Akola	4779.71
	Bhandara	3829.97
	Yavatmal	3020.64
	Gondia	2643.92
	Gadchiroli	1274.41
	Total	**68140.35**

21.6.2 District wise % contribution for Vidarbha region (2022-2024)

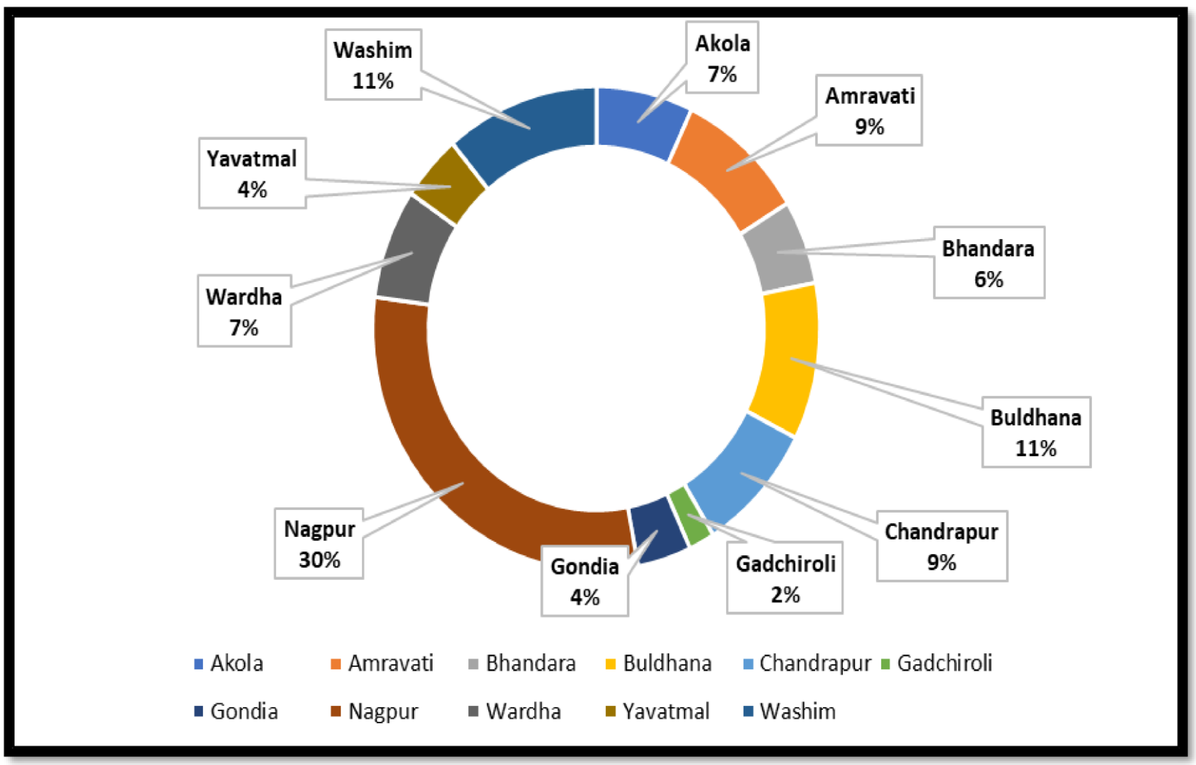


Figure 225: District wise % contribution for Vidarbha region (2022-2024)

Observations:

The plot shows % contribution of each district **for Vidarbha region**. The table below gives statistical insights.

Table 37: District-wise % energy consumption for Vidarbha region

District	Percentage (%)
Nagpur	30.11
Washim	11.13
Buldhana	10.51
Amravati	9.32
Chandrapur	8.77
Bhandara	5.62
Wardha	7.34
Yavatmal	4.43
Gondia	3.88
Gadchiroli	1.87
First 3 Districts Total	**51.75%**

21.6.3 Monthly energy consumption comparison for Vidarbha (2022-2024)

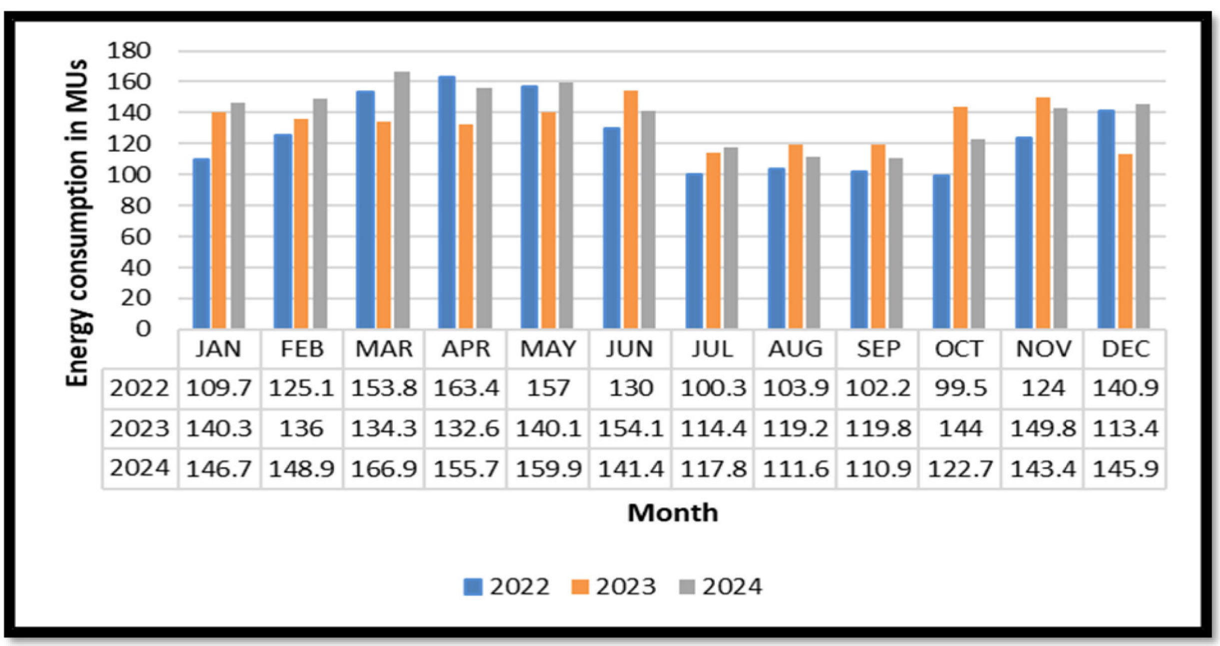


Figure 226: Monthly energy consumption comparison for Vidarbha region (2022-2024)

Summary

The above plot illustrates the comparison of Monthly energy consumption of Vidarbha region in MUs over years 2022 to 2024.

21.6.4 ΣMonthly energy consumption comparison for Vidarbha region (2022-2024)

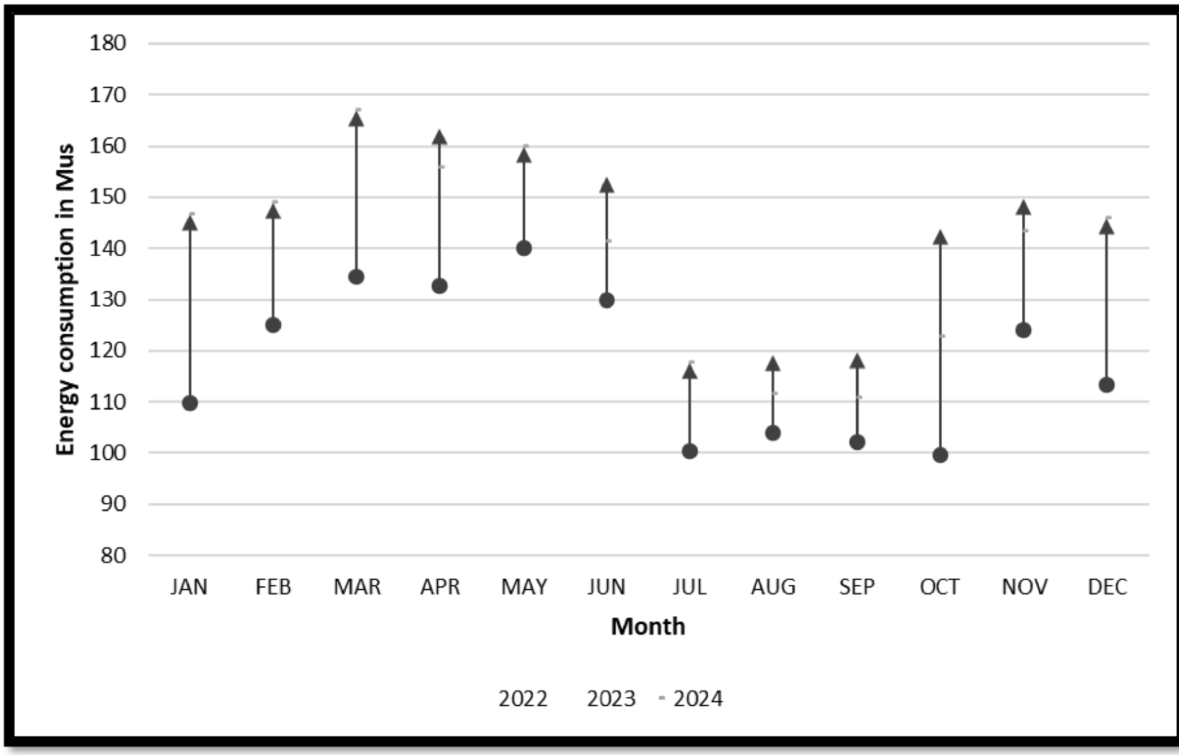


Figure 227: ΣMonthly energy consumption comparison for Vidarbha region (2022-2024)

Summary

The graph uses dots, line segment and triangles to show data points

▲: Represents energy consumption for 2024

|: The vertical line segment represents the trend for 2023

•: Indicates energy consumption for 2022

The above plot shows the variation in monthly energy consumption values (in MU) across the years 2022, 2023, and 2024.

21.7 Marathwada Region

21.7.1 District-wise energy consumption comparison for Marathwada region (2022-2024)

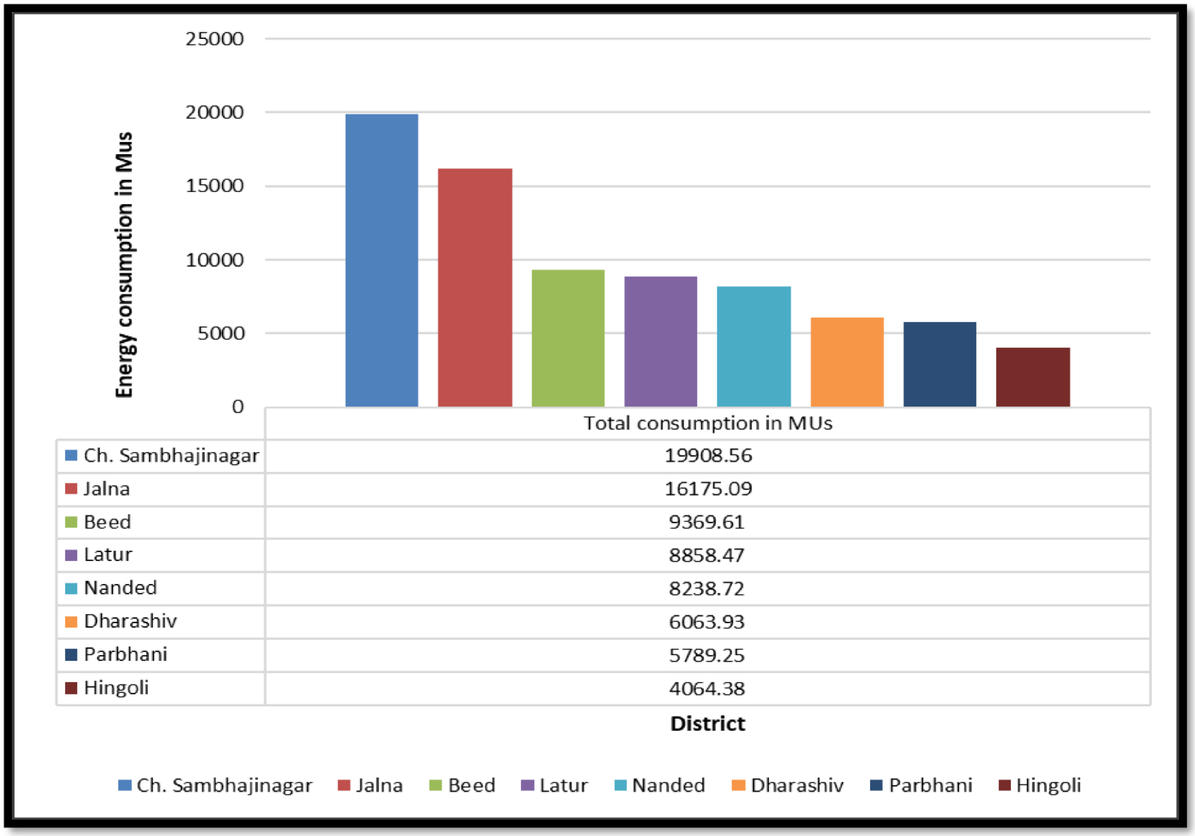


Figure 228: Monthly energy consumption comparison for Marathwada region (2022-2024)

Summary

The above plot shows district wise energy consumption in MUs for Marathwada region over a period of 2022-2024. The table below gives statistical insights.

Table 38: District-wise energy consumption for Marathwada region

Region	District	Total Consumption in MUs
Marathwada	Ch. Sambhajinagar	19908.56
	Jalna	16175.09
	Beed	9369.61
	Latur	8858.47
	Nanded	8238.72

Region	District	Total Consumption in MUs
	Dharashiv	6063.93
	Parbhani	5789.25
	Hingoli	4064.38
	Total	78468.03

21.7.2 District wise % contribution for Marathwada region (2022-2024)

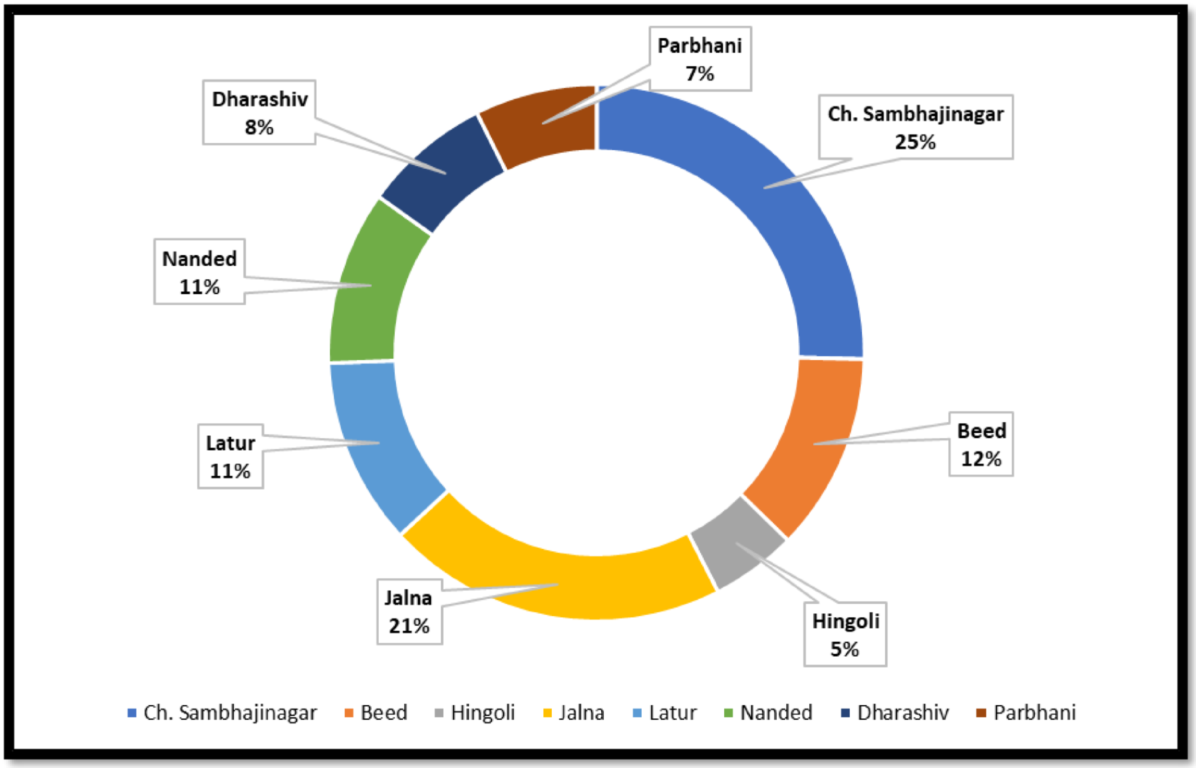


Figure 229: District wise % contribution for Marathwada region (2022-2024)

Observations:

The plot shows % contribution of each district **for Marathwada region**. The table below gives statistical insights.

Table 39: District-wise % energy consumption for Marathwada region

District	Percentage (%)
Ch. Sambhajinagar	24.86
Jalna	20.19
Beed	11.69
Latur	11.06
Nanded	10.29
Dharashiv	7.58
Parbhani	7.23
Hingoli	5.08
First 3 Districts Total	56.74

21.7.3 Monthly energy consumption comparison for Marathwada region (2022-2024)

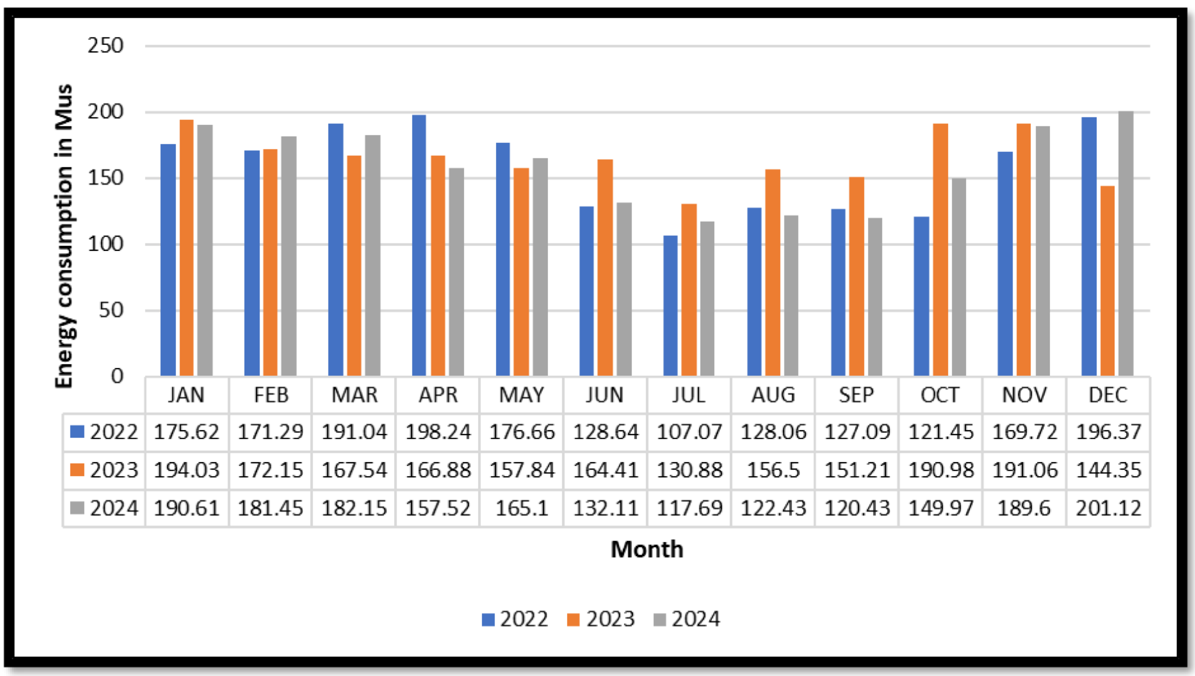


Figure 230: Monthly energy consumption comparison for Marathwada region (2022-2024)

Summary

The above plot illustrates the comparison of Monthly energy consumption of Marathwada region in MUs over years 2022 to 2024.

21.7.4 ΣMonthly energy consumption comparison for Marathwada region (2022-2024)

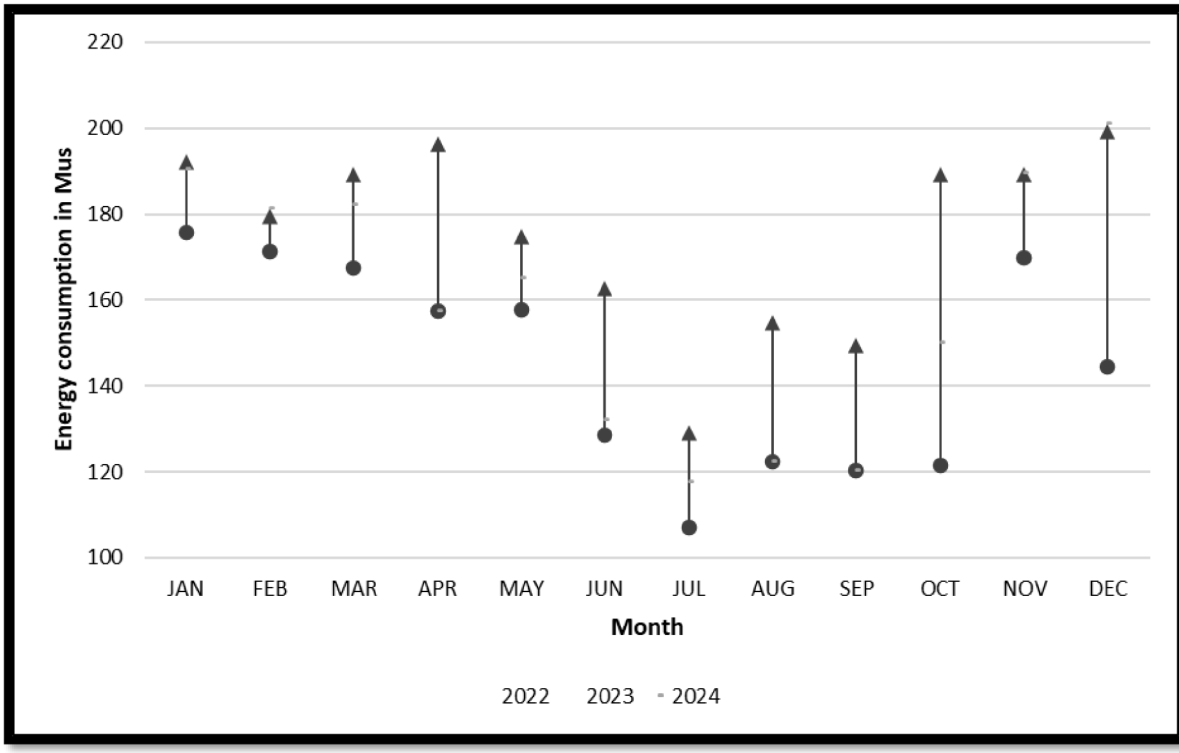


Figure 231: ΣMonthly energy consumption comparison for Marathwada region (2022-2024)

Summary

The graph uses dots, line segment and triangles to show data points

▲: Represents energy consumption for 2024

|: The vertical line segment represents the trend for 2023

•: Indicates energy consumption for 2022

The above plot shows the variation in monthly energy consumption values (in MU) across the years 2022, 2023, and 2024.

22. MMR Energy consumption comparison with other regions (2022-2024)

22.1 Introduction

This chapter presents a comparative analysis of the Mumbai Metropolitan Region (MMR) with other regions of Maharashtra. Further, the analysis focuses on MMR and the Pune district (Pune belongs to the Western Maharashtra region), as together they account for a significant share of the state's total energy consumption. MMR and Pune are analysed jointly since they represent two distinct yet comparable high-load urban clusters in Maharashtra. The table below outlines the districts falling under each of these regions. This classification serves as the foundational structure for analysing region-wise electricity consumption trends (2022-2024).

Region	Districts
MMR	Thane, Mumbai Suburban, Raigad, Mumbai, Palghar
Western Maharashtra	Pune, Solapur, Ahilyanagar, Kolhapur, Sangli, Satara
Marathwada	Ch. Sambhajinagar, Jalna, Beed, Latur, Nanded, Dharashiv, Parbhani, Hingoli
Vidarbha	Nagpur, Washim, Buldhana, Amravati, Chandrapur, Wardha, Akola, Bhandara, Yavatmal, Gondia, Gadchiroli
North Maharashtra	Nashik, Jalgaon, Dhule, Nandurbar

22.2 MMR energy consumption comparison with other regions (2022-2024)

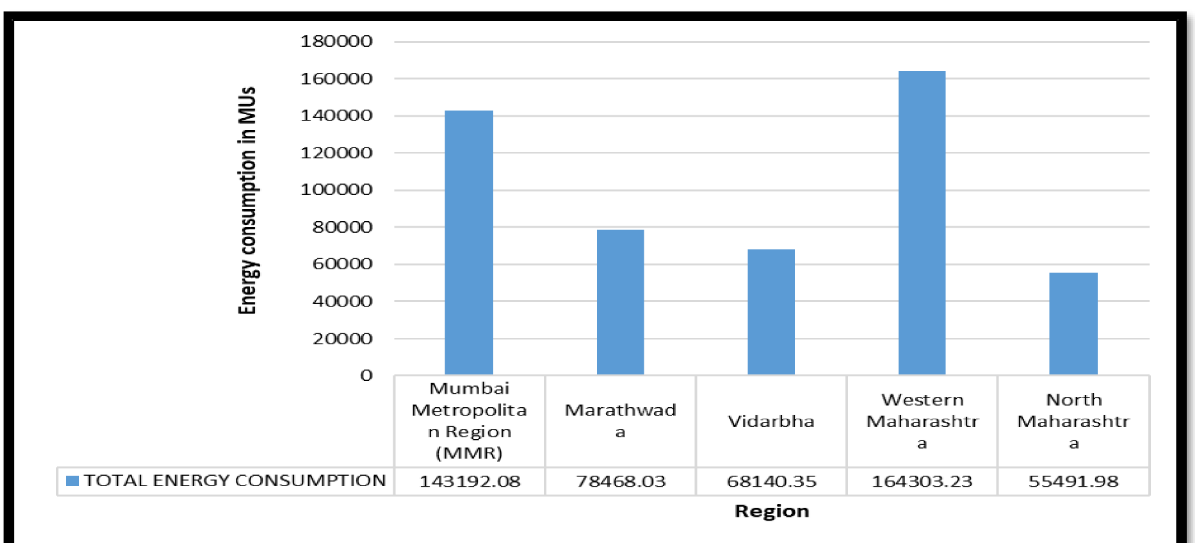


Figure 232: MMR energy consumption comparison with other regions (2022-2024)

Summary

The plot shows energy consumption (in MUs) comparison of MMR region with other regions over years 2022 to 2024. The table below gives statistical insights.

Table 40: Region wise energy consumption comparison over years 2022-2024

Region	Total Energy Consumption
Mumbai Metropolitan Region (MMR)	143192.08
Marathwada	78468.03
Vidarbha	68140.35
Western Maharashtra	164303.22
North Maharashtra	55491.98

22.3 Region-wise % energy consumption contribution (2022-2024)

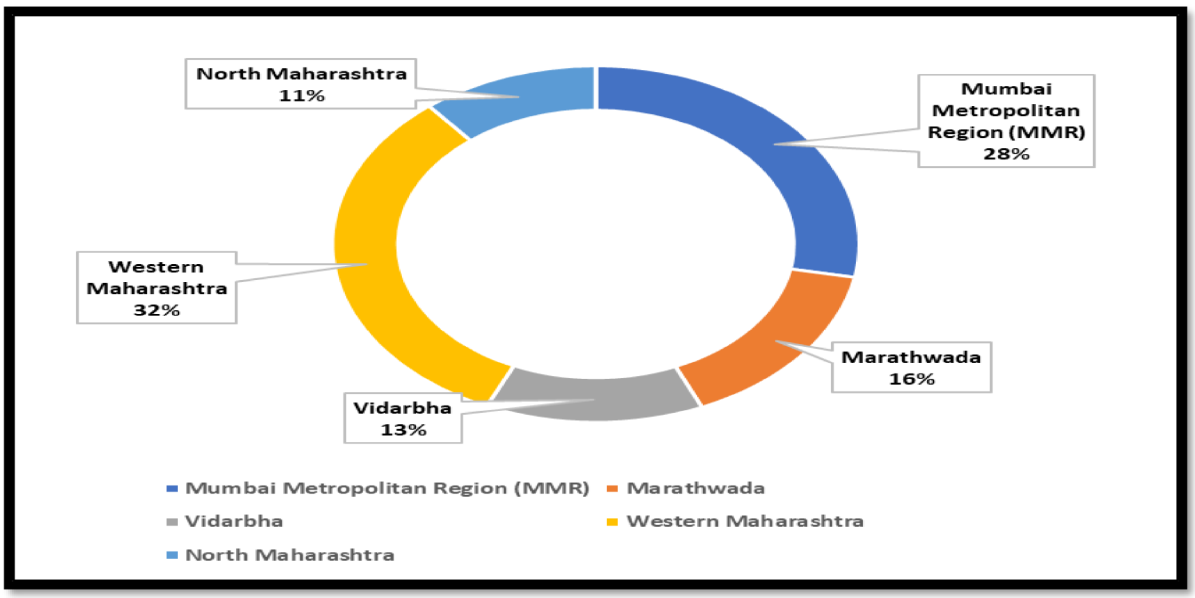


Figure 233:Region-wise % Energy consumption contribution (2022-2024)

Summary

The plot shows % contribution of each region. The table below gives statistical insights.

Table 41: Region-wise % energy consumption

Region	Percentage (%)
Western Maharashtra	32%
MMR (Mumbai Metro Region)	28%
Marathwada	16%
Vidarbha	13%
North Maharashtra	11%

22.4 Yearly energy consumption comparison of MMR with other regions (2022-2024)

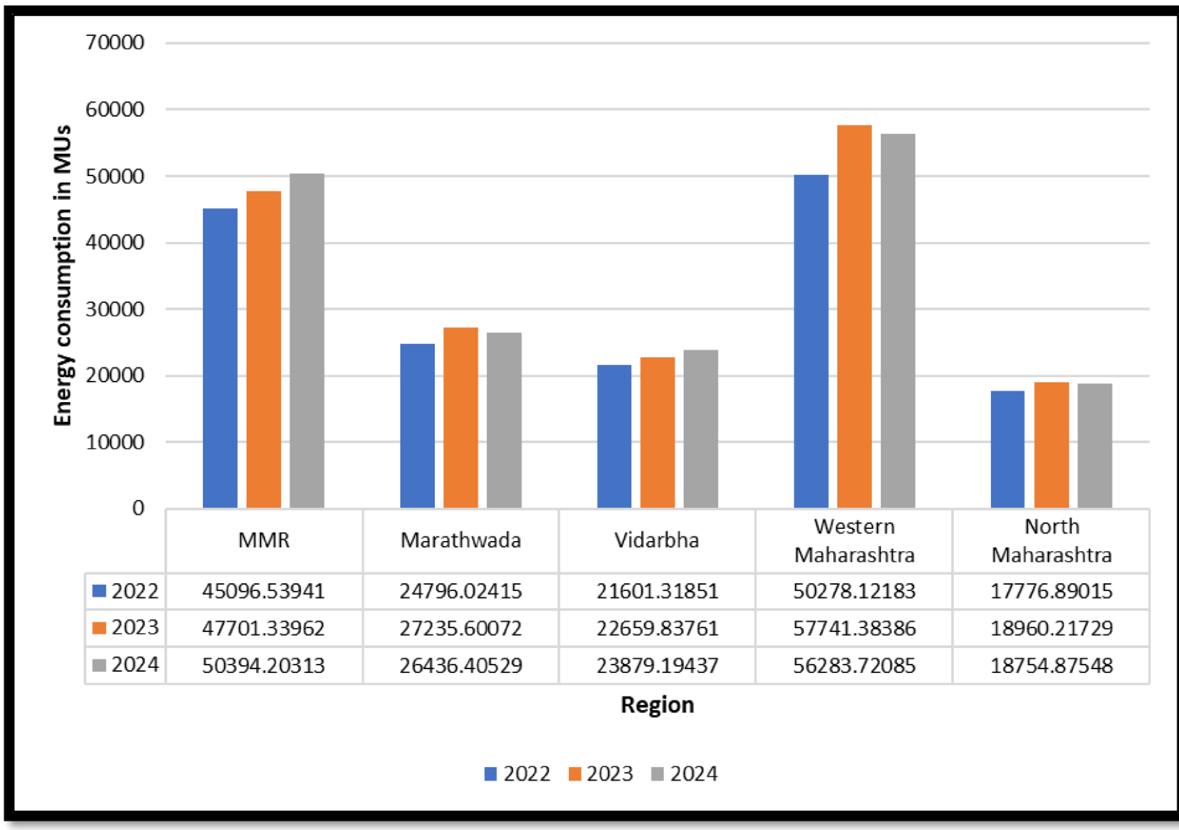


Figure 234: Yearly energy consumption comparison of MMR with other regions (2022-2024)

Summary

The above plot illustrates the comparison of yearly energy consumption of MMR, Marathwada, Vidarbha, Western Maharashtra and Northern Maharashtra region in MUs over years 2022 to 2024.

22.5 ΣYearly energy consumption comparison of MMR with other regions (2022-2024)

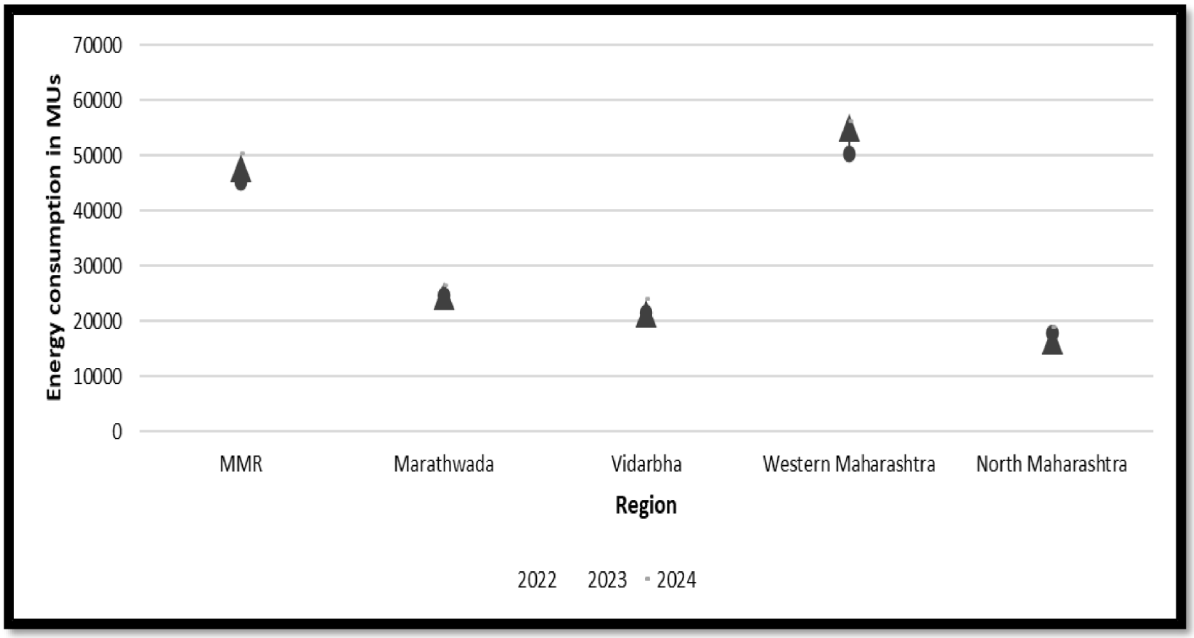


Figure 235: Σ Yearly energy consumption comparison of MMR with other regions (2022-2024)

Summary

The graph uses dots, line segment and triangles to show data points

▲: Represents energy consumption for 2024
|: The vertical line segment represents the trend for 2023
•: Indicates energy consumption for 2022

The above plot shows the variation in yearly energy consumption values (in MU) across the years 2022, 2023, and 2024.

22.6 MMR comparison with Pune (2022-2024)

MMR and Pune together account for a significant share of the state's total energy consumption; therefore, the comparative analysis is carried out jointly, as they represent two distinct yet comparable high-load urban clusters in Maharashtra.

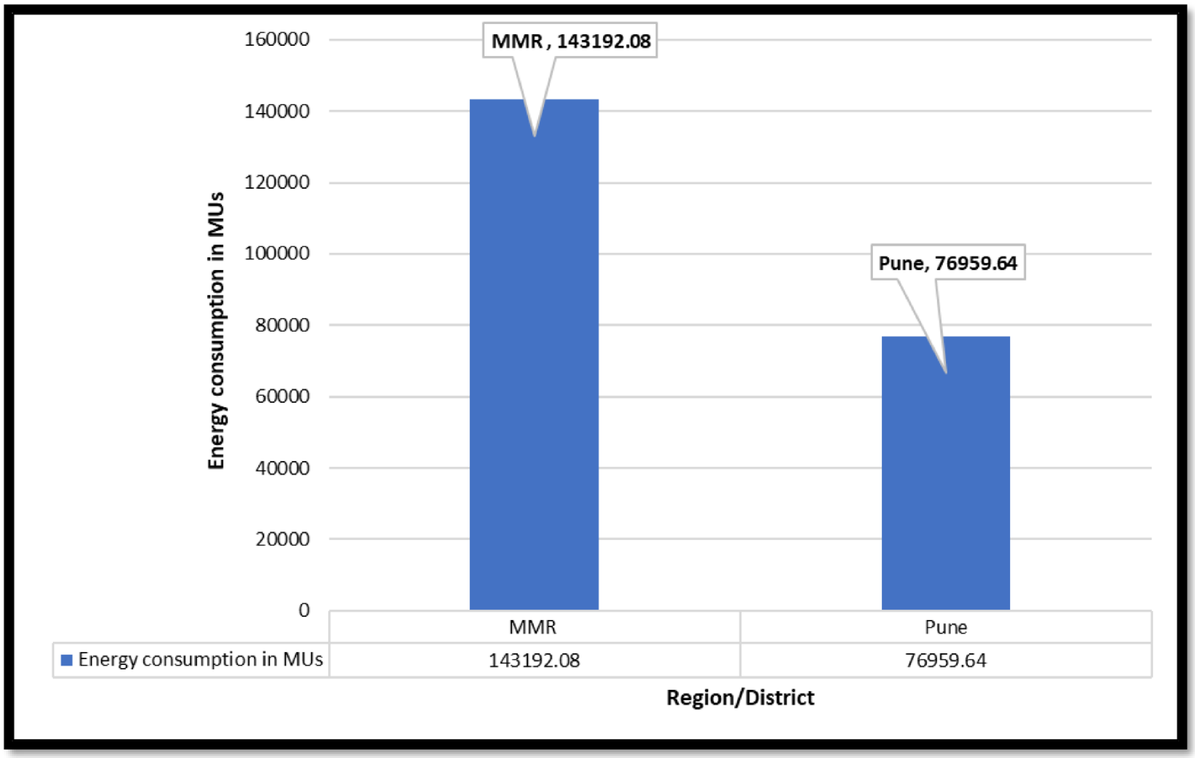


Figure 236: MMR energy consumption comparison with Pune (2022-2024)

Summary
The Plot shows the energy consumption in MUs for MMR and Pune for 3 years.
The table below gives statistical insights.

Table 42: Energy consumption (in MUs) for MMR and Pune

Region	Energy consumption in MUs
MMR	143192.08
Pune	76959.63

22.7 Yearly energy consumption comparison of MMR with Pune region (2022-2024)

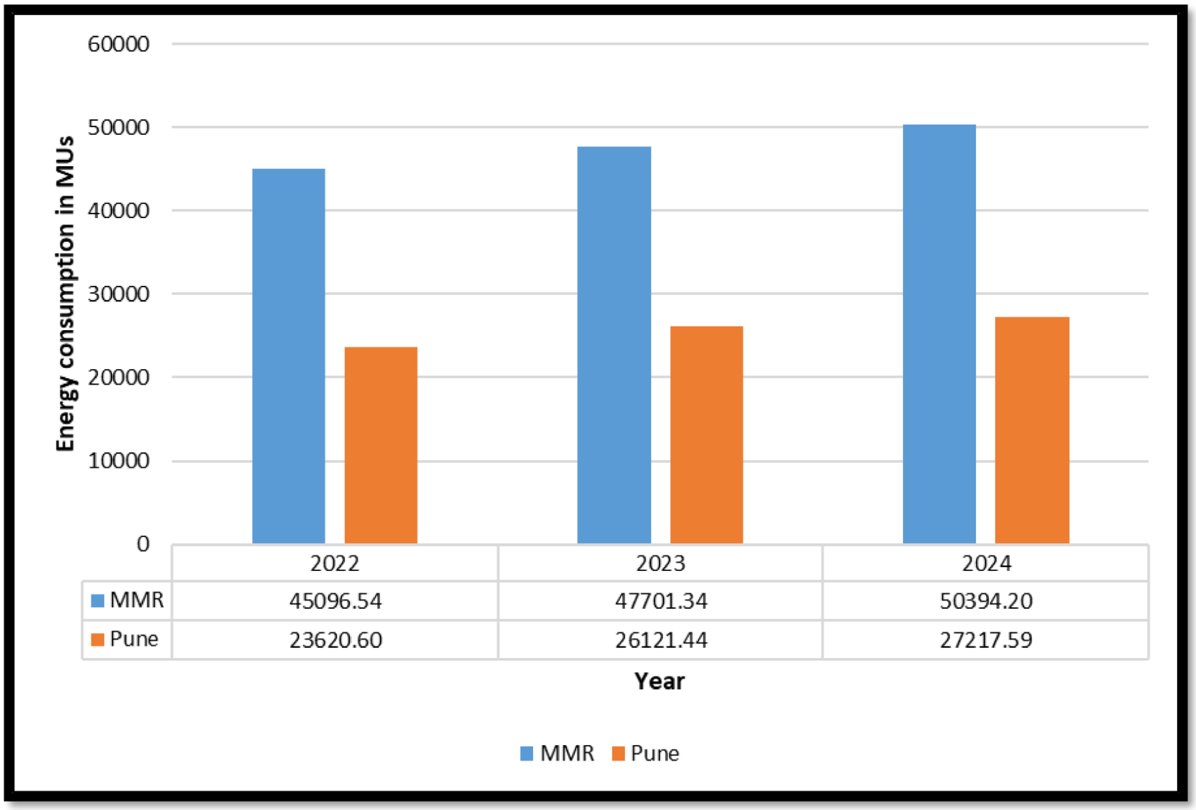


Figure 237: Yearly energy consumption comparison of MMR with Pune (2022-2024)

Summary

The plot shows the yearly energy consumption comparison of MMR and Pune over years 2022-2024.

22.8 Monthly Energy consumption comparison of MMR and Pune (2022-2024)

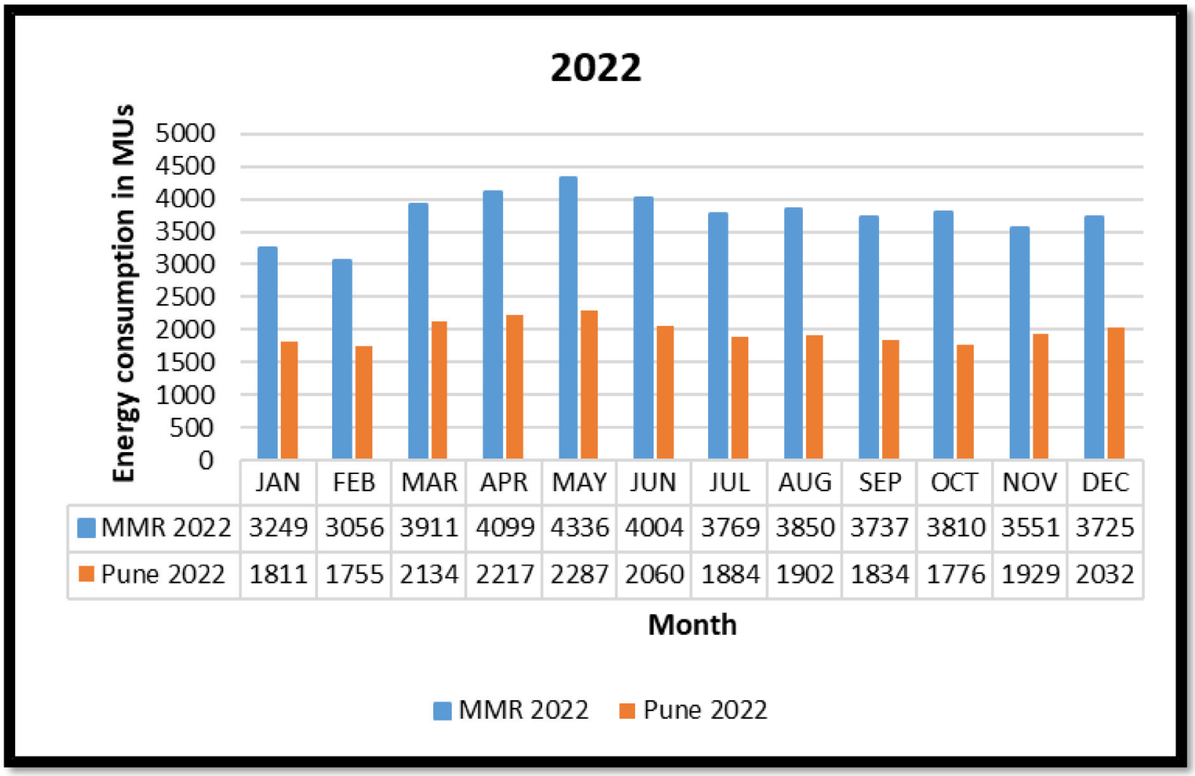


Figure 238: Monthly Energy consumption comparison of MMR and Pune-2022

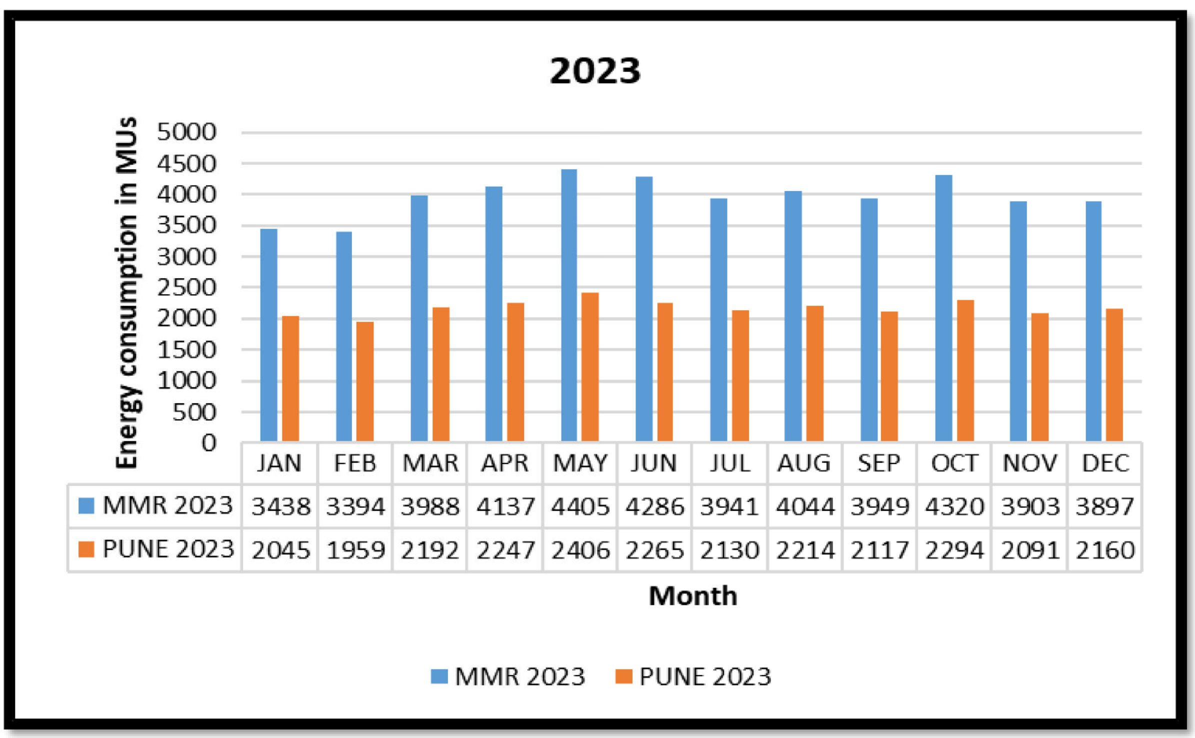


Figure 239: Monthly Energy consumption comparison of MMR and Pune-2023

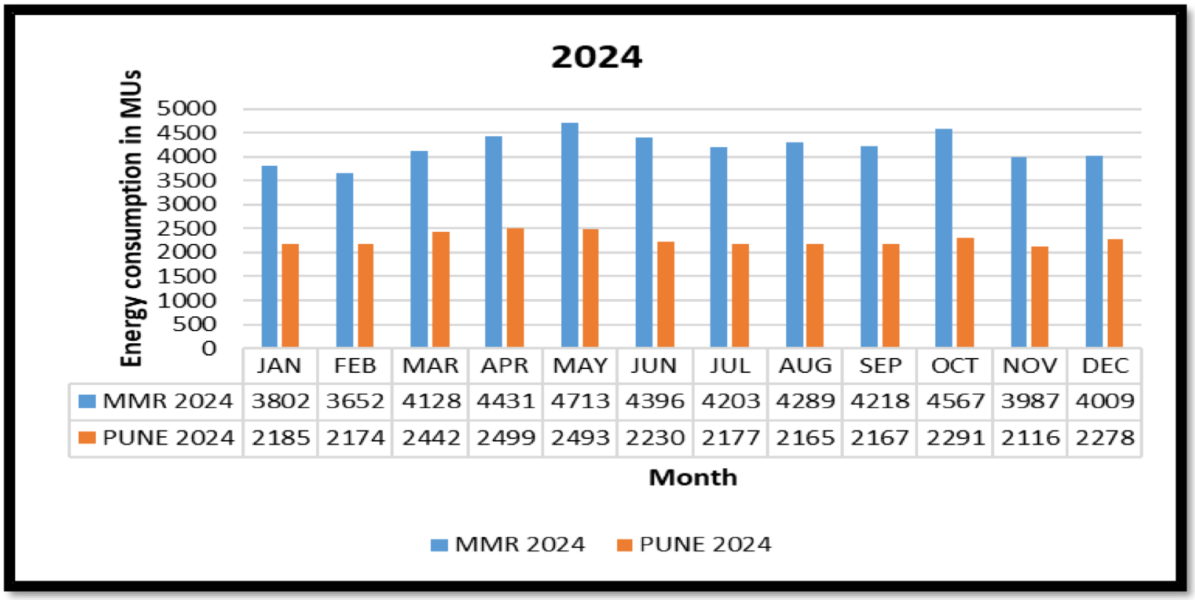


Figure 240: Monthly Energy consumption comparison of MMR and Pune-2024

Summary
The plot shows Monthly Energy consumption comparison of MMR and Pune over years 2022,2023 and 2024.

22.9 MMR+Pune comparison with State (2022-2024)

MMR and Pune together account for a significant share of the state's total energy consumption; therefore, the comparative analysis is carried out jointly with state energy consumption in MUs over years 2022-2023-2024.

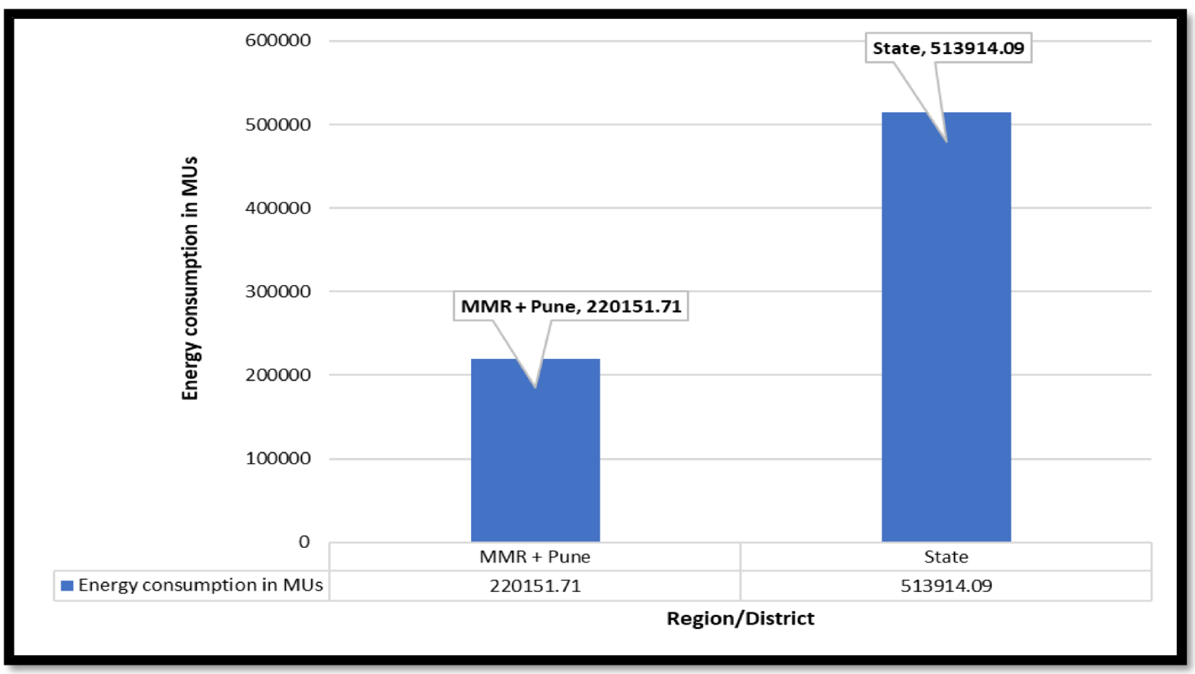


Figure 241: MMR+Pune energy consumption comparison with State (2022-2024)

Summary

The Plot shows the comparison of energy consumption in MUs for MMR+Pune with state for 3 years. The table below gives statistical insights.

Region	Energy consumption in MUs
MMR + Pune	220151.71
State	513914.09

Total 42.83% energy of state is consumed by MMR and Pune.

22.10 Yearly energy consumption comparison of MMR +Pune with State (2022-2024)

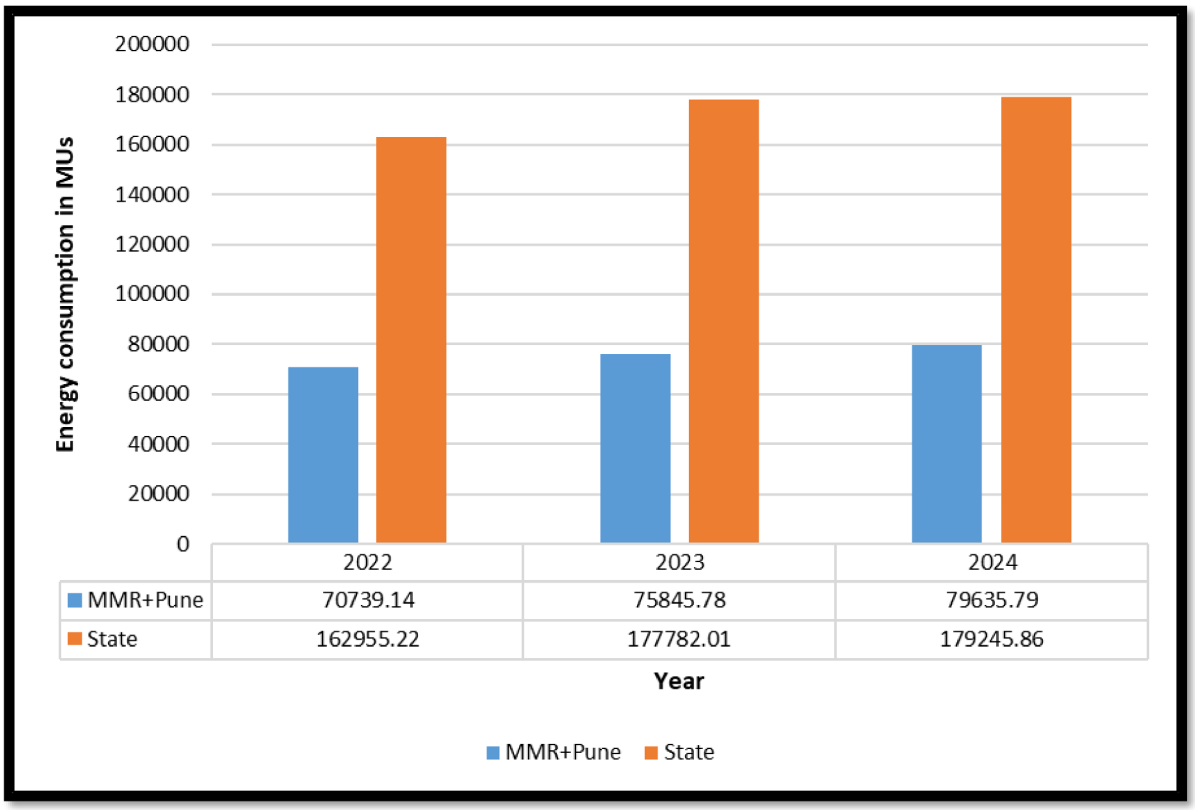


Figure 242: Yearly energy consumption comparison of MMR+Pune with state (2022-2024)

Summary

The plot shows the yearly energy consumption comparison of MMR and Pune with State over years 2022-2024.

The table below gives statistical insights.

Year	MMR +Pune (Energy consumption in MUs)	State (Energy consumption in MUs)	% Contribution of (MMR + Pune) in state energy
2022	70739.14298	162955.2186	43.41
2023	75845.77604	177782.0105	42.66
2024	79635.79259	179245.8595	44.43

22.11 Monthly Energy consumption comparison of MMR+Pune with State (2022-2024)

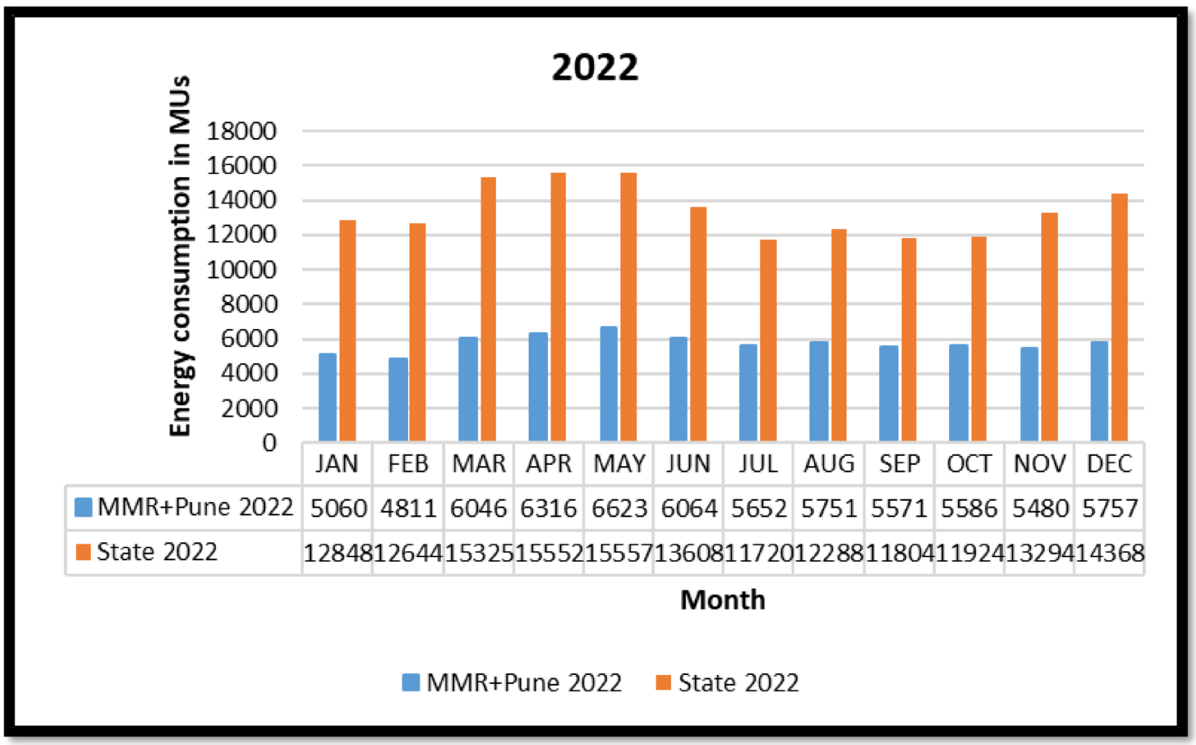


Figure 243: Monthly Energy consumption comparison of MMR and Pune with State-2022

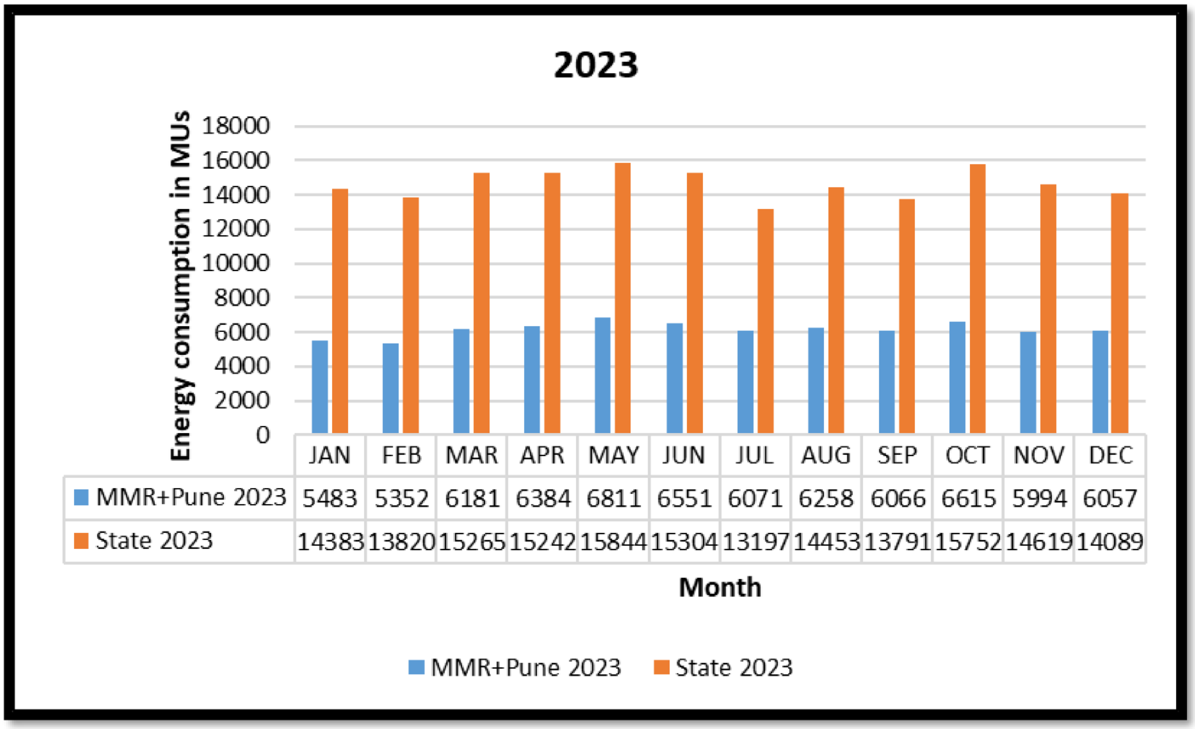


Figure 244: Monthly Energy consumption comparison of MMR and Pune with State-2023

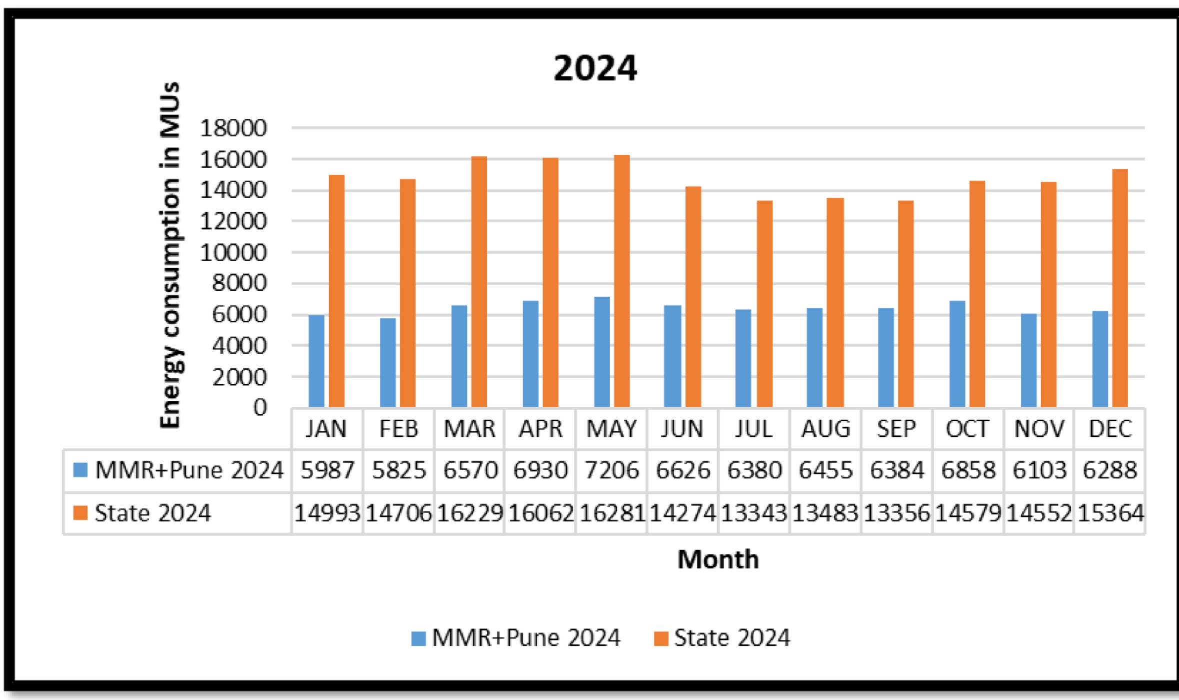


Figure 245: Monthly Energy consumption comparison of MMR and Pune with State-2024

Observations of Rooftop Solar in Maharashtra

23. Rooftop Solar Trends and Growth Patterns (2016–2025)

23.1 Introduction

This chapter provides the state-level scenario for the years 2016 to 2025 in terms of rooftop solar capacity (MW) and number of consumers. It includes year-on-year growth (%) of incremental rooftop solar capacity and consumers. Rooftop solar data is sourced from MSEDCL and was received as monthly values in kW; for analysis, the values are converted to MW. The analysis also presents insights for 34 districts using data from May 2016 to December 2025. In addition, rooftop solar data for Mumbai utilities (AEML, BEST, and TPC-D) is analyzed in MW, with data considered up to July 2025. Peak day analysis covers the state peak demand day, state solar peak day, and peak energy consumption days for the 10 districts in terms of highest energy consumption, to assess the impact of rooftop solar and its contribution to peak shaving or peak curtailment.

23.2 Annual Growth of Rooftop Solar Capacity and Consumer Base in the State (2016–2025 for Cumulative Data)

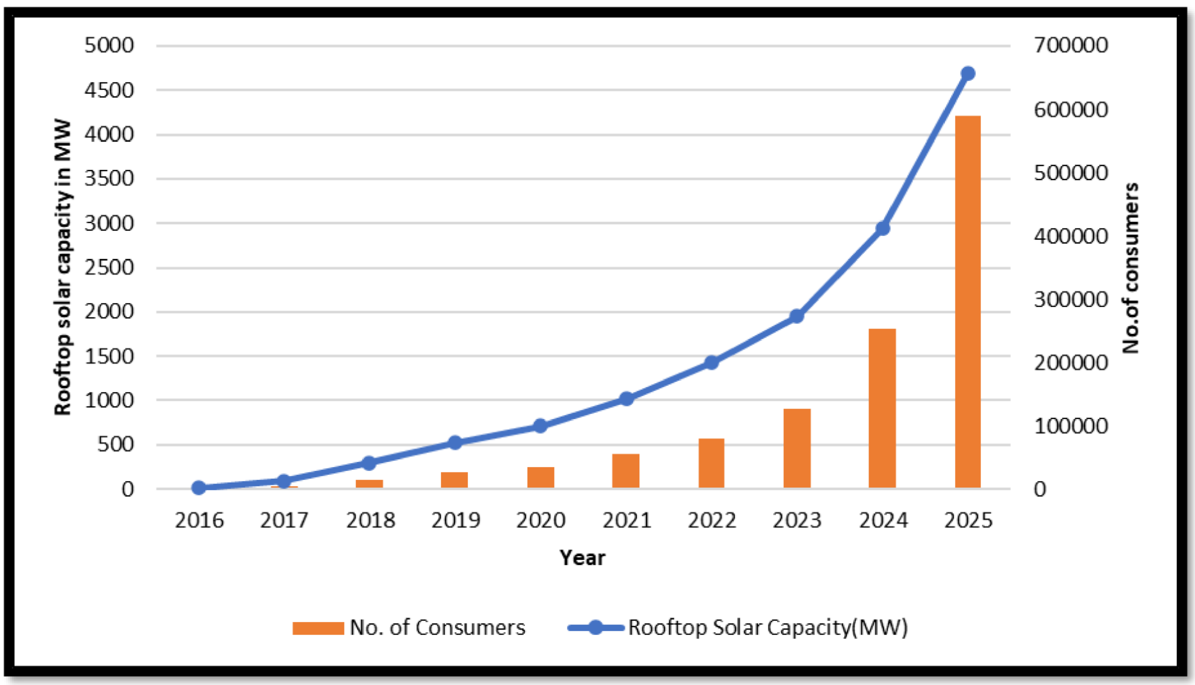


Figure 246: Annual Growth of rooftop solar Capacity and Consumer Base in the State (2016–2025 for Cumulative Data)

Note: The data covers the period from May 2016 to Dec 2025. Accordingly, the data for year 2016 is available partially.

Observations:

The plot illustrates the growth in rooftop solar capacity (MW) and the number of consumers over the period - May 2016 to December 2025. The table below provides statistical insights into the installed rooftop solar capacity (MW) and number of consumers.

Table 43: Annual Growth of Rooftop Solar Capacity (MW) and Consumer Base in the State (2016–2025)

Year	Rooftop solar Capacity in MW	No. of Consumers
2016	15.40	597
2017	95.54	4868
2018	296.76	14325
2019	524.64	26533
2020	709.39	35825
2021	1020.53	54418
2022	1426.62	79089
2023	1951.69	125902
2024	2938.53	253349
2025	4688.96	589910

23.3 Year-on-Year Growth of Incremental Rooftop Solar Capacity and Consumers (%) (for Cumulative Data)

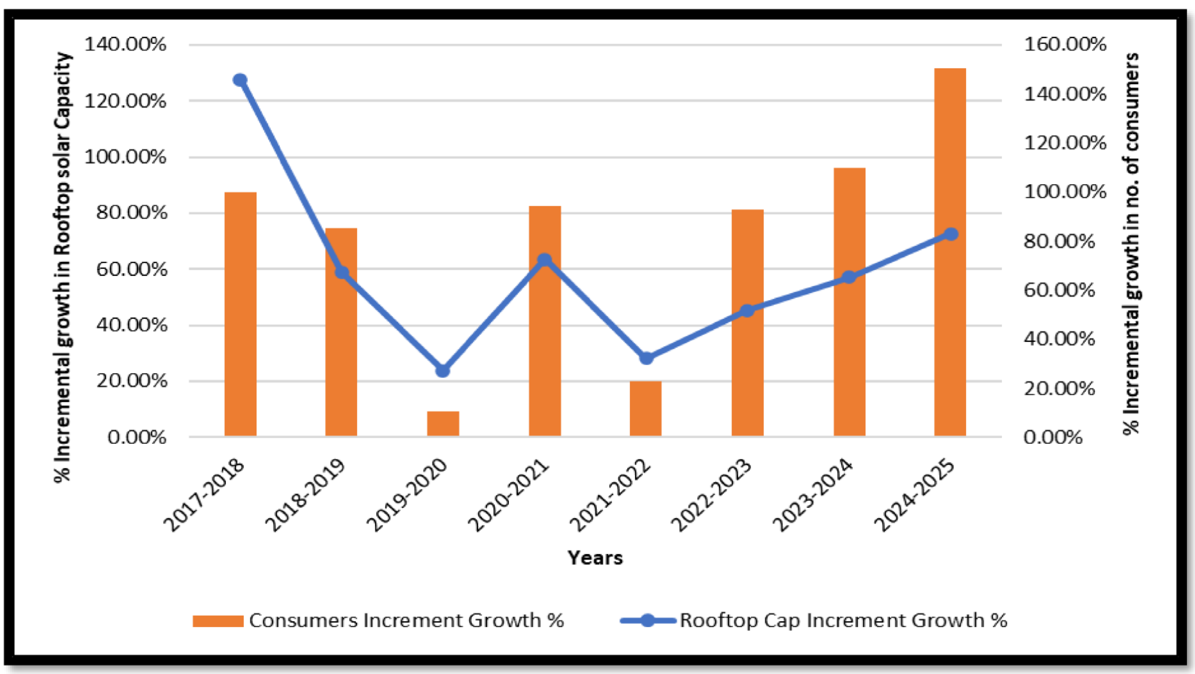


Figure 247: Year-on-Year Growth of Incremental Rooftop Solar Capacity and Consumers (%)

Note: The data covers the period from May 2016 to Dec 2025. Accordingly, the data for year 2016 is available partially.

Observations:

The plot illustrates the year-on-year growth in incremental rooftop solar capacity (MW) and the number of consumers over the period -May 2016 to December 2025. The table below provides statistical insights into the year-on-year growth of rooftop solar capacity (MW) and the number of consumers.

Table 44: Year-on-Year Growth of Incremental Rooftop Capacity and Consumers (%)

Year	Rooftop Solar Cap Increment Growth %	Consumers Increment Growth %
2017-2018	127.66%	100.05%
2018-2019	58.90%	85.31%
2019-2020	23.88%	10.36%
2020-2021	63.55%	94.11%
2021-2022	28.22%	22.68%
2022-2023	45.39%	92.68%
2023-2024	57.08%	110.03%
2024-2025	72.62%	150.32%

23.4 Rooftop Solar Capacity Across All Districts (2016–2025)

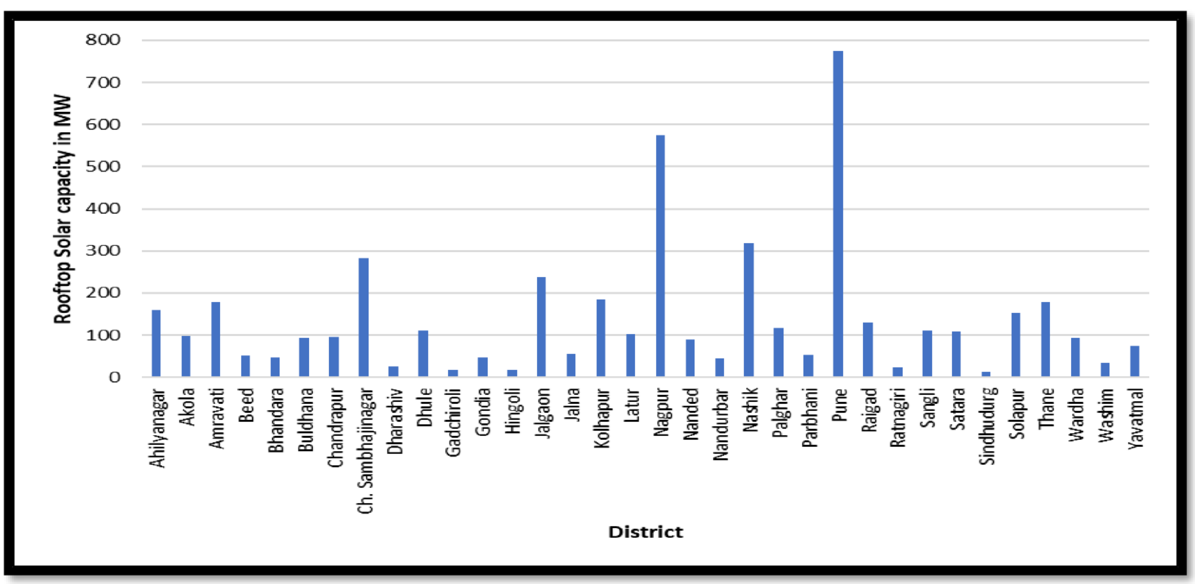


Figure 248: Rooftop Solar Capacity Across All Districts (2016–2025)

Note: The data covers the period from May 2016 to Dec 2025. Accordingly, the data for year 2016 is available partially.

Observations:

This plot illustrates the total rooftop solar capacity (MW) from May 2016 to December 2025 for 34 districts. The table below presents the rooftop solar capacity (MW) for all 34 districts.

Table 45: District-wise rooftop solar capacity in MW

District	Rooftop solar capacity in MW
Ahilyanagar	160.23
Akola	97.80
Amravati	177.64
Beed	51.18
Bhandara	47.78
Buldhana	94.25
Chandrapur	95.30
Ch. Sambhajinagar	282.90
Dharashiv	25.68
Dhule	110.06
Gadchiroli	17.18
Gondia	46.32
Hingoli	16.64
Jalgaon	237.64
Jalna	55.67
Kolhapur	183.98
Latur	102.20
Nagpur	575.41
Nanded	88.78
Nandurbar	43.96
Nashik	318.66
Palghar	116.82
Parbhani	52.36
Pune	773.46
Raigad	129.18
Ratnagiri	24.46
Sangli	110.57
Satara	108.03
Sindhudurg	12.68

District	Rooftop solar capacity in MW
Solapur	152.56
Thane	178.41
Wardha	92.48
Washim	34.49
Yavatmal	74.08
Total	**4688.96**

23.5 Total Consumers Across Districts (2016–2025 for cumulative data)

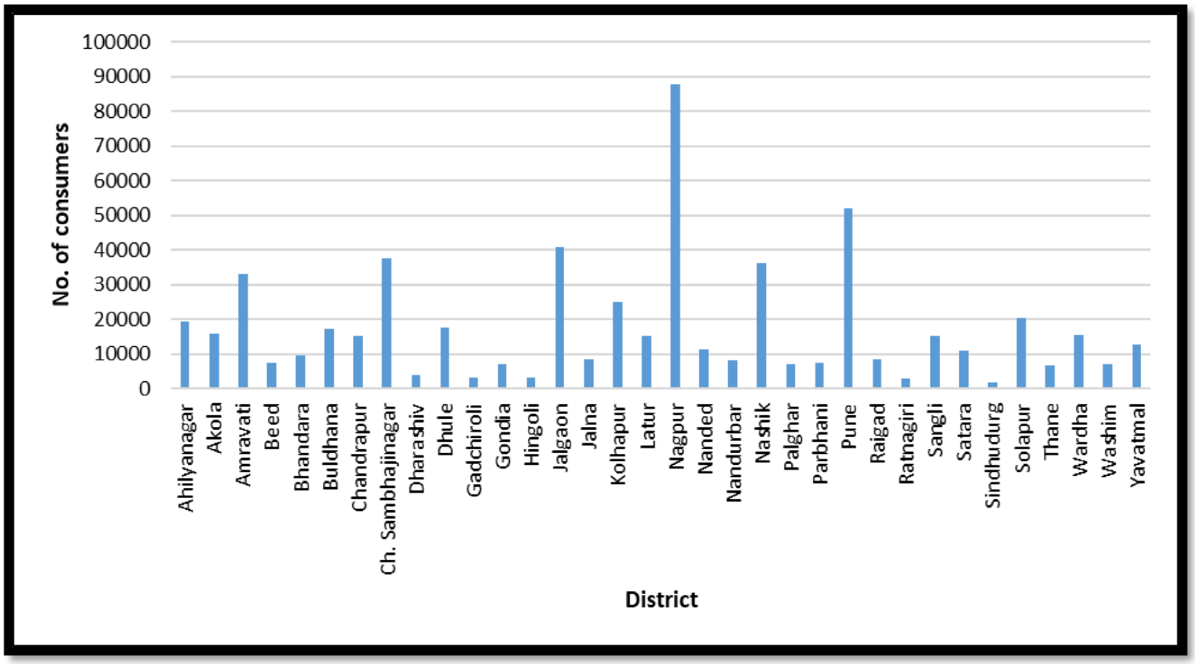


Figure 249: Total Rooftop solar Consumers Across Districts over years 2016-2025

Note: The data covers the period from May 2016 to Dec 2025. Accordingly, the data for year 2016 is available partially.

Observations:

The plot illustrates the district-wise total rooftop solar consumers from May 2016 to December 2025. The table below shows the district-wise rooftop solar consumers from 2016-2025.

Table 46: District-wise rooftop solar consumers

District	No. of consumers
Ahilyanagar	19272
Akola	15852

District	No. of consumers
Amravati	32890
Beed	7258
Bhandara	9451
Buldhana	17116
Chandrapur	15062
Ch. Sambhajinagar	37543
Dharashiv	3808
Dhule	17623
Gadchiroli	3039
Gondia	7213
Hingoli	3167
Jalgaon	40772
Jalna	8319
Kolhapur	24992
Latur	15039
Nagpur	87816
Nanded	11307
Nandurbar	7966
Nashik	36370
Palghar	7115
Parbhani	7468
Pune	52093
Raigad	8551
Ratnagiri	2687
Sangli	14990
Satara	10794
Sindhudurg	1693
Solapur	20478
Thane	6847
Wardha	15561
Washim	6978
Yavatmal	12780
Total	**589910**

23.6 Ten Districts with the Highest Rooftop Solar Capacity (MW) Scenario (2016–2025)

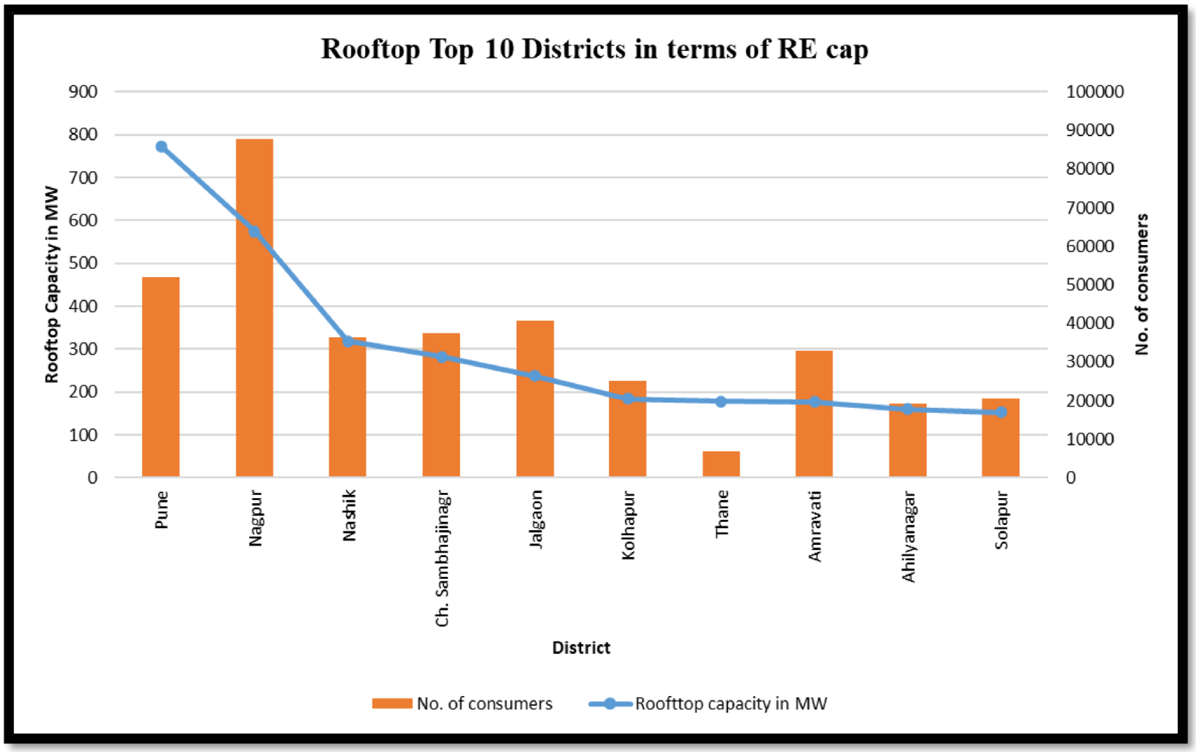


Figure 250: Ten Districts with the Highest Rooftop Solar Capacity (MW) Scenario (2016–2025)

Note: The data covers the period from May 2016 to Dec 2025. Accordingly, the data for year 2016 is available partially.

Observations:

The plot shows the ten Districts with the Highest Rooftop Solar Capacity (MW) and their number of consumers from May 2016 to December 2025, and the table below provides related statistics.

Table 47: Ten Districts with the Highest Rooftop Solar Capacity (MW) and no. of consumers (2016–2025)

District	Rooftop Solar capacity in MW	No. of consumers
Pune	773.46	52093
Nagpur	575.41	87816
Nashik	318.66	36370
Ch. Sambhajinagar	282.90	37543
Jalgaon	237.64	40772

District	Rooftop Solar capacity in MW	No. of consumers
Kolhapur	183.98	24992
Thane	178.41	6847
Amravati	177.64	32890
Ahilyanagar	160.23	19272
Solapur	152.56	20478

23.7 Mumbai Utilities (AEML, BEST, TPC-D)

23.7.1 Rooftop Solar Capacity (MW) and Rooftop Solar Consumers – Mumbai Utilities (AEML, BEST & TPC-D)

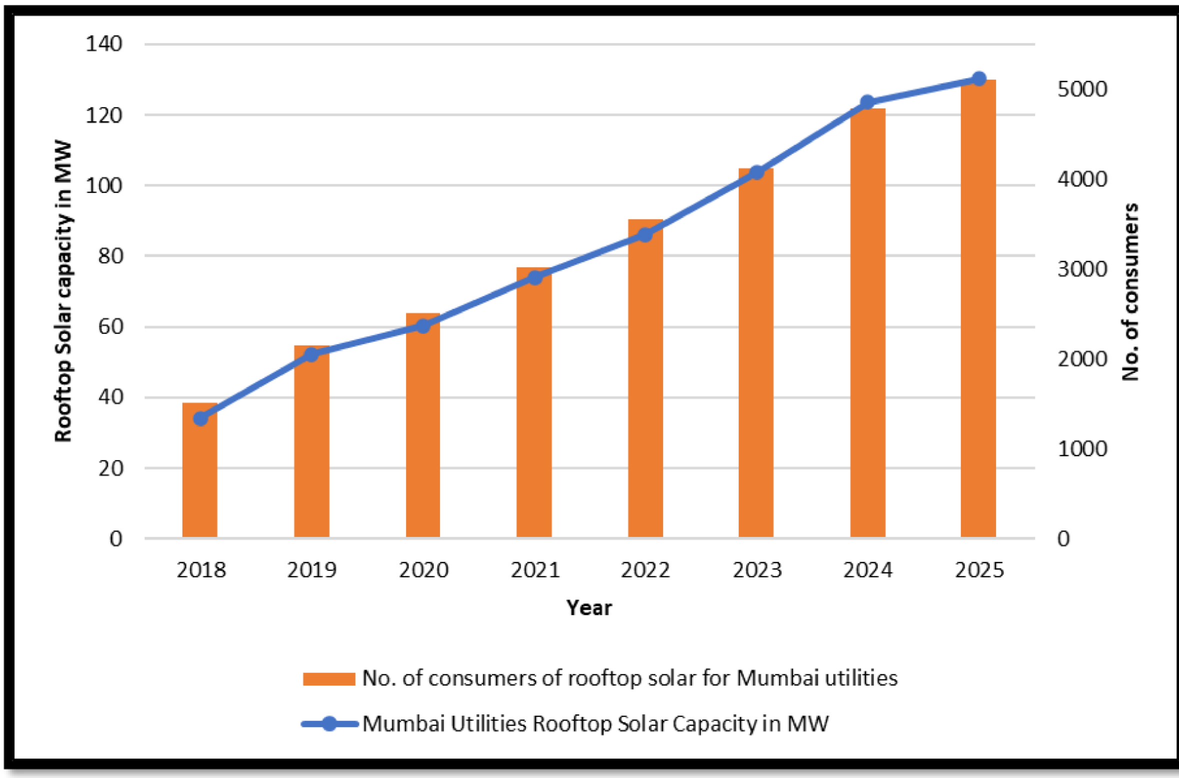


Figure 251: Rooftop Solar Capacity (MW) and Rooftop Solar Consumers – Mumbai Utilities (AEML, BEST & TPC-D)

Note: Data for Mumbai utilities (AEML, BEST, TPC-D) is available only up to July 2025. This data is received on FY (Financial Year) basis.

Summary

This plot illustrates the rooftop solar capacity in (MW) total for Mumbai utilities-AEML, BEST, TPC-D. The table shows the rooftop solar growth in Mumbai utilities the data is available up to Jul 2025 only. The data is received on FY basis.

Table 48: Rooftop Solar Growth in Mumbai Utilities (AEML, BEST & TPC-D): Capacity (MW) and Consumers (2018–2025)

Year	Mumbai Utilities Rooftop capacity in MW	No. of consumers of rooftop solar for Mumbai utilities
2018	34.17	1510
2019	52.28	2156
2020	60.36	2518
2021	74.04	3026
2022	86.17	3560
2023	103.65	4116
2024	123.62	4784
2025	130.20	5105

Note: Data for Mumbai utilities (AEML, BEST, TPC-D) is available only up to July 2025.

23.7.2 Rooftop Solar Capacity & Consumers – AEML (2018–2025)

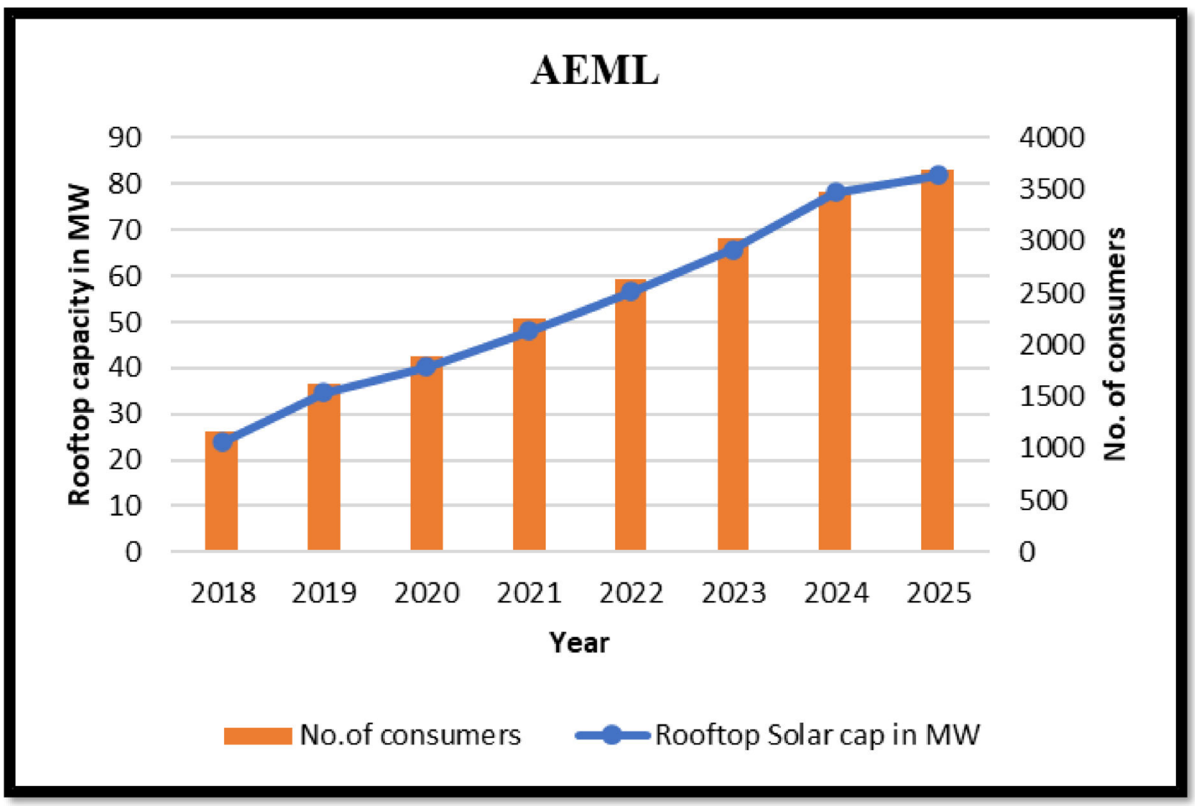


Figure 252: Rooftop Solar Capacity (MW) and Rooftop Solar Consumers AEML

Note: Data is available only up to July 2025.

Summary

The plot shows rooftop solar capacity (in MW) for AEML and the number of consumers up to July 2025. The table presents statistical insights.

Table 49: AEML Rooftop capacity (MW) and no. of consumers

Year	Rooftop capacity in MW	No. of consumers
2018	23.9	1159
2019	34.6	1632
2020	40.2	1894
2021	48.1	2255
2022	56.5	2642
2023	65.7	3031
2024	78.1	3483
2025	81.9	3693

Note: Data is available only up to July 2025.

23.7.3 Rooftop Solar Capacity & Consumers – BEST (2018–2025)

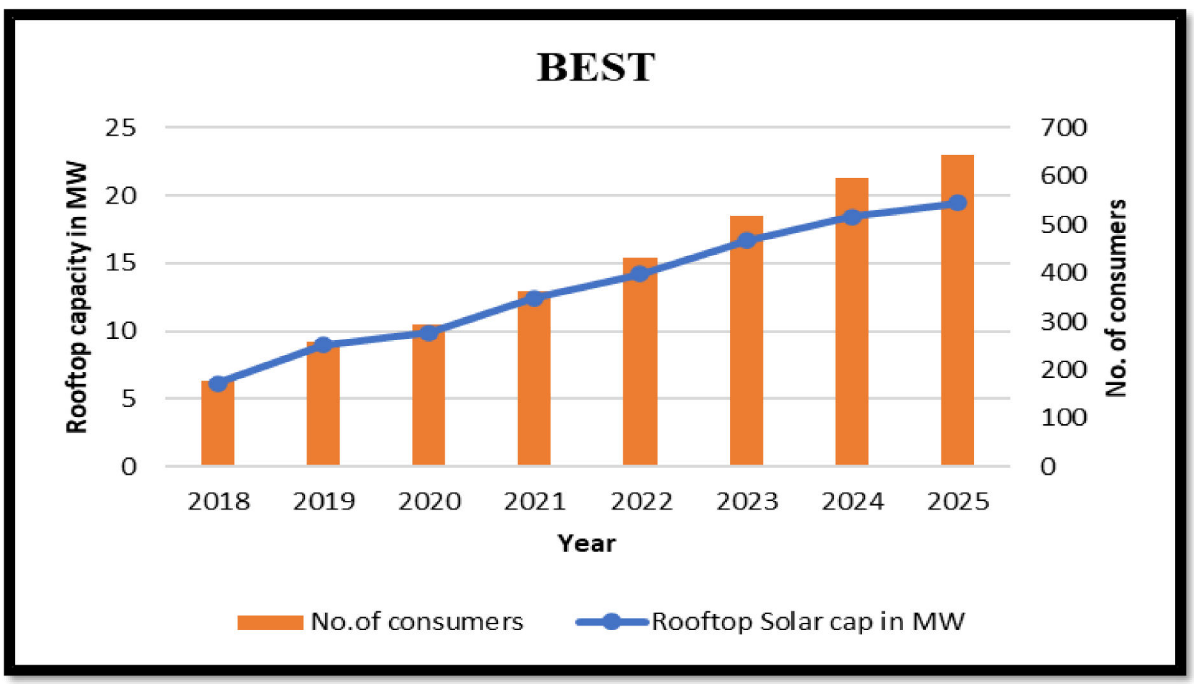


Figure 253: Rooftop Solar Capacity (MW) and Rooftop Solar Consumers BEST

Note: Data is available only up to July 2025.

Summary

The plot shows rooftop solar capacity (in MW) for BEST and the number of consumers up to July 2025. The table presents statistical insights.

Table 50: BEST Rooftop capacity (MW) and no. of consumers

Year	Rooftop capacity in MW	No. of consumers
2018	6.127	176
2019	8.994	258
2020	9.879	294
2021	12.465	362
2022	14.191	432
2023	16.681	517
2024	18.447	595
2025	19.421	643

Note: Data is available only up to July 2025.

23.7.4 Rooftop Solar Capacity & Consumers – TPC-D (2018–2025)

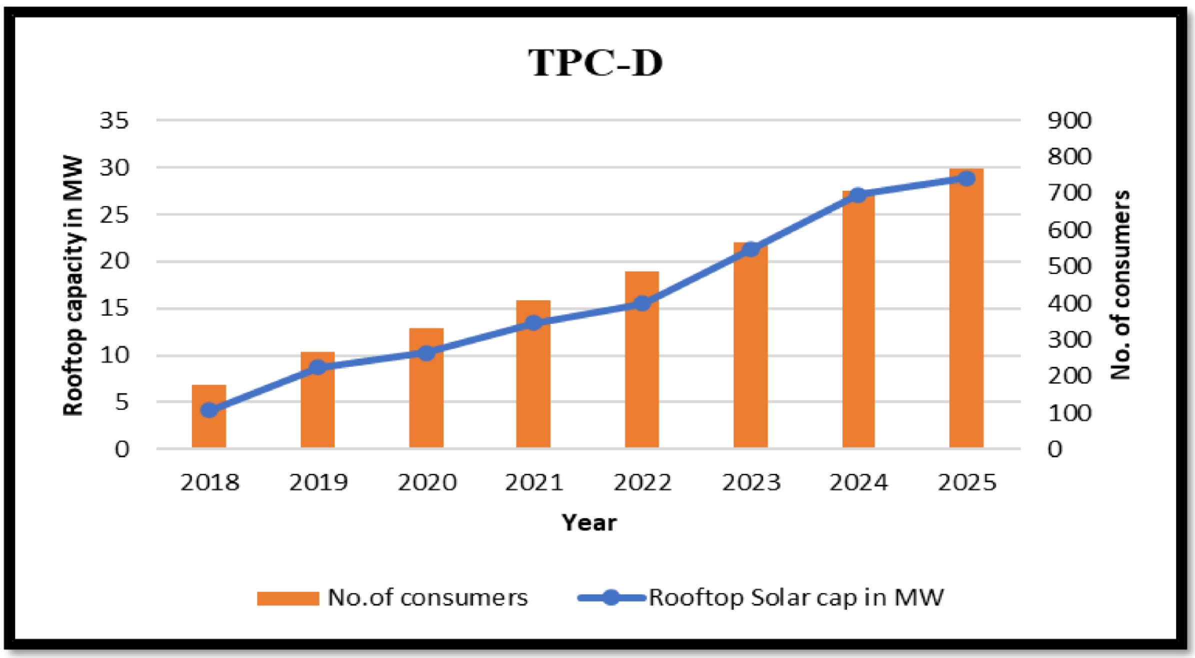


Figure 254: Rooftop Solar Capacity (MW) and Rooftop Solar Consumers TPC-D

Note: Data is available only up to July 2025.

Summary

The plot shows rooftop solar capacity (in MW) for TPC-D and the number of consumers up to July 2025. The table presents statistical insights.

Table 51: TPC-D Rooftop capacity (MW) and no. of consumers

Year	Rooftop capacity in MW	No. of consumers
2018	4.15	175
2019	8.69	266
2020	10.28	330
2021	13.48	409
2022	15.48	486
2023	21.27	568
2024	27.07	706
2025	28.88	769

Note: Data is available only up to July 2025.

23.7.5 Comparison of Rooftop capacity in MW for Mumbai utilities

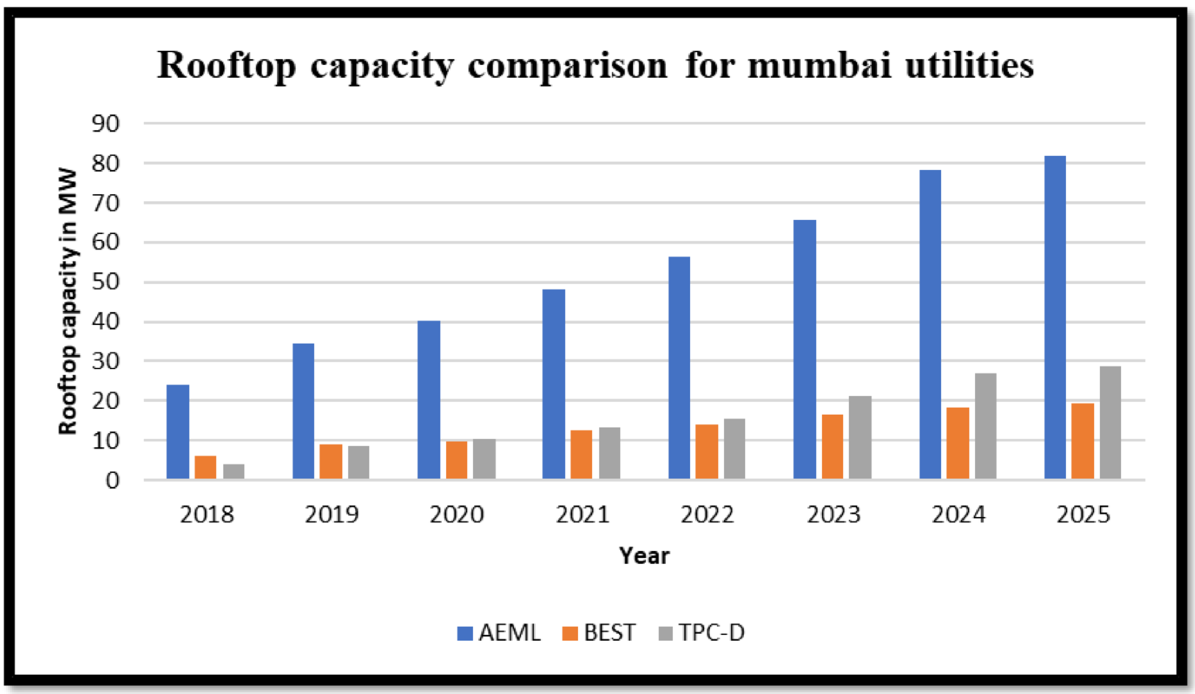


Figure 255: Rooftop Solar Capacity (MW) comparison for Mumbai utilities

Note: Data for Mumbai utilities (AEML, BEST, TPC-D) is available only up to July 2025.

Observations

The plot shows yearly comparison of AEML, BEST, and TPC-D rooftop solar capacity (in MW) for 2018–2025.The table presents statistical insights.

Table 52: Rooftop capacity of Mumbai Utilities-AEML, BEST and TPC-D

Rooftop Capacity in MW				
Year	**AEML**	**BEST**	**TPC-D**	**Mumbai Utilities Rooftop capacity in MW**
2018	23.9	6.13	4.15	34.177
2019	34.6	8.99	8.69	52.284
2020	40.2	9.88	10.28	60.359
2021	48.1	12.46	13.48	74.045
2022	56.5	14.19	15.48	86.171
2023	65.7	16.68	21.27	103.651
2024	78.1	18.45	27.07	123.617
2025	81.9	19.42	28.88	130.201

Note: Data is available only up to July 2025.

23.7.6 Consumer scenario For Mumbai utilities

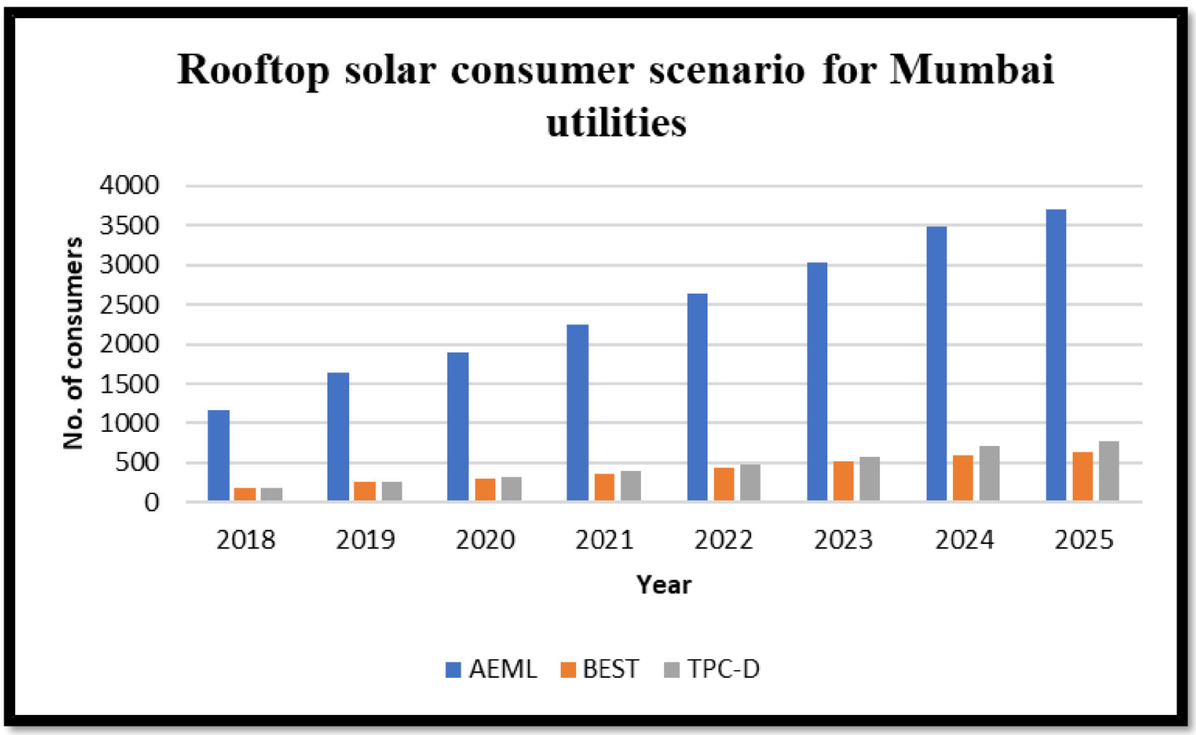


Figure 256: Consumer scenario For Mumbai utilities

Note: Data for Mumbai utilities (AEML, BEST, TPC-D) is available only up to July 2025.

The plot shows yearly comparison of AEML, BEST, and TPC-D rooftop solar consumers for 2018–2025. The table below indicates the number of rooftop solar consumers for Mumbai Utilities-AEML, BEST and TPC-D.

Table 53: Rooftop solar consumer scenario for Mumbai utilities

Year	AEML	BEST	TPC-D	No. of consumers of rooftop solar for Mumbai utilities
2018	1159	176	175	1510
2019	1632	258	266	2156
2020	1894	294	330	2518
2021	2255	362	409	3026
2022	2642	432	486	3560
2023	3031	517	568	4116
2024	3483	595	706	4784
2025	3693	643	769	5105

Note: Data is available only up to July 2025.

24. Assessment of Rooftop Solar on State Demand Peak days (2022-2025)

24.1 Introduction

This chapter analyzes the impact of rooftop solar on state peak demand days and state solar peak days in Maharashtra. The analysis further focuses on peak demand days for districts having highest rooftop installation capacity in MW.

24.2 Data and Method Used for Assessment

1. Limited Rooftop Data Availability:
   Rooftop solar (energy) data is not available on a daily basis, and only monthly gross capacity figures in MSEDCL area in kilowatts (kW) are available. For the sake of analysis, capacity is converted to MW.

2. The energy generated from rooftop solar is assessed by considering the CUF of last year as observed for InSTS connected solar plants during this period. However, considering that the InSTS plants are likely to be better maintained and cleaned regularly, their output is reduced by 15%.
   Rooftop generation for each 15-minute block was calculated using this formula:

$$\boldsymbol{Rooftop\ Generation\ Assessed} = \frac{\boldsymbol{Rooftop\ capacity * InSTS\ solar\ generation * 0.85}}{\boldsymbol{InSTS\ Solar\ AvC}}$$

Where:

- **Rooftop Capacity** = Installed rooftop solar capacity (MW).
- **InSTS Solar Generation** = Actual grid-scale solar generation in the InSTS
- **InSTS Solar AvC** = Available capacity of InSTS solar (to normalize generation)

This helped estimate rooftop solar generation across 96 time blocks per day.

3. Focus of the Assessment:

   - The rooftop solar generation being behind the meter generation, is not visible to SLDC. However, with increased penetration of such generation, the demand pattern of the state is bound to change. This assessment focuses on ascertaining such effect on state demand curve and demand curves of 10 districts in terms of highest rooftop installation capacity.
   - Peak demand days of the 10 districts, the state peak demand day and the state solar peak day have been examined for the years 2022–2025, to understand the impact of rooftop solar on grid demand.
   - The contribution of rooftop solar in meeting demand was evaluated for the selected day, to assess the impact of rooftop solar on peak shaving and peak curtailment.

- While analyzing peak demand days, the demand curve and the combined curve of demand plus rooftop solar generation were plotted. The peak values of demand, rooftop generation, and the combined demand plus rooftop generation were analyzed across time blocks. When the time block of the peak demand day coincides with the peak of the combined curve, it indicates that rooftop solar has contributed to peak shaving or peak curtailment.

24.3 Impact of rooftop solar on State peak demand day (2022-2025)

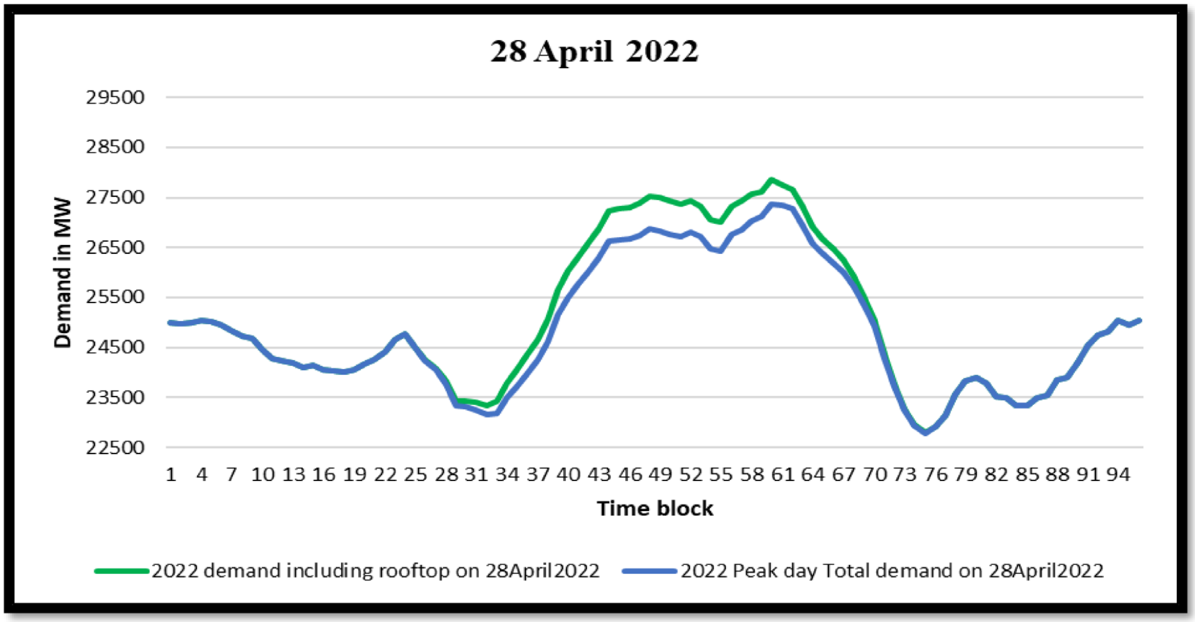


Figure 257: Rooftop Solar impact on State peak demand day-28 April 2022

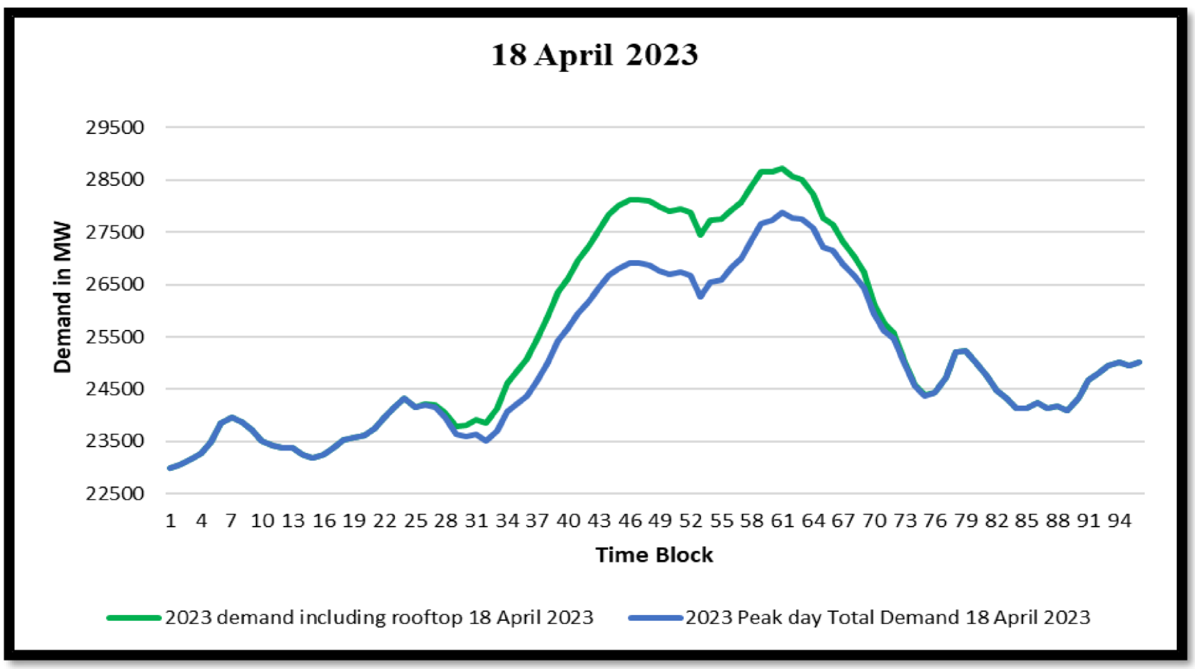


Figure 258: Rooftop Solar impact on State peak demand day-18 April 2023

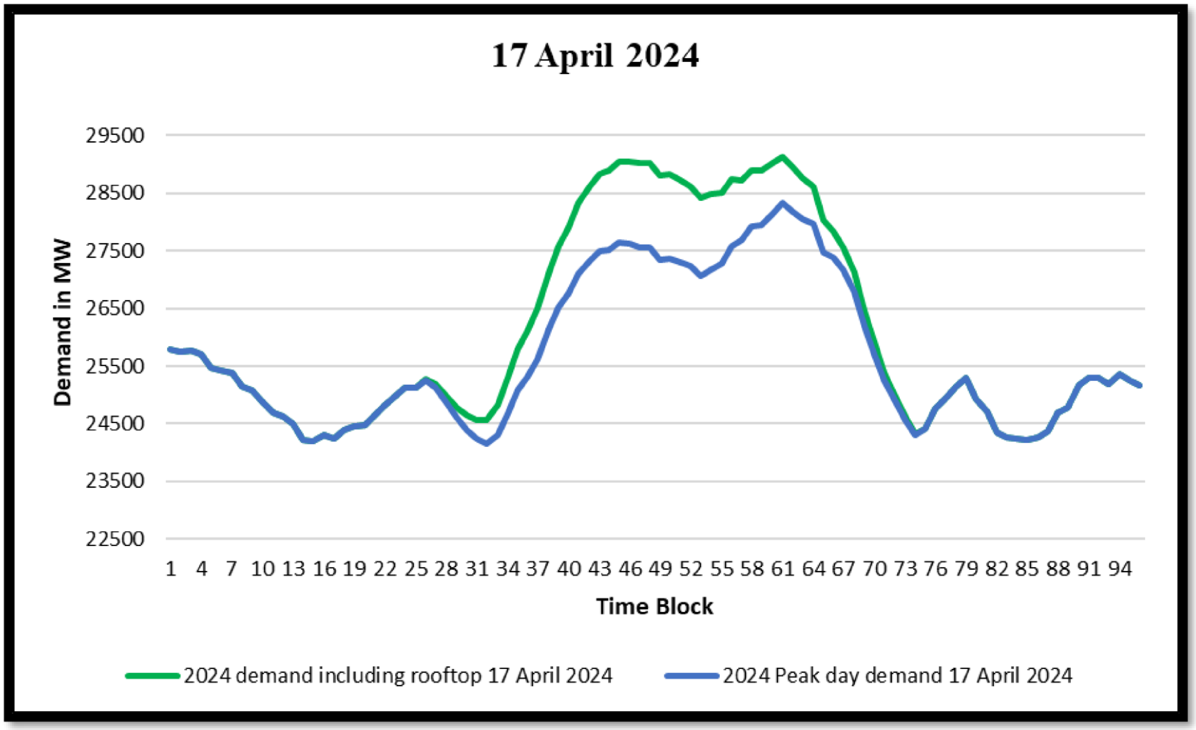


Figure 259: Rooftop Solar impact on State peak demand day-17 April 2024

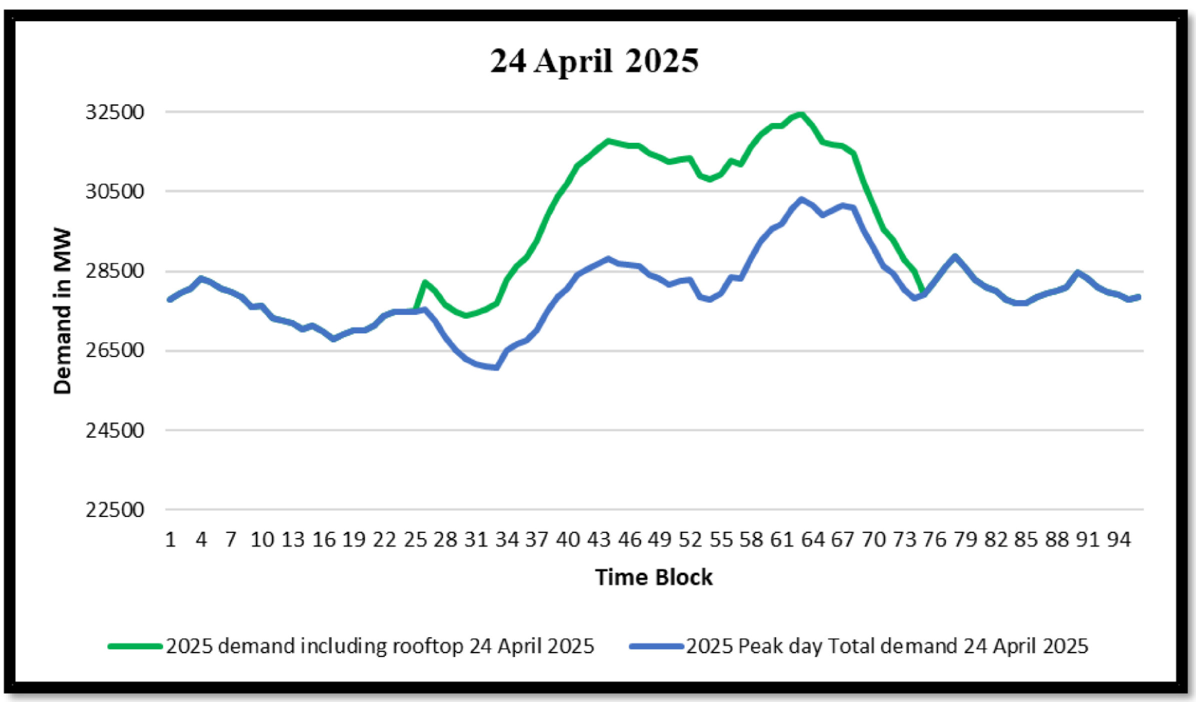


Figure 260: Rooftop Solar impact on State peak demand day-24 April 2025

Summary

The plots above show peak demand days of Maharashtra state over years 2022 to 2025.

The table below gives statistical insights.

Observations:

Table 54: Rooftop Solar Impact on Peak Demand Days – Maharashtra State

Parameter	2022	2023	2024	2025
Peak Demand Day	28th April 2022	18th April 2023	17th April 2024	24th April 2025
Time Blocks with Rooftop Impact	Blocks 33–67 (08:15 AM to 04:45 PM)	Blocks 33–70 (08:15 AM to 05:00 PM)	Blocks 33–70 (08:15 AM to 05:00 PM)	Blocks 33–70 (08:15 AM to 05:00 PM)
Peak	Peak of the day: 27363 MW at Block 60 (03:00 PM)	Peak of the day: 27,879 MW at Block 61 (03:15 PM)	Peak of the day: 28327 MW at Block 61 (02:45 PM)	Peak of the day: 30307 MW at Block 63 (03:15 PM)
	Rooftop Contribution: ~495 MW	Rooftop Contribution: ~847 MW	Rooftop Contribution: ~805.67 MW	Rooftop Contribution: ~2148.02 MW
Max Rooftop Generation	~666 MW at Block 49 (12:15 PM), when demand was ~26826 MW	~1230 MW at Block 48 (12:00 PM), when demand was ~26863 MW	~1,473 MW at Block 48 (12:00 PM), when demand was ~27,548 MW	~3066.96 MW at Block 50 (12:30 PM), when demand was ~28173 MW
Peak value (Demand +Rooftop generation)	Peak:27858.62 MW	Peak:28727.66 MW	Peak:29133.12 MW	Peak:32455.82 MW
	Time block:60	Time block:61	Time block:61	Time block:63
	Rooftop contribution: 495 MW	Rooftop contribution: 847.67 MW	Rooftop contribution: 805.67 MW	Rooftop contribution: 2148.02 MW
Average Demand (MW)	~24872 MW	~26,110 MW	~26,188 MW	~28021 MW
Average Rooftop Generation (MW)	~195 MW	~1,210 MW	~1,266 MW	~1080 MW
Observation Summary	Rooftop solar has helped in peak shaving on state	Rooftop solar has helped in peak shaving on	Rooftop solar has helped in peak shaving on state	Rooftop solar has helped in peak shaving on state

Parameter	2022	2023	2024	2025
	peak demand day as the peak value on the peak demand day occurs at Time Block 60, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 49 shows the possibility of a shift in the peak demand time block.	state peak demand day, as the peak value on the peak demand day occurs at Time Block 61, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 48 shows the possibility of a shift in the peak demand time block.	peak demand day, as the peak value on the peak demand day occurs at Time Block 61, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 48 shows the possibility of a shift in the peak demand time block.	peak demand day, as the peak value on the peak demand day occurs at Time Block 63, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.

24.4 Impact of rooftop solar on State solar peak day (2022-2025)

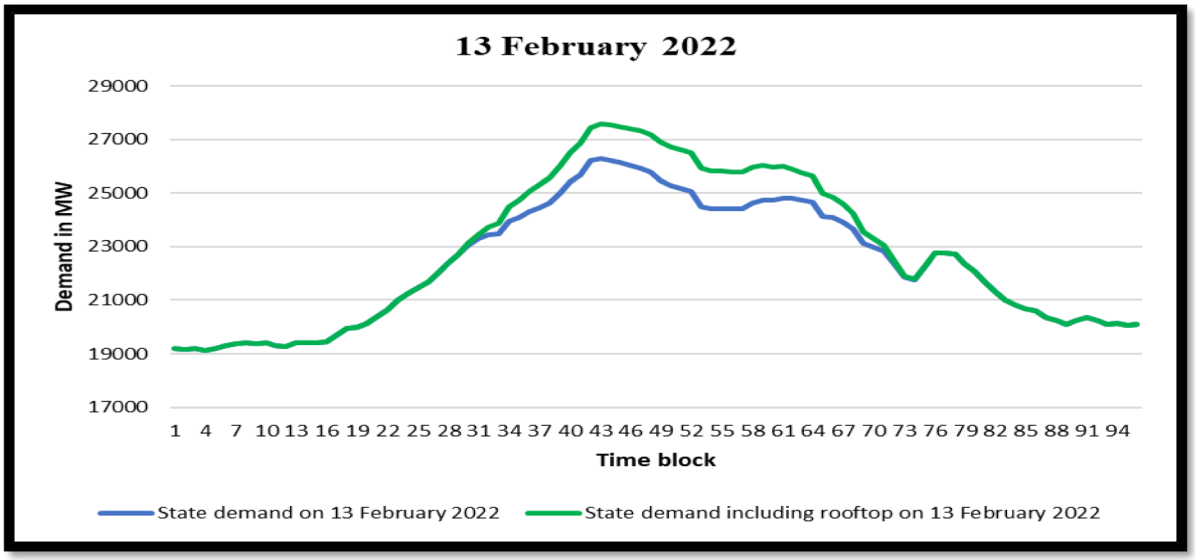


Figure 261: Rooftop Solar impact on State solar peak demand day-13 February 2022

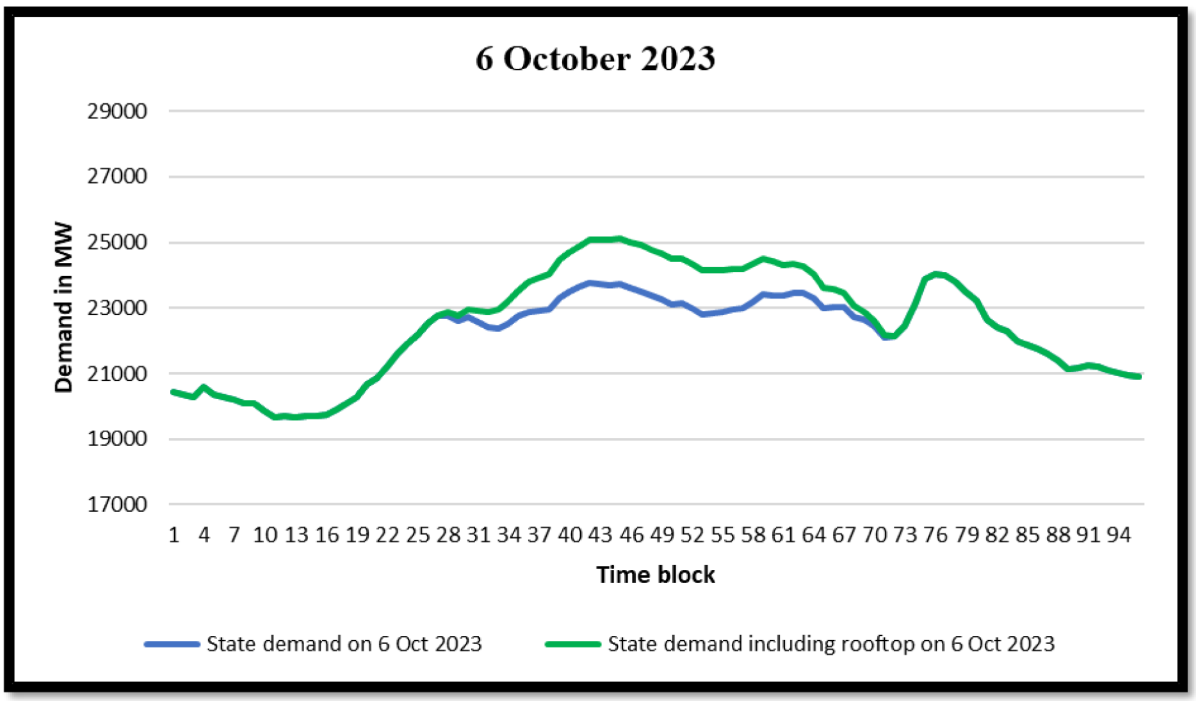


Figure 262: Rooftop Solar impact on State solar peak demand day-6 October 2023

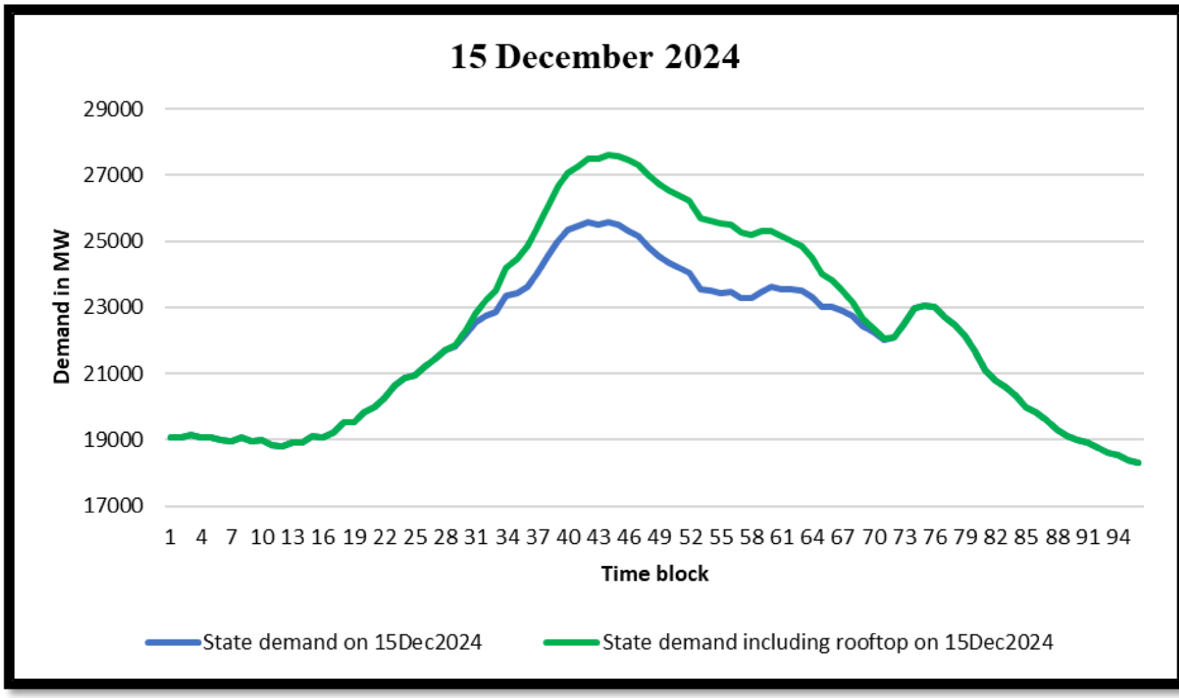


Figure 263: Rooftop Solar impact on State solar peak demand day-15 December 2024

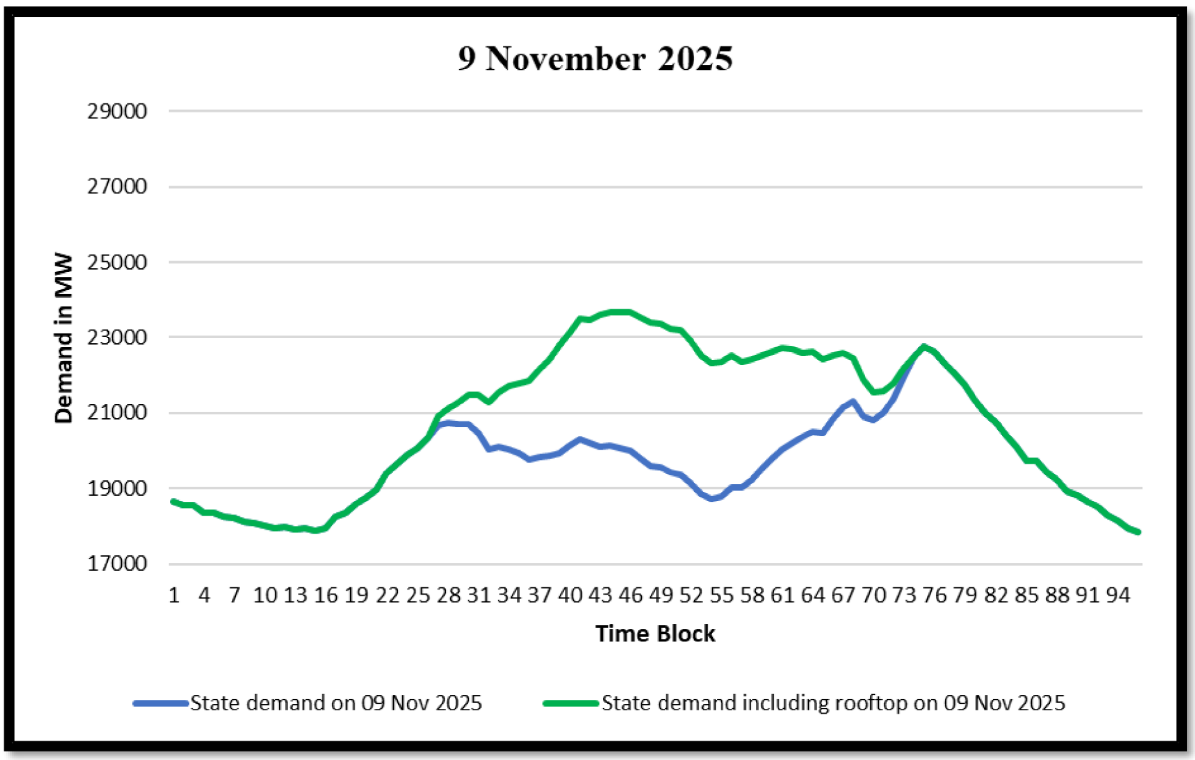


Figure 264: Rooftop Solar impact on State solar peak demand day-9 November 2025

Summary

The above plot shows the State Solar Peak Day demand for Maharashtra over years 2022 to 2025. The State Solar Peak Day is identified as the day on which the ISTS solar generation attains its maximum value.

This day is therefore selected as the State Solar Peak Day for each respective year and the state demand for this day is used for analysis.

The table below gives statistical insights.

Observations:

Table 55: Rooftop Solar Impact on Solar Peak Days – Maharashtra State

Parameter	2022	2023	2024	2025
Solar Peak Day	13rd February 2022	6^{th} October 2023	15^{th} December 2024	9th November 2025
Time Blocks with Rooftop Impact	Blocks 32–70 (08:00 AM to 5:30 PM)	Blocks 29–70 (07:15 AM to 5:30 PM)	Blocks 34–65 (08:30 AM to 04:15 PM)	Blocks 28–71 (07:00 AM to 05:45 PM)
Peak	Rooftop: 1290.485 MW at Block 43 (10:45 AM)	Rooftop: 0 MW at Block 76 (07:00 PM)	Rooftop: ~1915 MW at Block 42 (10:30 AM)	Rooftop: 0 at Block 75 (06:45)
	Demand: ~26290 MW	Demand: ~24022 MW	Demand: ~25587 MW	Demand: ~22768.56 MW
Max Rooftop Generation	~1426 MW at Block 50 (12:30 PM),	~1,396 MW at Block 47 (11:45 AM),	~2185 MW at Block 50 (12:30 PM),	~3821 MW at Block 48 (12:00 PM),
	Demand ~25279 MW	Demand ~23513 MW	Demand ~24367 MW	Demand ~19592 MW
Peak value (Demand +Rooftop generation)	Peak:27581.05 MW	Peak:25109.87 MW	Peak:27616.8 MW	Peak:23686.71 MW
	Time block:43	Time block:45	Time block:44	Time block:46

Parameter	2022	2023	2024	2025
	Rooftop contribution: 1290.48 MW	Rooftop contribution: 1385.52 MW	Rooftop contribution: 2047.05 MW	Rooftop contribution: 3678.54 MW
Average Demand (MW)	~22353 MW	~22131 MW	~21715 MW	~19693 MW
Average Rooftop Generation (MW)	~439 MW	~422 MW	~631 MW	~1156 MW
Observation Summary	Rooftop solar has helped in peak shaving on state solar peak day, as the peak value on the peak demand day occurs at Time Block 43, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the	The peak value of peak demand day occurs at Time Block 76 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 47, and the combined peak of demand and rooftop generation occurs at Time Block 45,	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 42, which is nearby time block 44 of the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the	The peak value of peak demand day occurs at Time Block 75 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 48, and the combined peak of demand and rooftop generation occurs at Time Block 46,

Parameter	2022	2023	2024	2025
	possibility of a shift in the peak demand time block.	indicating a probable shift in the peak demand time block, with rooftop solar providing significant support during solar hours.	possibility of a shift in the peak demand time block.	indicating a probable shift in the peak demand time block, with rooftop solar providing significant support during solar hours.

24.5 Impact of rooftop solar on 10 districts with highest rooftop solar installation capacity (in MW)

24.5.1 Pune

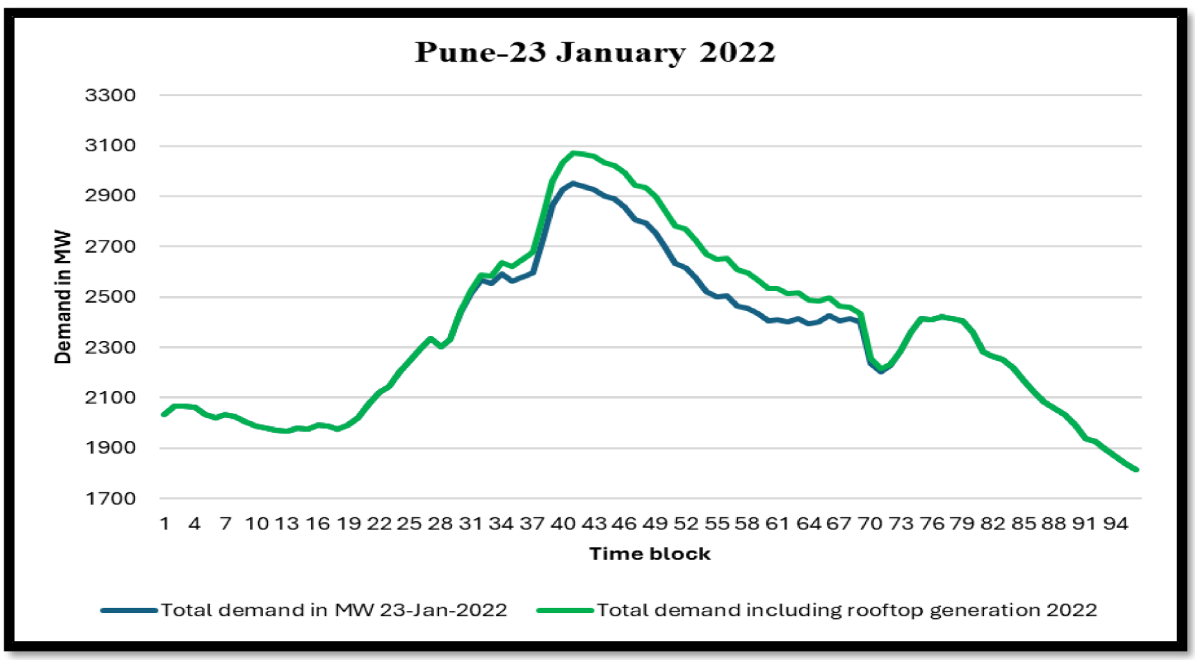


Figure 265: Rooftop Solar impact on Pune peak demand day 23 January 2022

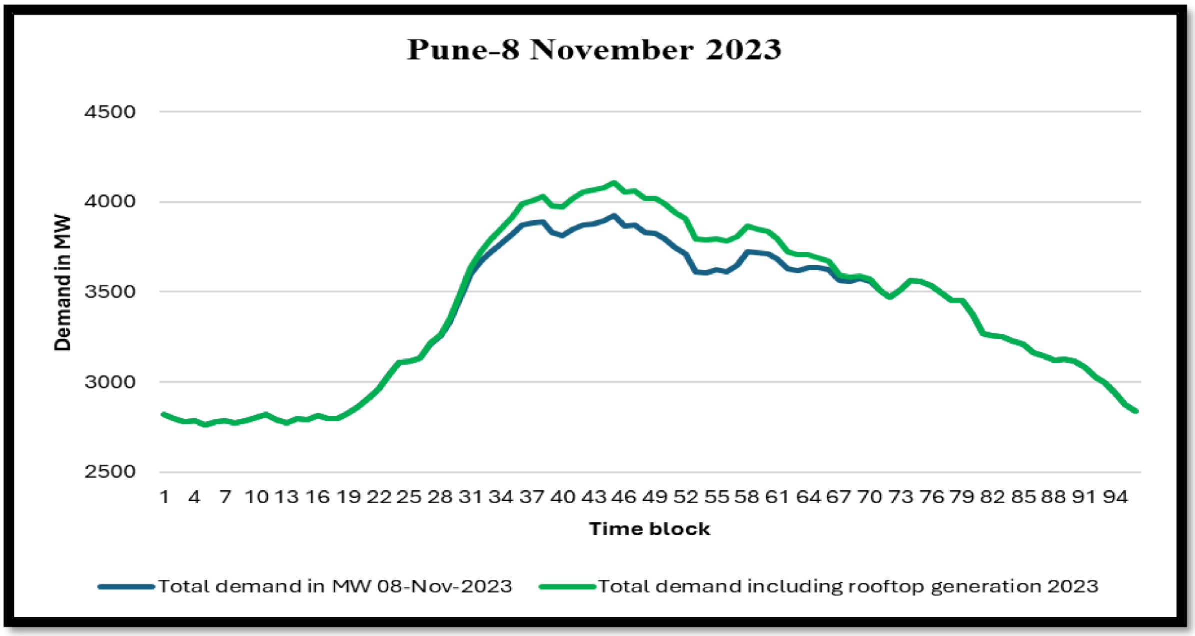


Figure 266: Rooftop Solar impact on Pune peak demand day 8 November 2023

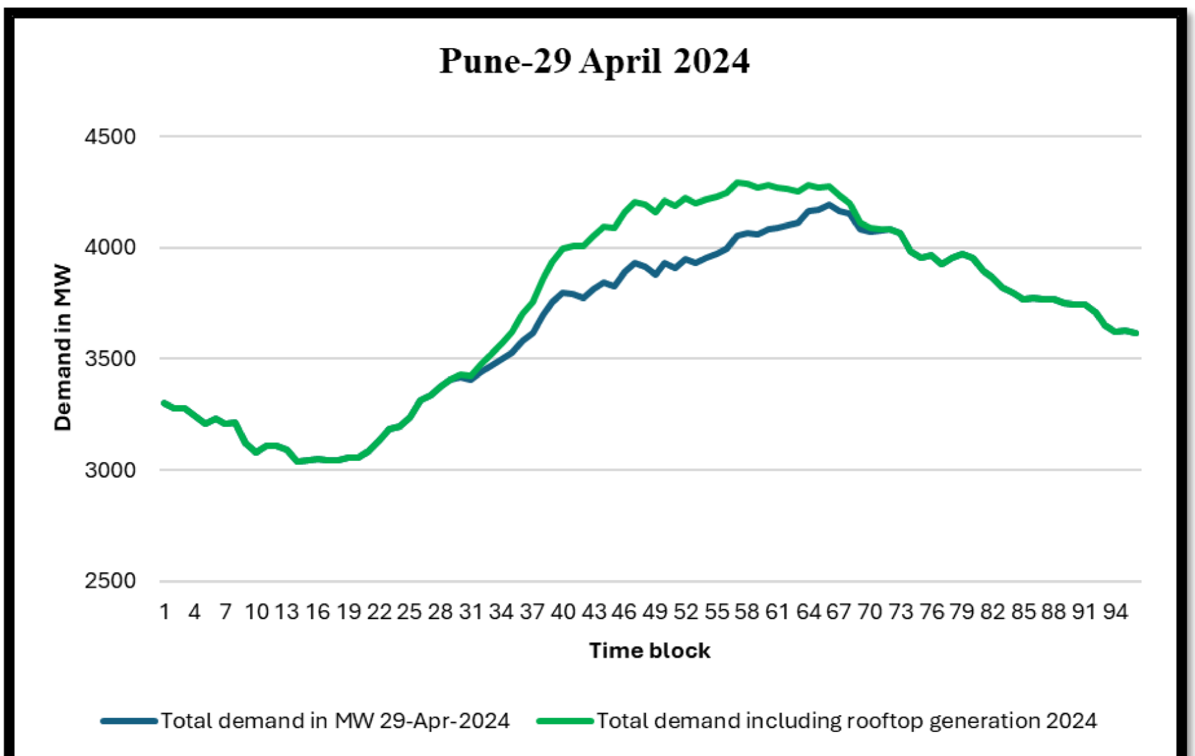


Figure 267: Rooftop Solar impact on Pune peak demand day 29 April 2024

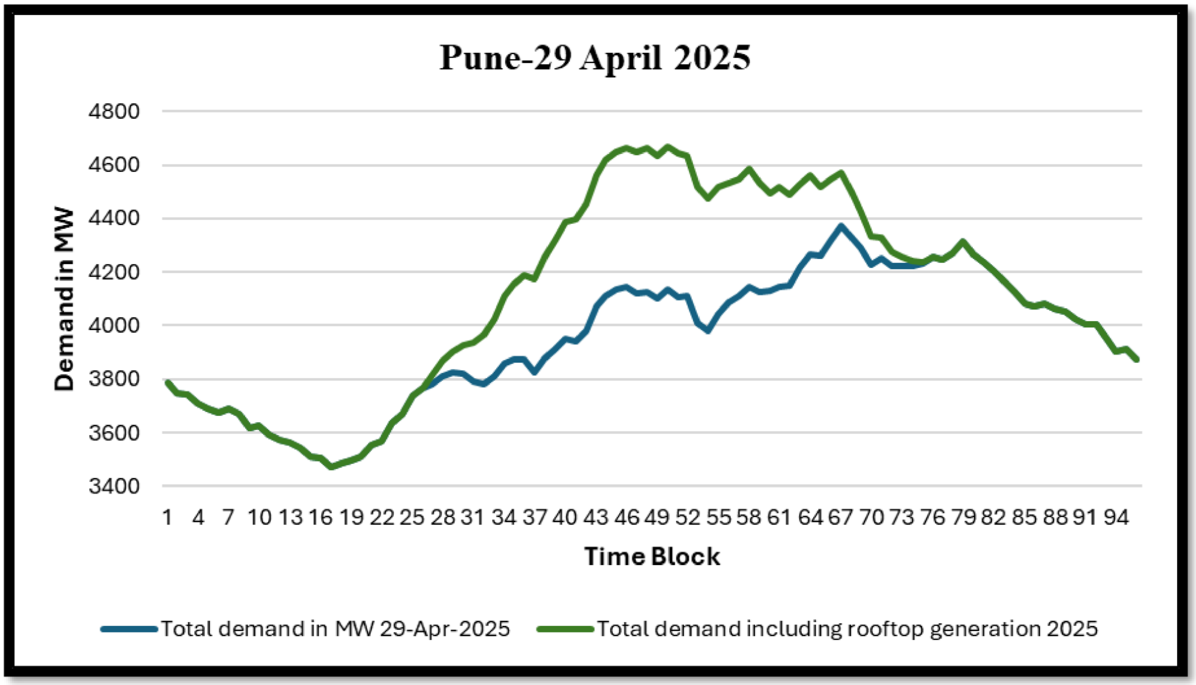


Figure 268: Rooftop Solar impact on Pune peak demand day 29 April 2025

Summary

The above plots show the Peak demand days for Pune over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 56: Rooftop Solar Impact on Peak Demand Days – Pune

Parameter	2022	2023	2024	2025
Peak Demand Day	23rd January 2022	8th November 2023	29th April 2024	29th April 2025
Time Blocks with Rooftop Impact	Blocks 35-69 (8:45 AM to 5:15 PM)	Blocks 32–68 (08:00 AM to 05:00 PM)	Blocks 32–69 (08:00 AM to 05:15 PM)	Blocks 32–69 (08:00 AM to 05:15 PM)
Rooftop Solar Contribution at Peak demand block	Peak of the day: 2952.55 MW at Block 41 (10:15 AM)	Peak of the day: 3924.48 MW at Block 45 (11:15 AM)	Peak of the day: 4193.02 MW at Block 66 (4:30 PM)	Peak of the day: 4371.46 MW at Block 67 (4:45 PM)

Parameter	2022	2023	2024	2025
	Rooftop Contribution at peak: 116.78 MW	Rooftop Contribution at peak: 133.51 MW	Rooftop contribution at peak: 84.11 MW	Rooftop contribution at peak: 198.17 MW
Max Rooftop generation	151.83 MW at time block 55 when peak day demand was 2499.23 MW	194.48 MW at time block 48 when peak day demand was 3827.682 MW	280.9348 MW at block 50 when peak day demand was 3933.768 MW	535.9 MW at block 50 when peak day demand was 4134.29 MW
Peak value (Demand +Rooftop generation)	Peak:3069.33 MW	Peak:4057.99 MW	Peak:4295.70 MW	Peak:4670.19 MW
	Time block:41	Time block:45	Time block:57	Time block:50
	Rooftop contribution:116.78 MW	Rooftop contribution:133.51 MW	Rooftop contribution:239.57 MW	Rooftop contribution:535.9 MW
Average Demand (MW)	~2322 MW	~3347 MW	~3657 MW	~3952 MW
Average Rooftop Generation (MW)	~43 MW	~54 MW	~74 MW	~161 MW
Observation Summary	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 41, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 55 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 45, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 48 shows the possibility of a shift in the peak demand time block.	The peak value of peak demand day occurs at Time Block 66, while the combined peak of demand and rooftop solar generation occurs at Time Block 57, indicating a shift in the time block of the peak value due to rooftop solar impact.	The peak value of peak demand day occurs at Time Block 67, while the combined peak of demand and rooftop solar generation occurs at Time Block 50, indicating a shift in the time block of the peak value due to rooftop solar impact.

24.5.2 Nagpur

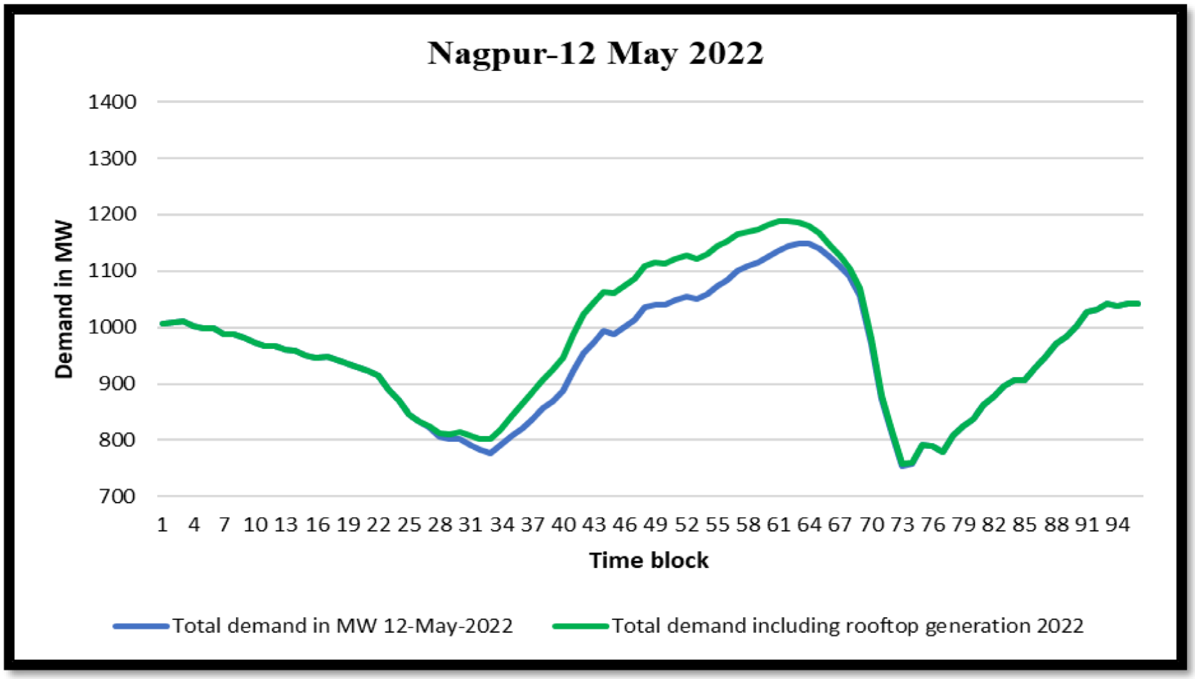


Figure 269: Rooftop Solar impact on Nagpur peak demand day 12 May 2022

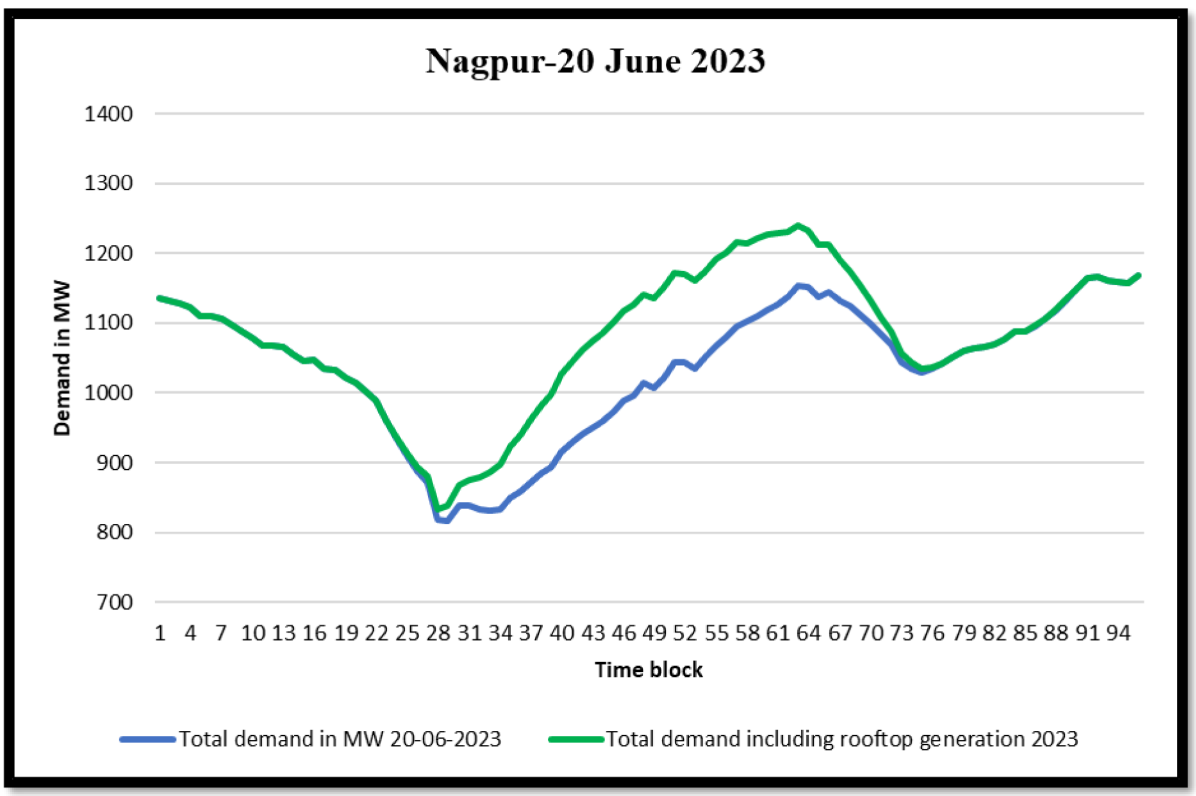


Figure 270: Rooftop Solar impact on Nagpur peak demand day 20 June 2023

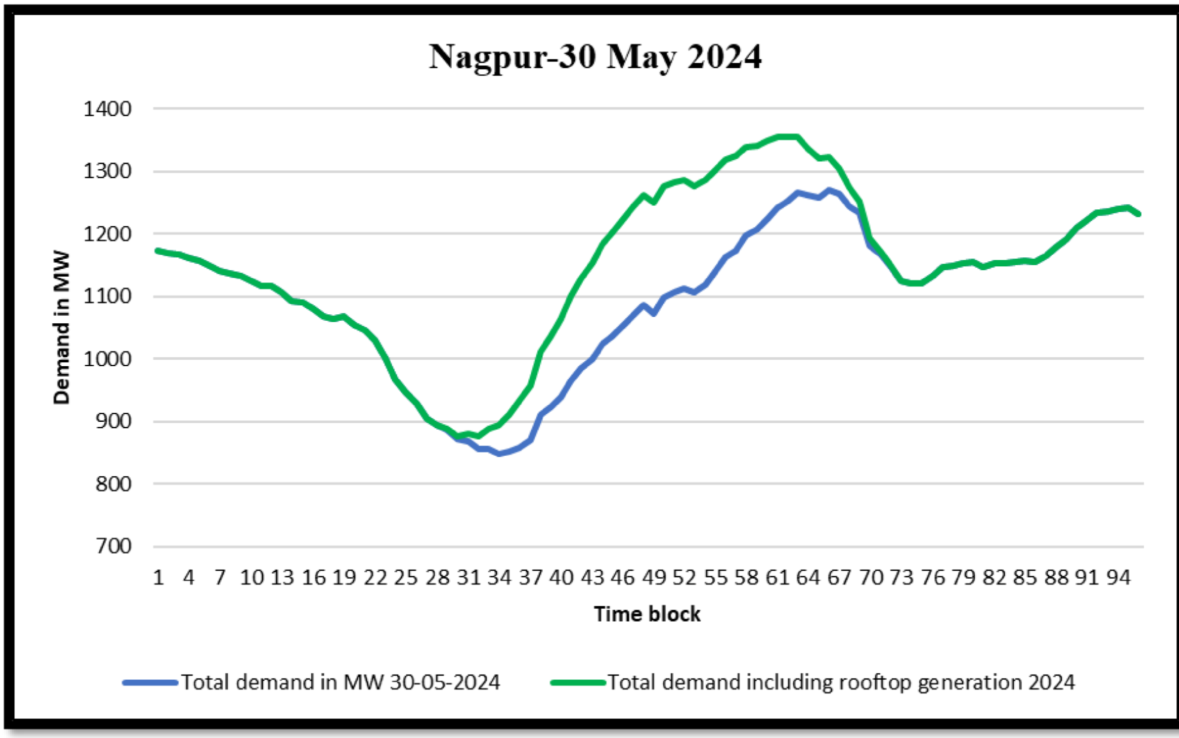


Figure 271: Rooftop Solar impact on Nagpur peak demand day 30 May 2024

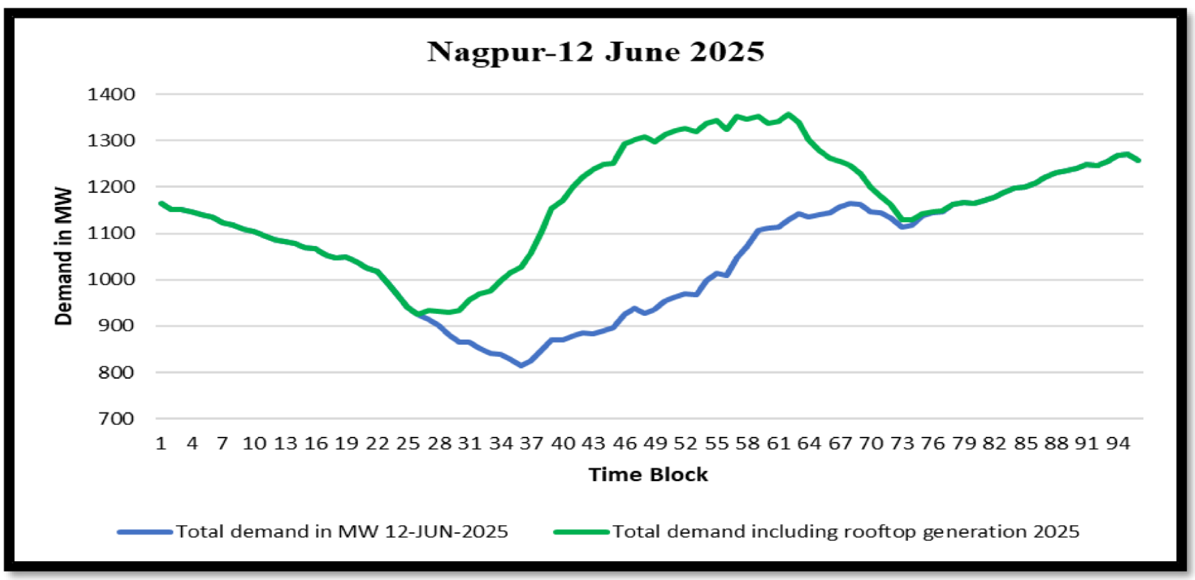


Figure 272: Rooftop Solar impact on Nagpur peak demand day 12 June 2025

Summary

The above plots show the Peak demand days for Nagpur over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 57: Rooftop Solar Impact on Peak Demand Days – Nagpur

Parameter	2022	2023	2024	2025
Peak Demand Day	12th May 2022	20th June 2023	30th May 2024	12th June 2025
Time Blocks with Rooftop Impact	Blocks 33-66 (08:15 AM to 04:30 PM)	Blocks 29–74 (07:15 AM to 06:30 PM)	Blocks 32–69 (08:00 AM to 05:15 PM)	Blocks 32–70 (08:00 AM to 05:30 PM)
Peak of the day (MW)	Peak :1149.51 MW at Block 63 (3:45 PM)	Peak :1168.59 MW at Block 96 (11:45PM)	Peak: 1270.35 MW at Block 66 (4:30 PM)	Peak: 1270.67 MW at Block 95 (11:30 PM)
	Rooftop Contribution at Peak: 37.00 MW	Rooftop Contribution at Peak: 0.0 MW	Rooftop Contribution at Peak:53.04 MW	Rooftop Contribution at Peak: 0 MW
Max Rooftop generation	74.58 MW at block 49 when peak day demand was 1040.56 MW	130.943 MW at block 47 when peak day demand was 995.65 MW	177.5845 MW at block 50 when peak day demand was 1097.90 MW	381.27 MW at block 48 when peak day demand was 926.50 MW
Peak value (Demand +Rooftop generation)	Peak:1189.03 MW	Peak:1239.79 MW	Peak:1355.01 MW	Peak:1356.98 MW
	Time block:62	Time block:63	Time block:63	Time block:62
	Rooftop contribution:45.48 MW	Rooftop contribution:86.20 MW	Rooftop contribution:88.45 MW	Rooftop contribution:228.34 MW
Average Demand	953.889 MW	1036.56 MW	1099.21 MW	1060.06 MW
Average Rooftop Generation	21.75 MW	42.56 MW	46.56 MW	107.13 MW

Parameter	2022	2023	2024	2025
Observation Summary	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 63, which is almost the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 49 shows the possibility of a shift in the peak demand time block.	The peak value of peak demand day occurs at Time Block 96 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 47, and the combined peak of demand and rooftop generation occurs at Time Block 63, indicating a probable shift in the peak demand time block, with rooftop solar providing significant support during solar hours.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 63, which is nearby time block 66 of the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.	The peak value of peak demand day occurs at Time Block 95 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 48, and the combined peak of demand and rooftop generation occurs at Time Block 62, indicating a probable shift in the peak demand time block, with rooftop solar providing significant support during solar hours.

24.5.3 Nashik

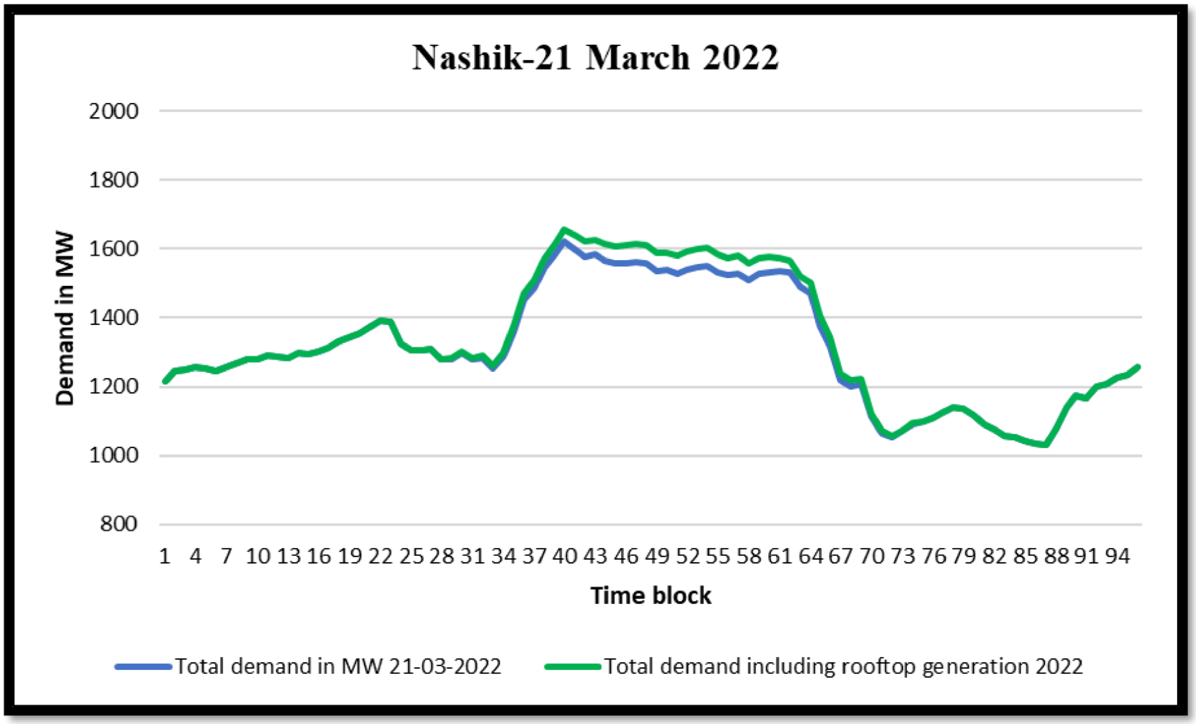


Figure 273: Rooftop Solar impact on Nashik peak demand day 21 March 2022

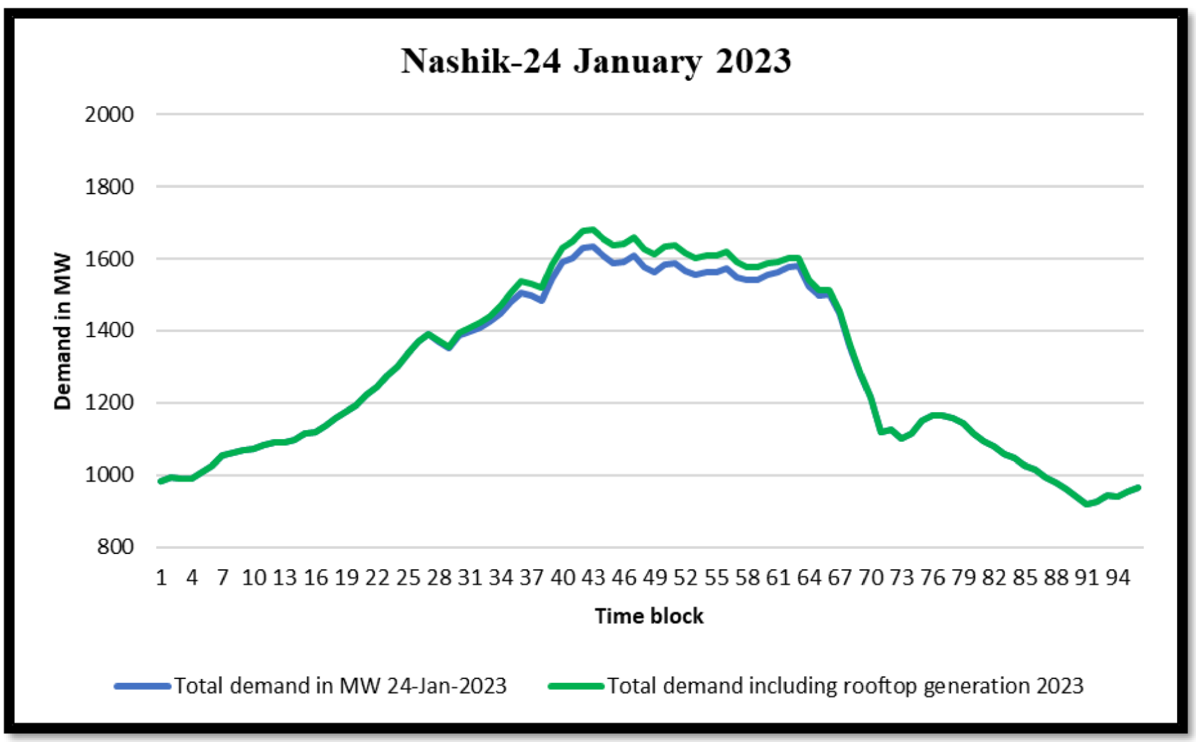


Figure 274: Rooftop Solar impact on Nashik peak demand day 24 January 2023

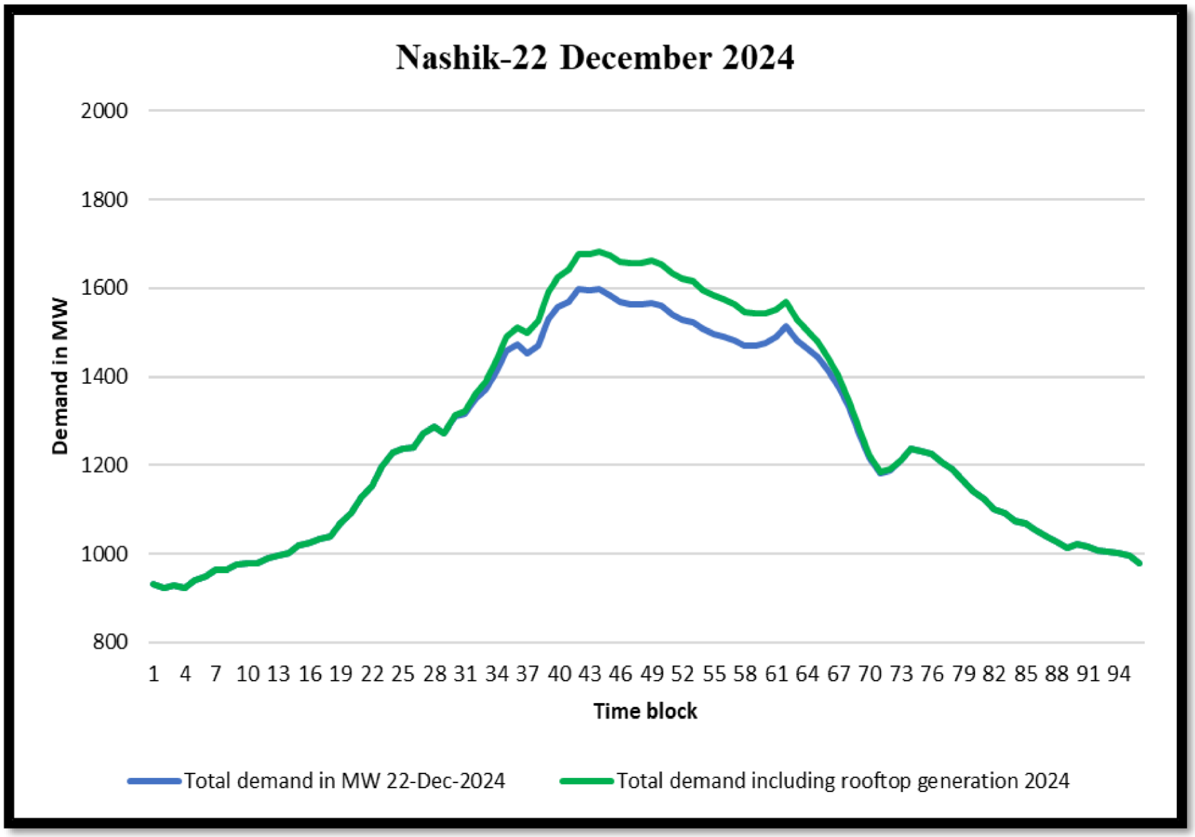


Figure 275: Rooftop Solar impact on Nashik peak demand day 22 December 2024

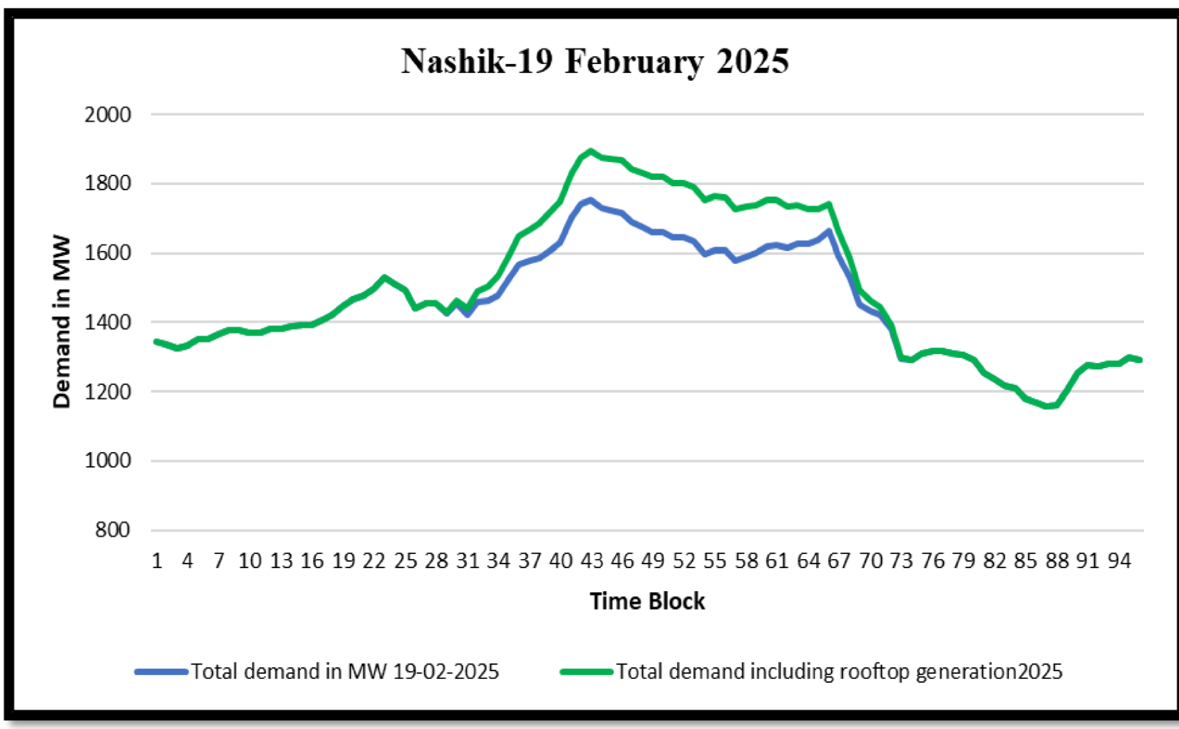


Figure 276: Rooftop Solar impact on Nashik peak demand day 19 February 2025

Summary

The above plots show the Peak demand days for Nashik over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 58: Rooftop Solar Impact on Peak Demand Days – Nashik

Parameter	2022	2023	2024	2025
Peak Demand Day	21st March 2022	24th January 2023	22nd December 2024	19th February 2025
Time Blocks with Rooftop Impact	Blocks 41-64 (10:15 AM to 04:00 PM)	Blocks 30–66 (07:30 AM to 04:30 PM)	Blocks 32–67 (08:00 AM to 04:45 PM)	Blocks 33–66 (08:15 AM to 04:30 PM)
Peak (MW)	1621.10 MW at Block 40 (10:00 AM)	1633.54 MW at Block 43 (10:45 AM)	1599.04 MW at Block 42 (10:30 AM)	1754.71 MW at Block 43 (10:45 AM)
	Rooftop Contribution at Peak (MW): 34.80 MW	Rooftop Contribution at Peak (MW): 48.05	Rooftop Contribution at Peak (MW): 101.75 MW	Rooftop Contribution at Peak (MW): 140.32 MW
Max Rooftop Output	53.08 MW at Block 47 (10:45 AM), when demand was 1560.90 MW	50.47 MW at Block 48 (11:00 AM), when demand was 1577.85 MW	128.05 MW at Block 51 (11:30 AM), when demand was 1538.91 MW	158.77 MW at Block 50 (11:15 AM), when demand was 1659.76 MW
Peak value (Demand +Rooftop generation)	Peak:1655.90 MW	Peak:1681.59 MW	Peak:1711.53 MW	Peak:1895.04 MW
	Time block:40	Time block:43	Time block:44	Time block:43
	Rooftop contribution:34.80 MW	Rooftop contribution:48.05 MW	Rooftop contribution: 113.64 MW	Rooftop contribution: 140.32 MW
Average Demand (MW)	1318.258 MW	1293.36 MW	1272.63 MW	1454 MW
Average Rooftop Generation (MW)	14.85 MW	13.94 MW	24.96 MW	47.59 MW

Parameter	2022	2023	2024	2025
Observation Summary	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 40, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 47 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 43, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 48 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 42, which is nearby time block 44 of the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 51 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 43, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.

24.5.4 Chhatrapati Sambhajinagar

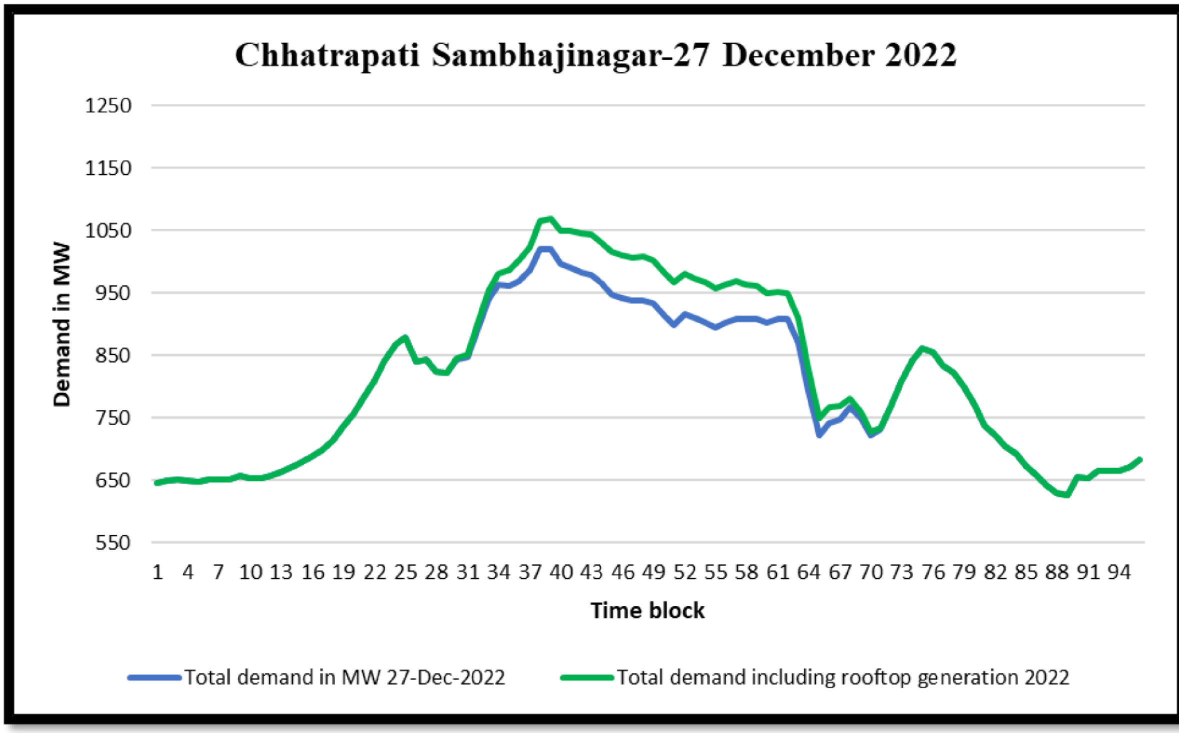


Figure 277: Rooftop Solar impact on Chhatrapati Sambhajinagar peak demand day 27 December 2022

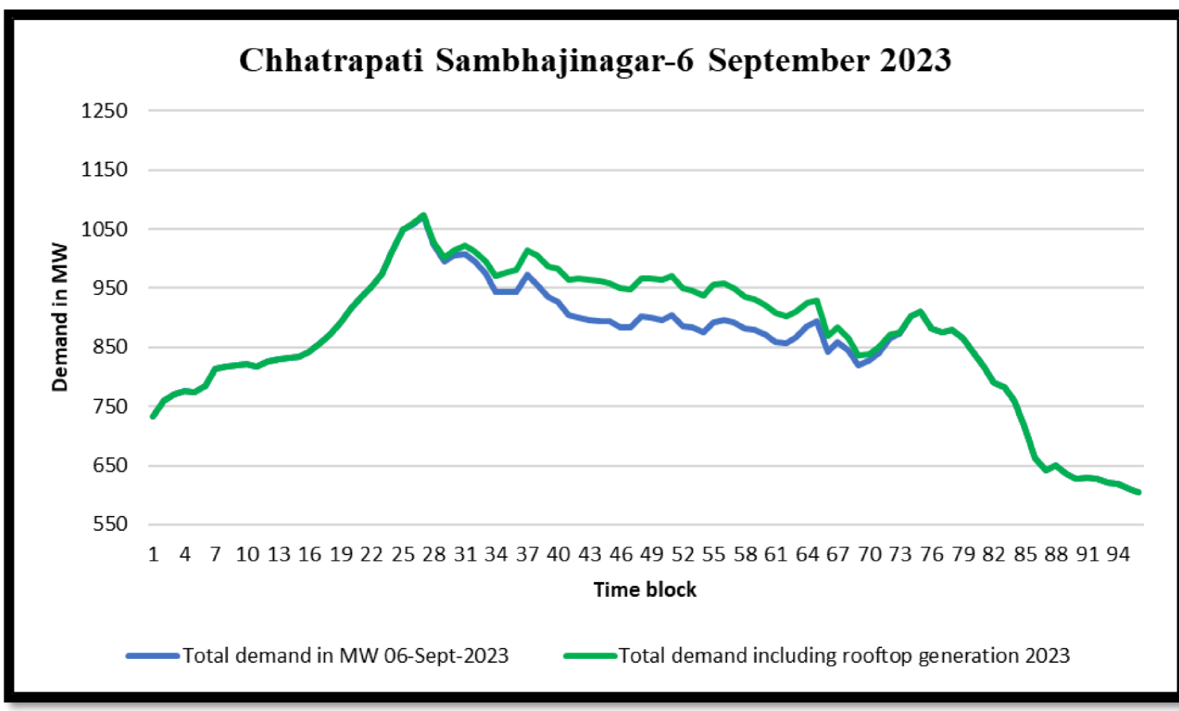


Figure 278: Rooftop Solar impact on Chhatrapati Sambhajinagar peak demand day 6 September 2023

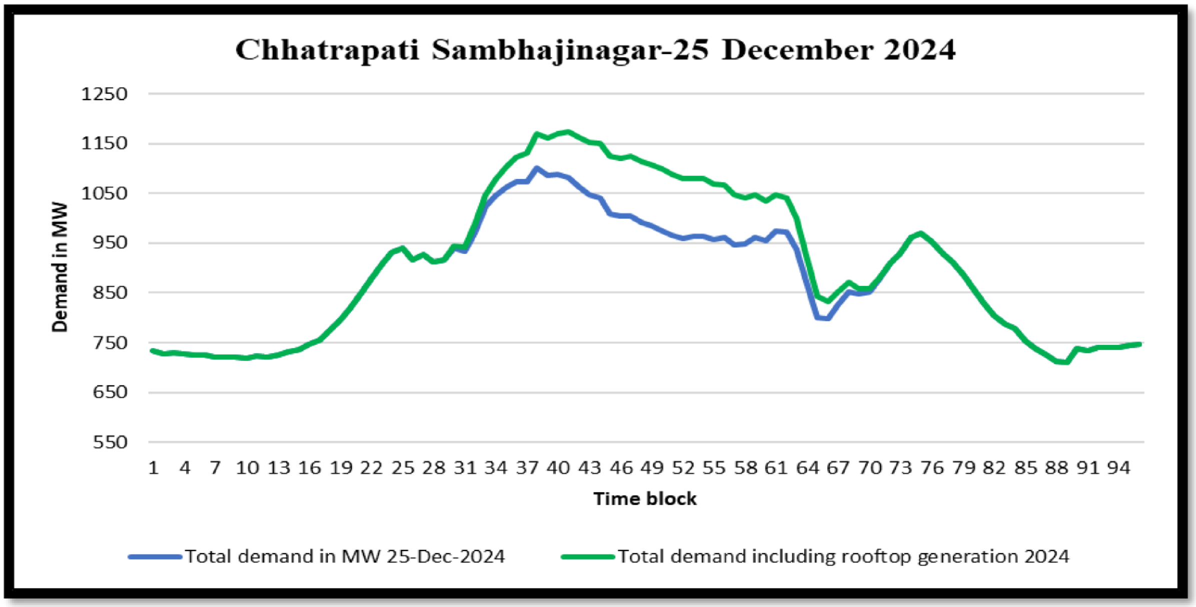


Figure 279: Rooftop Solar impact on Chhatrapati Sambhajinagar peak demand day 25 December 2024

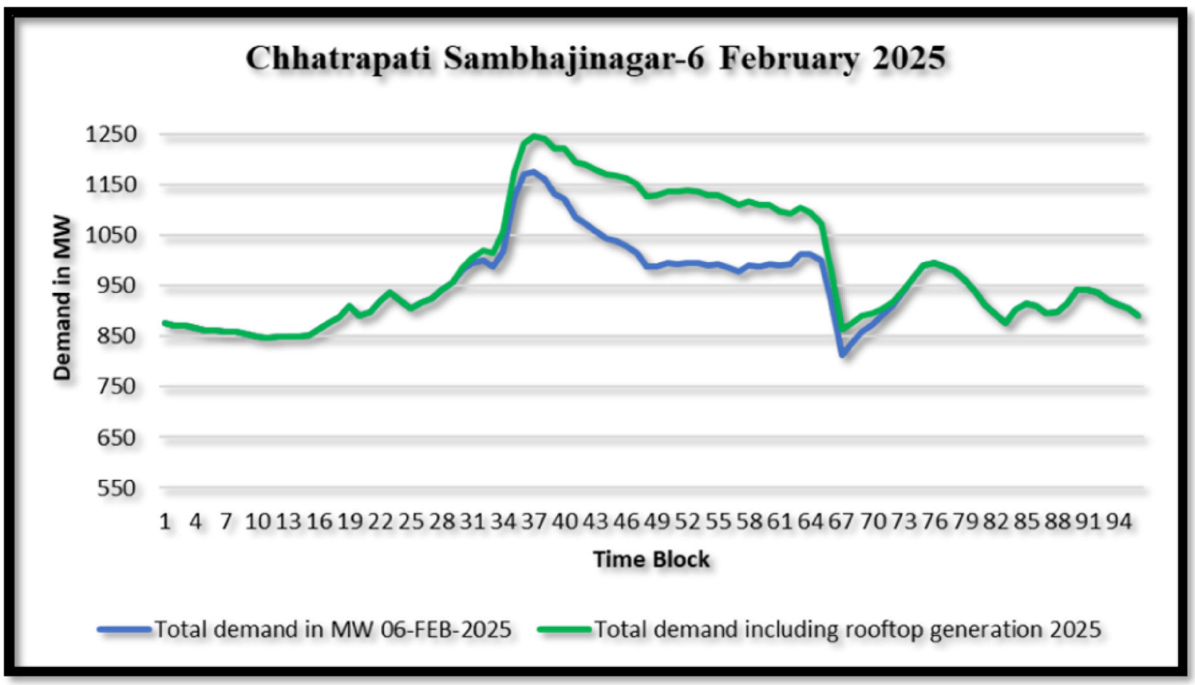


Figure 280: Rooftop Solar impact on Chhatrapati Sambhajinagar peak demand day 6 February 2025

Summary

The above plots show the Peak demand days for Chhatrapati Sambhajinagar over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 59: Rooftop Solar Impact on Peak Demand Days – Chhatrapati Sambhajinagar

Parameter	2022	2023	2024	2025
Peak Demand Day	27th December 2022	6th September 2023	25th December 2024	6th February 2025
Time Blocks with Rooftop Impact	Blocks 35–63 (08:45 AM to 03:45 PM)	Blocks 32–69 (08:00 AM to 05:15 PM)	Blocks 33–70 (08:15 AM to 05:30 PM)	Blocks 37–65 (09:15 AM to 04:15 PM)
Peak	Peak of the day: 1020.20 MW at Block 38 (09:30 AM)	Peak of the day: 1071.06 MW at Block 27 (09:00 AM)	Peak of the day: 1101.97 MW at Block 38 (09:30 AM)	Peak of the day: 1174.90 MW at Block 37 (09:15 AM)
	Rooftop Contribution at Peak (MW): 44.97 MW at Block 38	Rooftop Contribution at Peak (MW): 1.84 MW at Block 27	Rooftop Contribution at Peak (MW): 67.22 MW at Block 38	Rooftop Contribution at Peak (MW): 72 MW at Block 39
Max Rooftop Generation	70.04 MW at Block 48 (12:00 PM), when demand was 938.68 MW	68.46 MW at Block 44 (11:00 AM), when demand was 894.13 MW	123.45 MW at Block 50 (12:30 AM), when demand was 974.93 MW	142.57 MW at Block 52 (01:00 PM), when demand was 996.54 MW
Peak value (Demand +Rooftop generation)	Peak:1069.74 MW	Peak:1072.90 MW	Peak:1174.18 MW	Peak:1246.90 MW
	Time block:39	Time block:27	Time block:41	Time block:37
	Rooftop contribution:49.91 MW	Rooftop contribution:1.84MW	Rooftop contribution: 91.67 MW	Rooftop contribution: 72 MW
Average Demand (MW)	799.31 MW	853.68 MW	875.83 MW	949.64 MW
Average Rooftop Generation (MW)	19 MW	20.41 MW	31.65 MW	40.27 MW

Parameter	2022	2023	2024	2025
Observation Summary	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 38, which is nearby time block 39 of the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 48 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 27 before actual solar generation starts, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 44 shows the possibility of a shift in the peak demand time block suggesting rooftop solar supported well during solar hours.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 38, which is nearby time block 41 of the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 37 before actual solar generation starts, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 52 shows the possibility of a shift in the peak demand time block suggesting rooftop solar supported well during solar hours.

24.5.5 Jalgaon

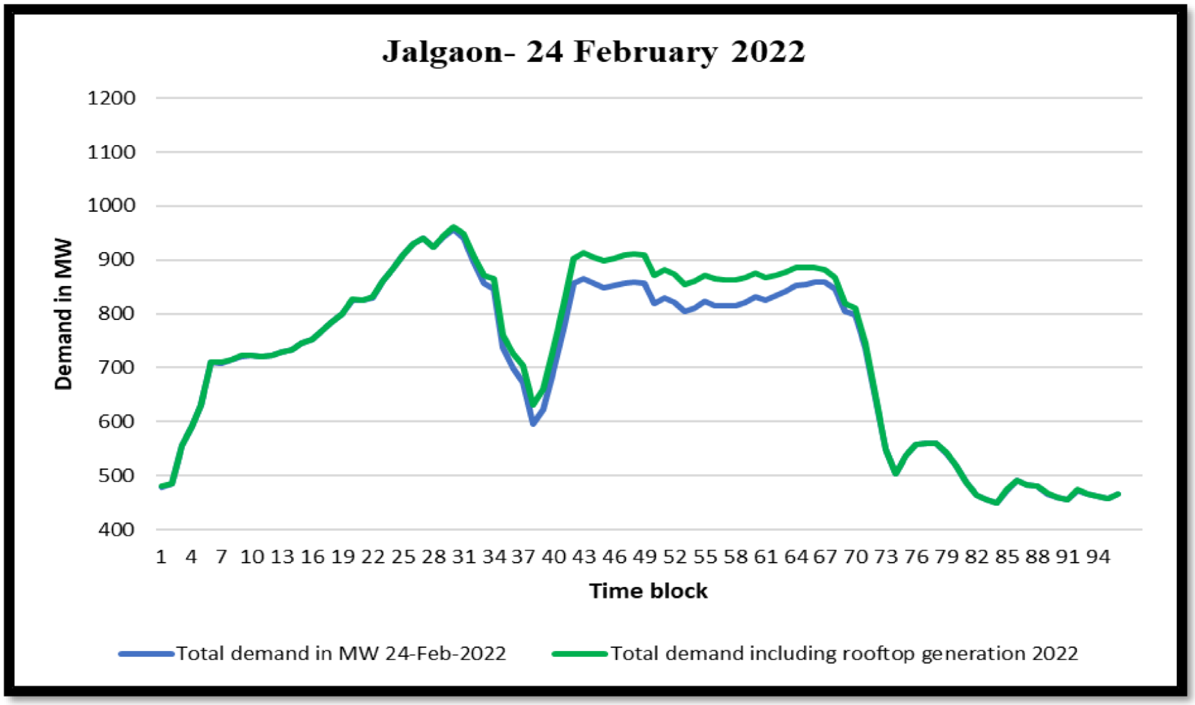


Figure 281: Rooftop Solar impact on Jalgaon peak demand day 24 February 2022

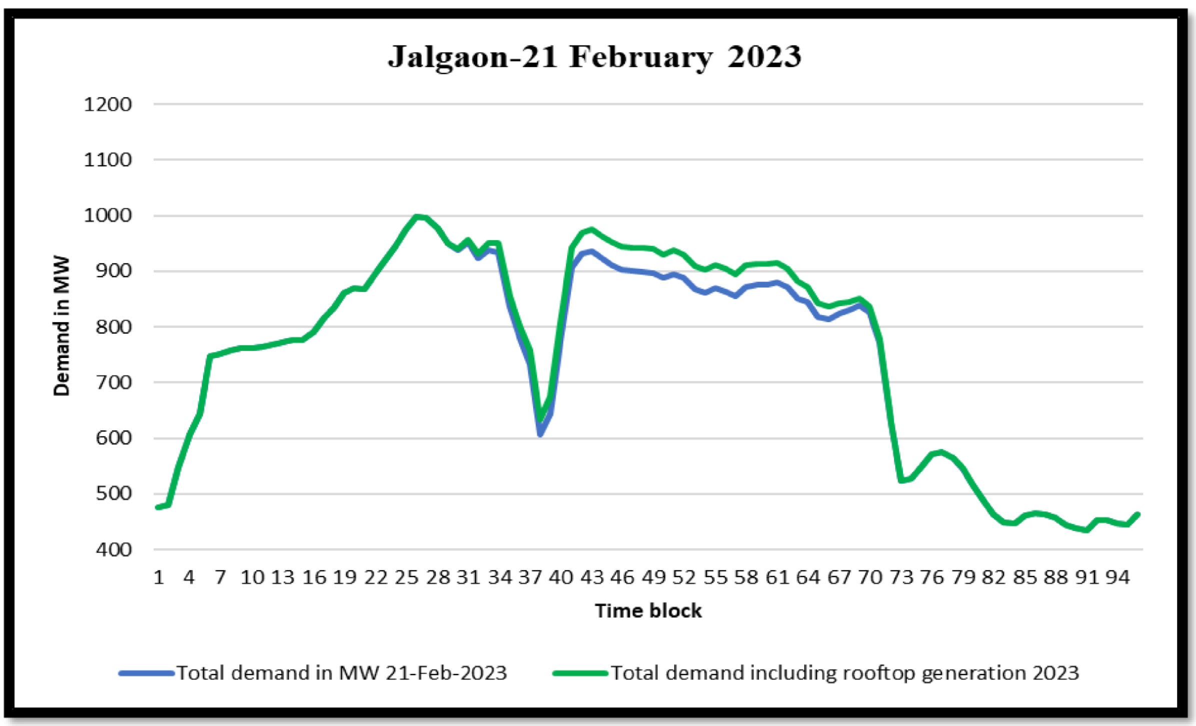


Figure 282: Rooftop Solar impact on Jalgaon peak demand day 21 February 2023

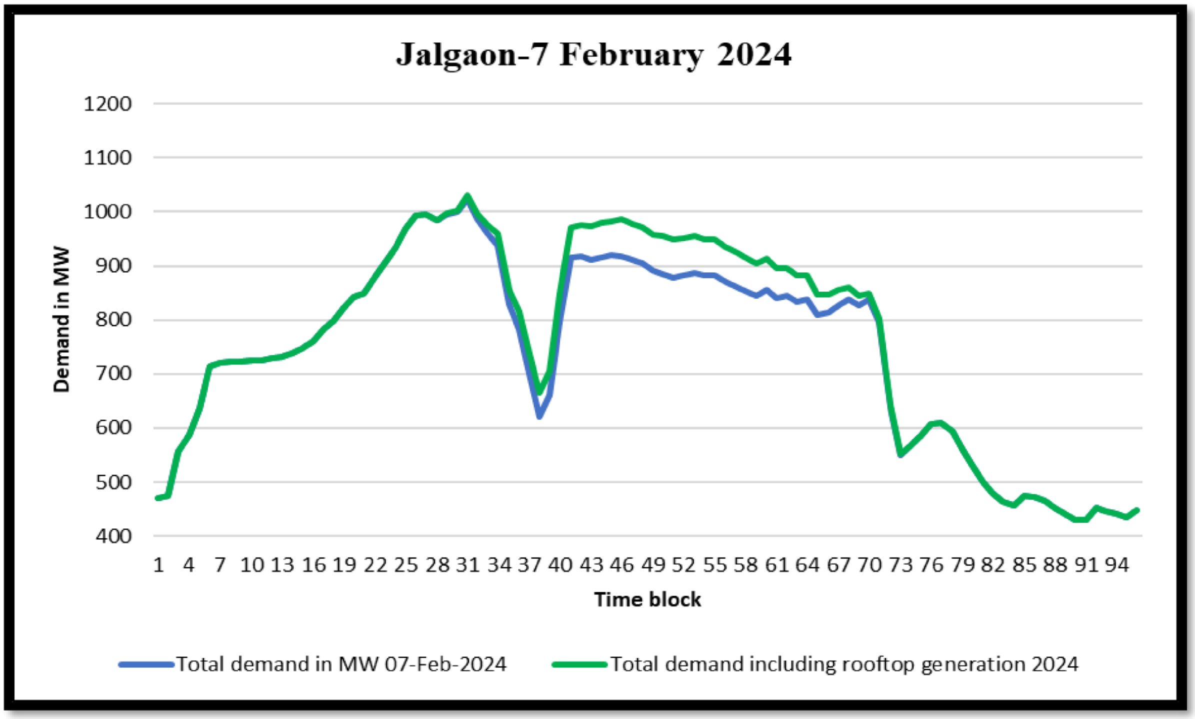


Figure 283: Rooftop Solar impact on Jalgaon peak demand day 7 February 2024

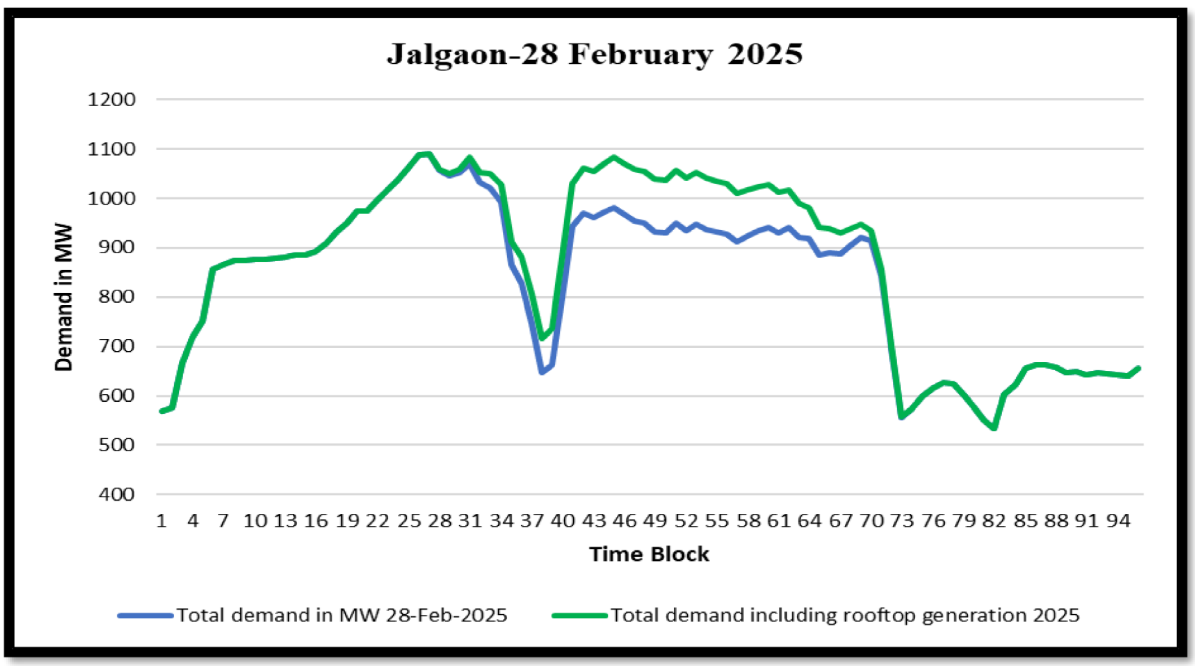


Figure 284: Rooftop Solar impact on Jalgaon peak demand day 28 February 2025

Summary

The above plots show the Peak demand days for Jalgaon over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 60: Rooftop Solar Impact on Peak Demand Days – Jalgaon

Parameter	2022	2023	2024	2025
Peak Demand Day	24th February 2022	21st February 2023	7th February 2024	28th February 2025
Time Blocks with Rooftop Impact	Blocks 42-69 (10:30 AM to 05:15 PM)	Blocks 32–70 (08:00 AM to 05:45 PM)	Blocks 31–70 (07:45 AM to 05:45 PM)	Blocks 41-66 (10:15 AM to 12:30 PM)
Peak	Peak of the day: 957.03 MW at Block 30 (07:30 AM)	Peak of the day: 998.76 MW at Block 26 (06:30 AM)	Peak of the day: 1025.18 MW at Block 31 (07:45 AM)	Peak of the day: 1090.72 MW at Block 27 (06:45 AM)
	Rooftop Contribution at Peak: ~3.44 MW	Rooftop Contribution at Peak: ~0 MW	Rooftop Contribution at Peak: 5.47 MW	Rooftop Contribution at Peak: 0.03 MW
Max Rooftop Generation	52.61 MW at Block 52 (01:15 PM), when demand was 820.40 MW	42.75 MW at Block 49 (12:15 PM), when demand was 897.16 MW	69.39 MW at Block 51 (12:45 PM), when demand was 878.68 MW	107.05 MW at Block 49 (12:15 PM), when demand was 932.75 MW
Peak value (Demand +Rooftop generation)	Peak:960.47 MW	Peak:998.76 MW	Peak:1030.657 MW	Peak:1090.75MW
	Time block:30	Time block:26	Time block:31	Time block:27
	Rooftop contribution:3.44 MW	Rooftop contribution:0 MW	Rooftop contribution: 5.47 MW	Rooftop contribution: 0.03 MW
Average Demand (MW)	715.21 MW	743.99 MW	742.13 MW	835.62 MW
Average Rooftop Generation (MW)	15.99 MW	12.98 MW	20.24 MW	31.68 MW

Parameter	2022	2023	2024	2025
Observation Summary	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 30, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 52 shows the possibility of a shift in the peak demand time block.	The peak value of peak demand day occurs at Time Block 26 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 49, and the combined peak of demand and rooftop generation occurs at Time Block 26, indicating a potential shift in the peak demand time block, with rooftop solar providing significant support during solar hours.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 31 almost before actual solar generation starts, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 51 shows the possibility of a shift in the peak demand time block suggesting rooftop solar supported well during solar hours.	The peak value of peak demand day occurs at Time Block 27 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 49, and the combined peak of demand and rooftop generation occurs at Time Block 27, indicating a potential shift in the peak demand time block, with rooftop solar providing significant support during solar hours.

24.5.6 Thane

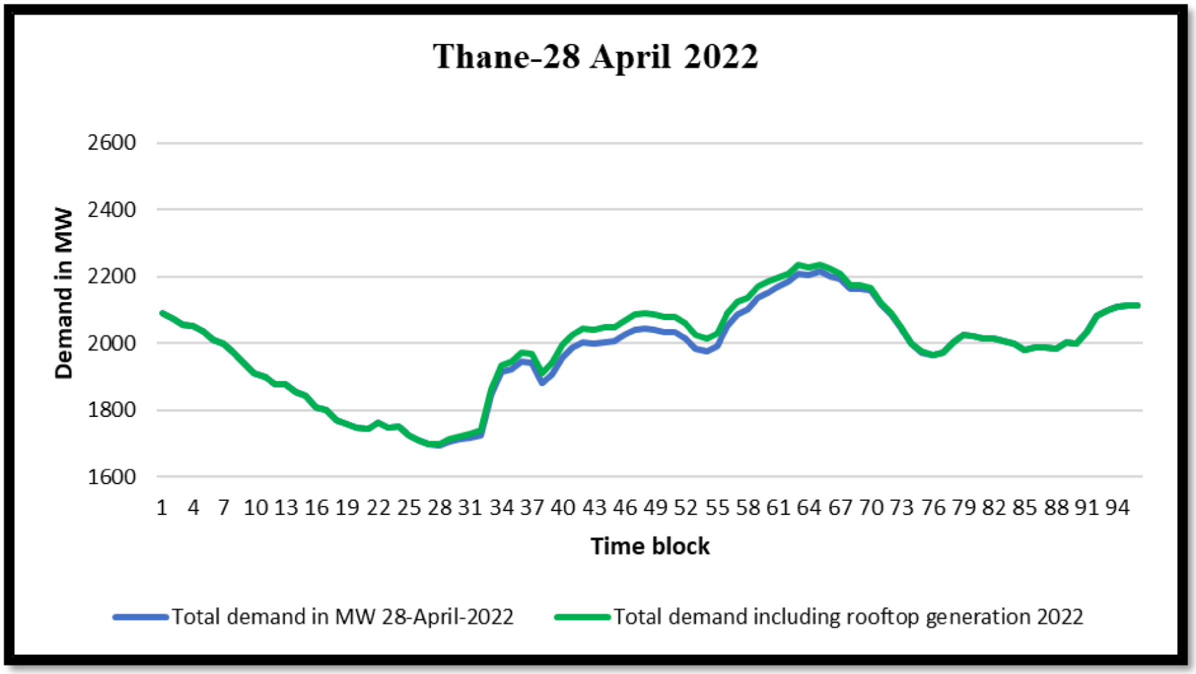


Figure 285: Rooftop Solar impact on Thane peak demand day 28 April 2022

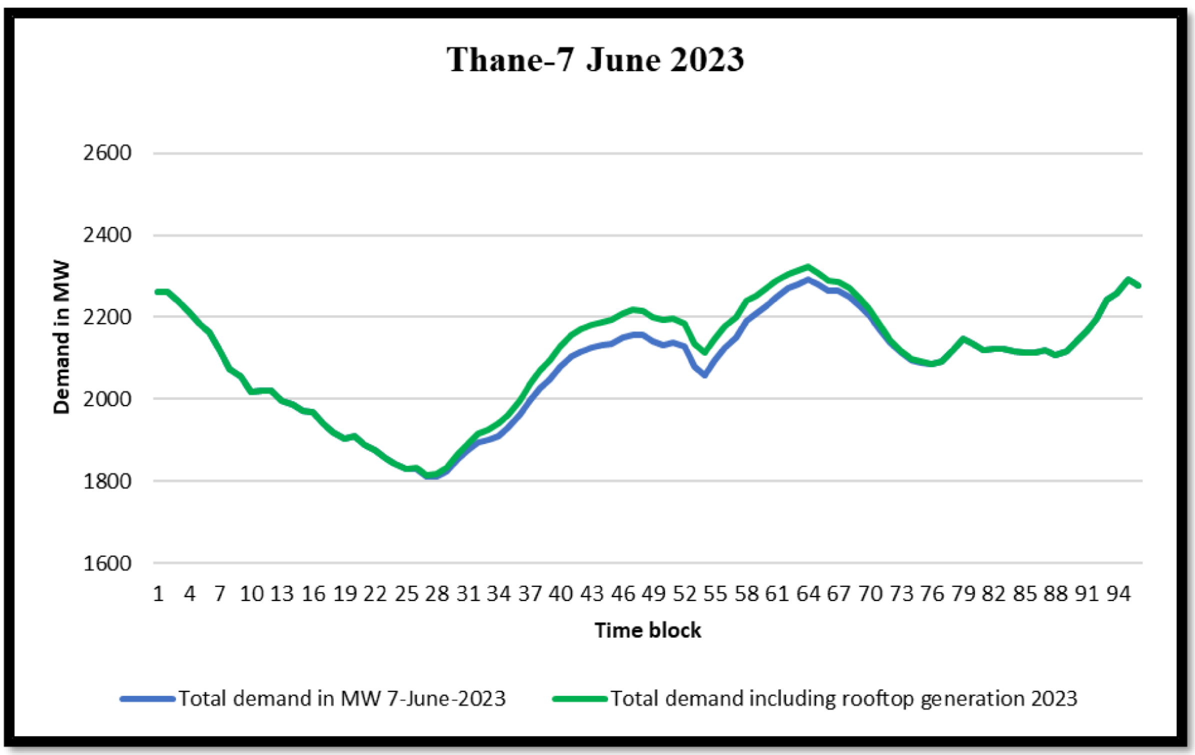


Figure 286: Rooftop Solar impact on Thane peak demand day 7 June 2023

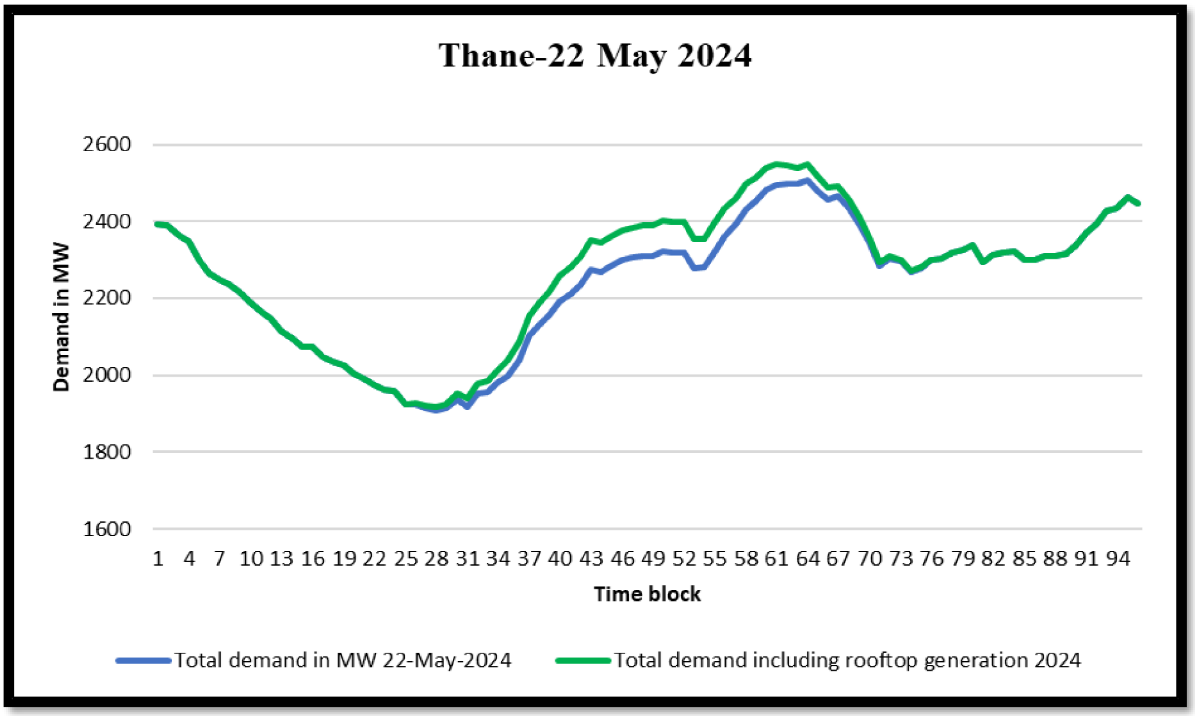


Figure 287: Rooftop Solar impact on Thane peak demand day 22 May 2024

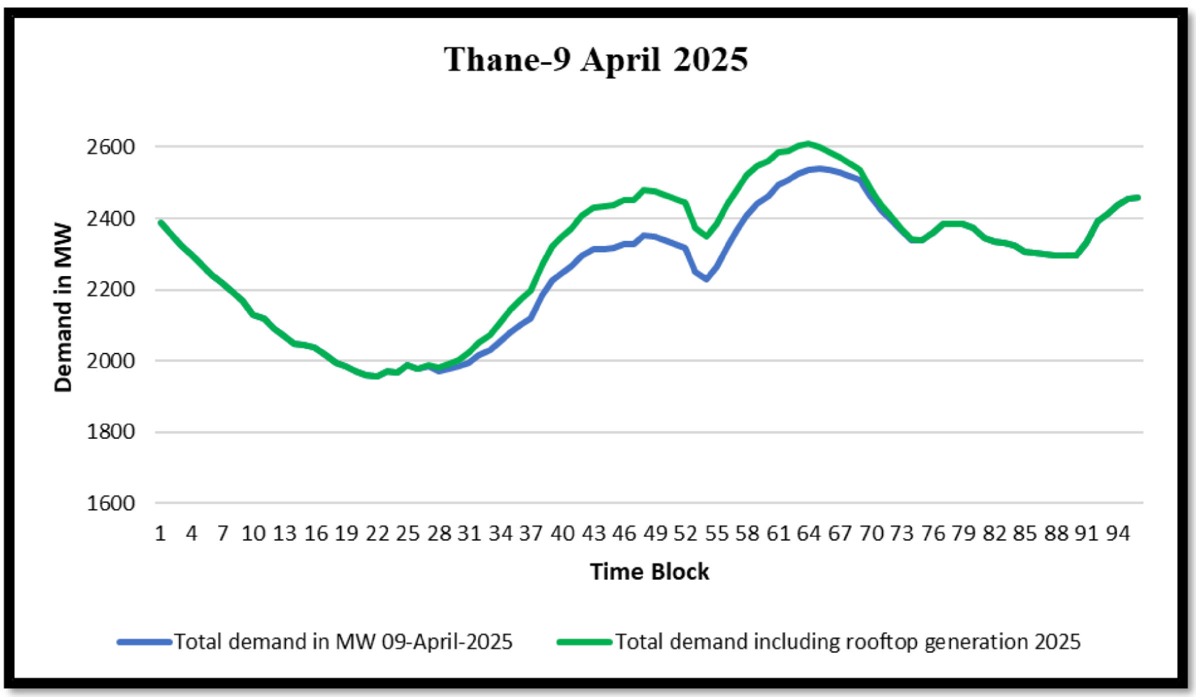


Figure 288: Rooftop Solar impact on Thane peak demand day 9 April 2025

Summary

The above plots show the Peak demand days for Thane over years 2022 to 2025. The table below gives statistical insights.

Observations

Table 61: Rooftop Solar Impact on Peak Demand Days – Thane

Parameter	2022	2023	2024	2025
Peak Demand Day	28th April 2022	7th June 2023	22nd May 2024	9th April 2025
Time Blocks with Rooftop Impact	Blocks 39–61 (09:45 AM to 3:15 PM)	Blocks 31–68 (08:00 AM to 05:15 PM)	Blocks 31–68 (08:00 AM to 05:15 PM)	Blocks 31–68 (08:00 AM to 05:15 PM)
Peak	Peak of the day: 2214.18 MW at Block 65 (04:15 PM)	Peak of the day: 2292.59 MW at Block 95 (11:30PM)	Peak of the day: 2507.66 MW at Block 64 (04:00 PM)	Peak of the day: 2538.22 MW at Block 65 (04:15 PM)
	Rooftop Contribution at Peak (MW):19.74	Rooftop Contribution at Peak (MW): 0.00	Rooftop Contribution at Peak (MW): 60.23	Rooftop Contribution at Peak (MW): 40.30
Max Rooftop Generation	45.77 MW at Block 49 (12:15 PM), when demand was 2042.36 MW	59.45 MW at Block 48 (12:00 PM), when demand was 2156.00 MW	80.15 MW at Block 48 (12:00 PM), when demand was 2309.54 MW	127.81 MW at Block 49 (12:15 PM), when demand was 2347.39 MW
Peak value (Demand +Rooftop generation)	Peak:2234.64 MW	Peak:2322.64 MW	Peak:2549.19 MW	Peak:2610.63 MW
	Time block:63	Time block:64	Time block:61	Time block:64
	Rooftop contribution:24.71 MW	Rooftop contribution:30.95 MW	Rooftop contribution: 55.85 MW	Rooftop contribution: 73.11 MW
Average Demand (MW)	1975.96 MW	2087.60 MW	2242.51 MW	2258.69 MW
Average Rooftop Generation (MW)	13.48 MW	18.35 MW	23.95 MW	38.32 MW
Observation Summary	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 65, which is nearby time block 63 of the	The peak value of peak demand day occurs at Time Block 95 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 64, which is nearby time block 61 of	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 65, which is nearby time

Parameter	2022	2023	2024	2025
	combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 49 shows the possibility of a shift in the peak demand time block.	generation is observed at Time Block 48, and the combined peak of demand and rooftop generation occurs at Time Block 64, indicating a potential shift in the peak demand time block, with rooftop solar providing significant support during solar hours.	the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 48 shows the possibility of a shift in the peak demand time block.	block 64 of the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 49 shows the possibility of a shift in the peak demand time block.

24.5.7 Kolhapur

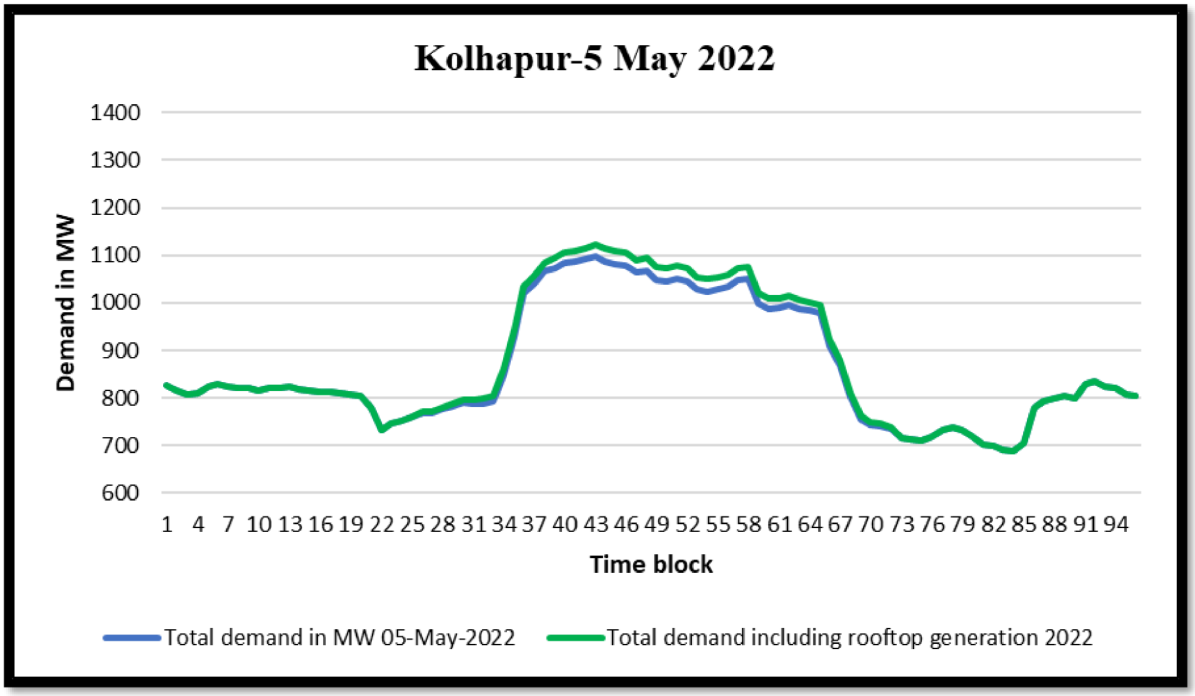


Figure 289: Rooftop Solar impact on Kolhapur peak demand day 5 May 2022

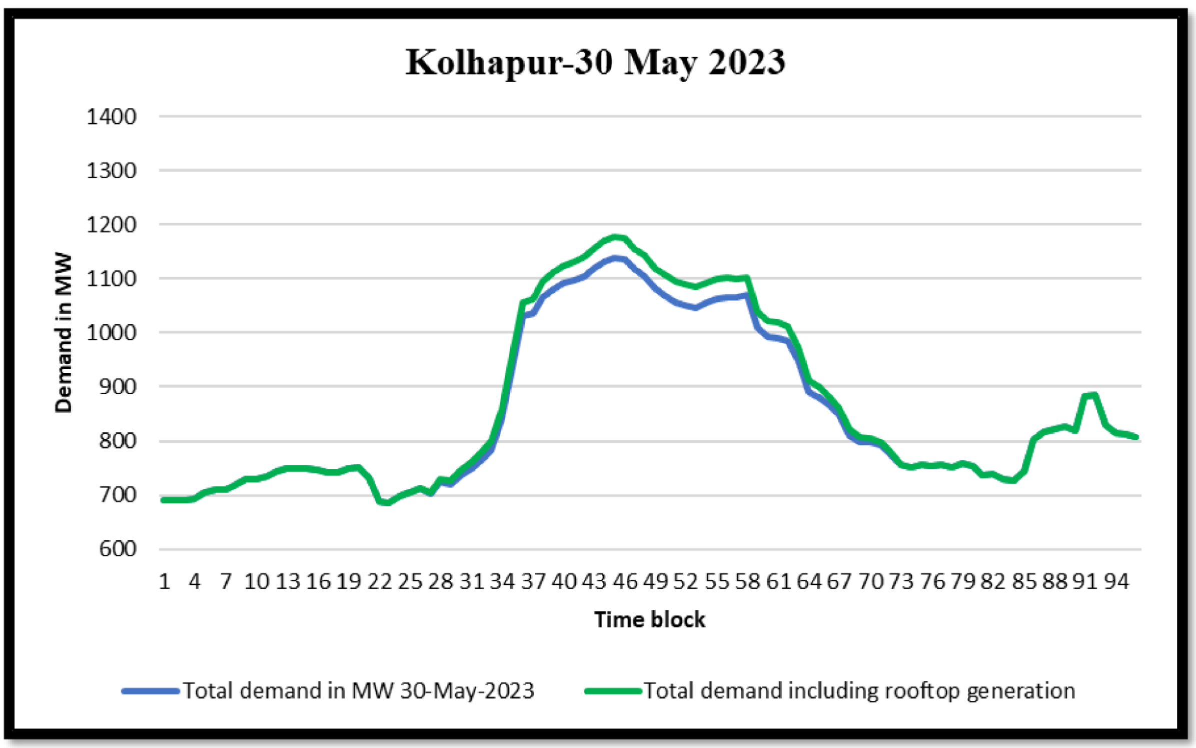


Figure 290: Rooftop Solar impact on Kolhapur peak demand day 30 May 2023

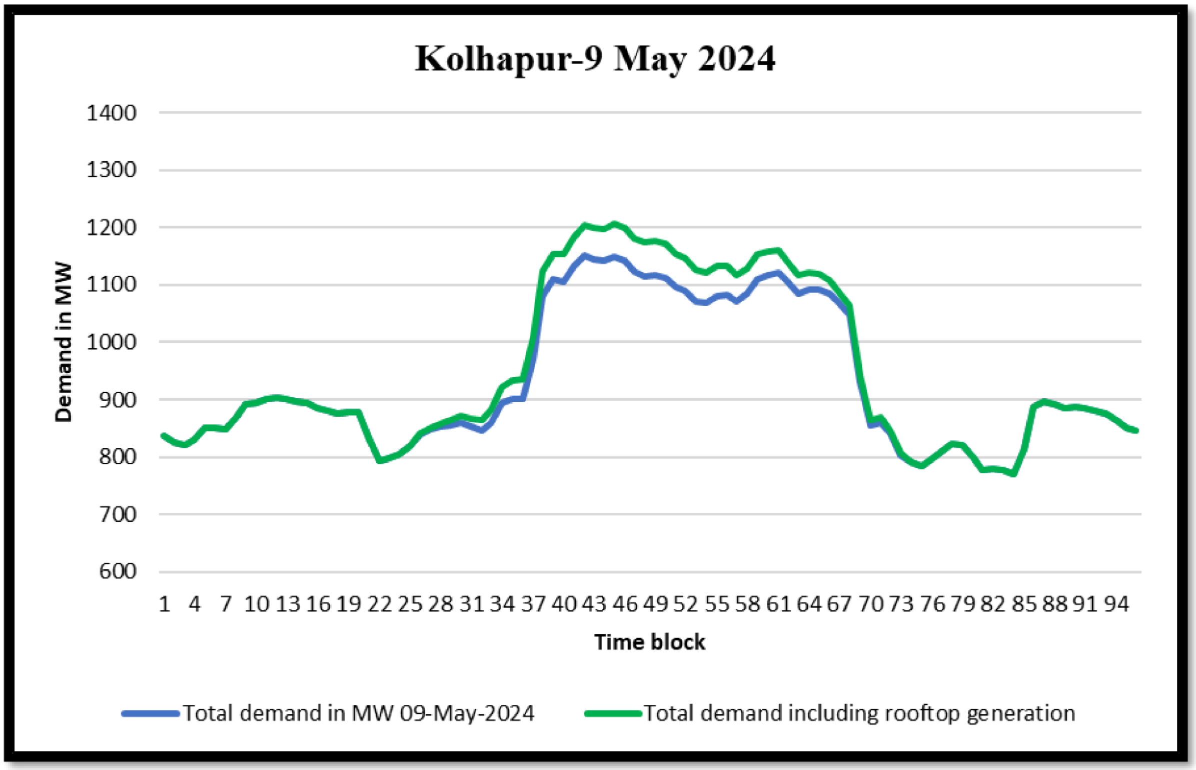


Figure 291: Rooftop Solar impact on Kolhapur peak demand day 9 May 2024

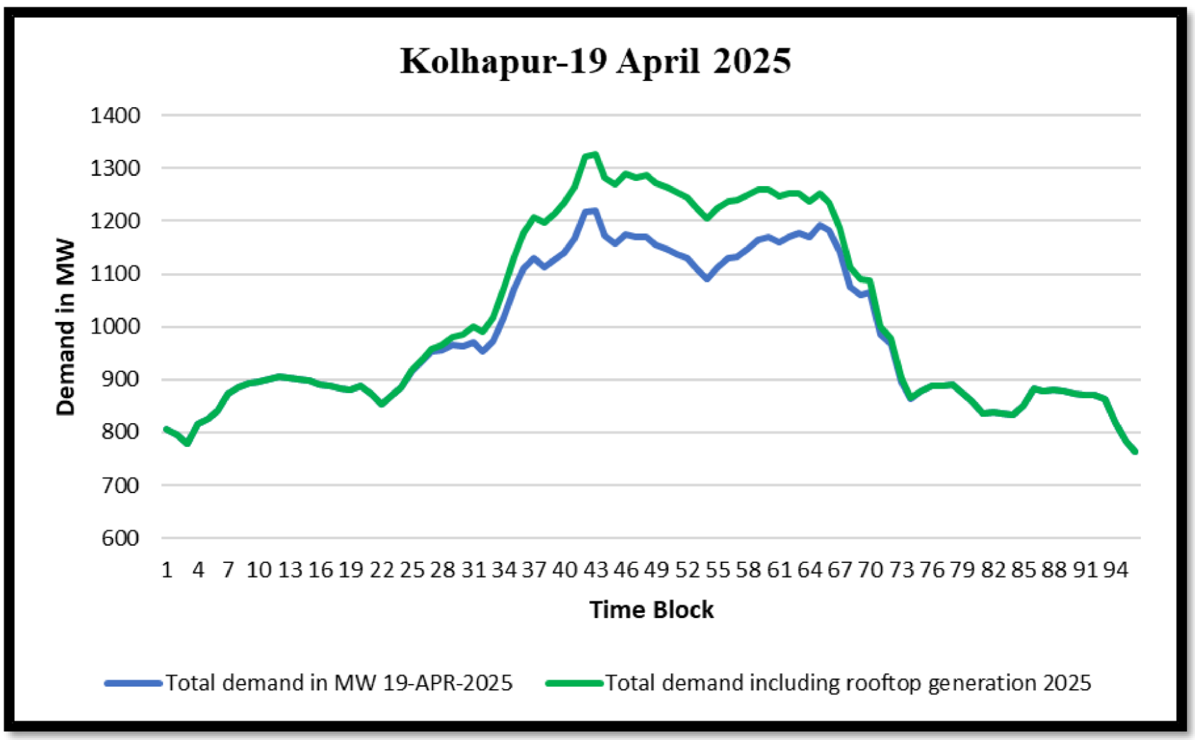


Figure 292: Rooftop Solar impact on Kolhapur peak demand day 19 April 2025

Summary

The above plots show the Peak demand days for Kolhapur over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 62: Rooftop Solar Impact on Peak Demand Days – Kolhapur

Parameter	2022	2023	2024	2025
Peak Demand Day	5th May 2022	30th May 2023	9th May 2024	19th April 2025
Time Blocks with Rooftop Impact	Blocks 39–56 (09:45 AM to 02:00 PM)	Blocks 36–69 (09:00 AM to 05:15 PM)	Blocks 30–68 (07:30 AM to 05:00 PM)	Blocks 34–68 (08:30 AM to 05:00 PM)
Peak	Peak of the day: 1097.55 MW at Block 43 (10:45 AM)	Peak of the day: 1139.27 MW at Block 45 (11:15 AM)	Peak of the day: 1150.74 MW at Block 42 (10:30 AM)	Peak of the day: 1220.57 MW at Block 43 (10:45 AM)
	Rooftop at Peak: 24.95 MW	Rooftop at Peak: 38.52 MW	Rooftop at Peak: 52.75 MW	Rooftop at Peak: 106.79 MW
Max Rooftop Generation	27.56 MW at Block 50 (12:30 PM), when demand was 1045.29 MW	38.86 MW at Block 52 (01:00 PM), when demand was 1051.70 MW	59.81 MW at Block 48 (12:00 PM), when demand was 1113.53 MW	117.89 MW at Block 49 (12:15 PM), when demand was 1155.13 MW
Peak value (Demand +Rooftop generation)	Peak:1122.50 MW	Peak:1177.79 MW	Peak:1206.22 MW	Peak:1327.36 MW
	Time block:43	Time block:45	Time block:45	Time block:43
	Rooftop contribution:24.95 MW	Rooftop contribution:38.52 MW	Rooftop contribution: 58.26 MW	Rooftop contribution: 106.79 MW
Average Demand (MW)	1975.96 MW	852.10 MW	933.39 MW	980.90 MW
Average Rooftop Generation (MW)	13.48 MW	12.00 MW	17.54 MW	36.09 MW

Parameter	2022	2023	2024	2025
Observation Summary	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 43, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 45, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 52 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 42, which is nearby time block 45 of the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 48 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 43, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 49 shows the possibility of a shift in the peak demand time block.

24.5.8 Amravati

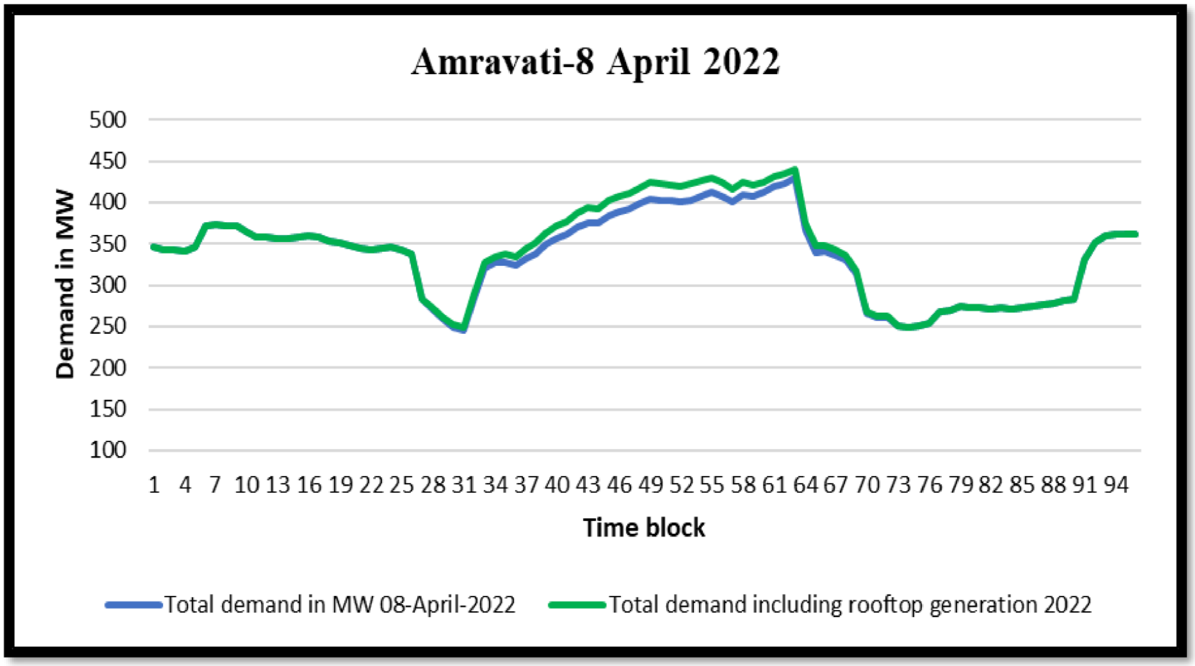


Figure 293: Rooftop Solar impact on Amravati peak demand day 8 April 2022

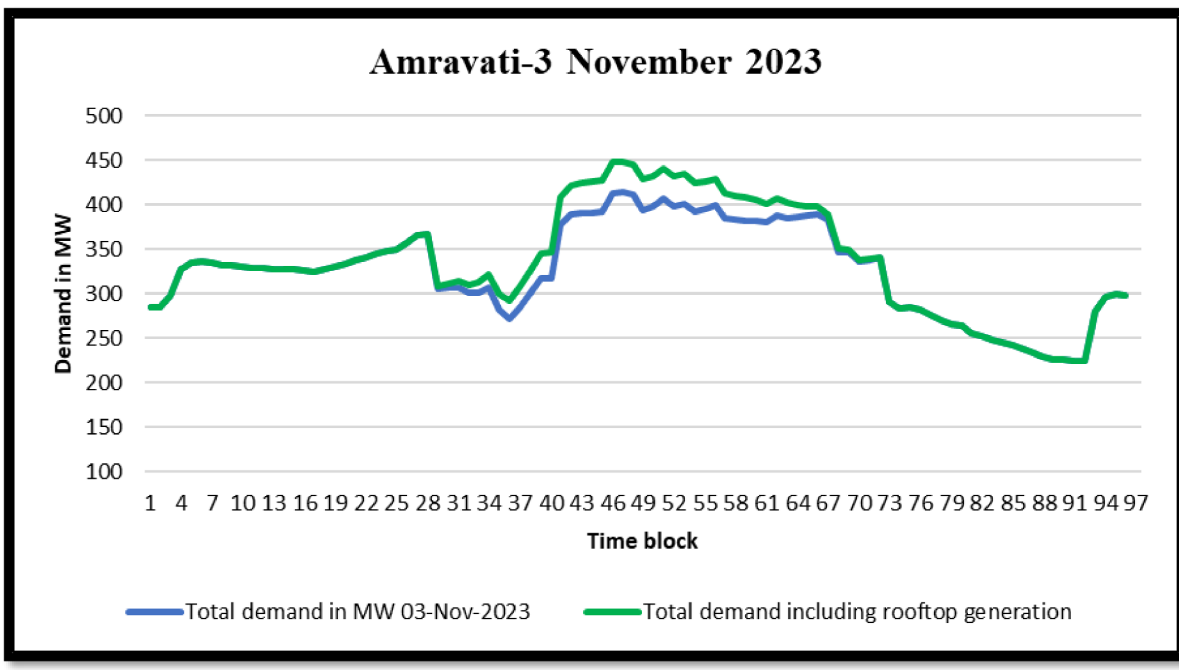


Figure 294: Rooftop Solar impact on Amravati peak demand day 3 November 2023

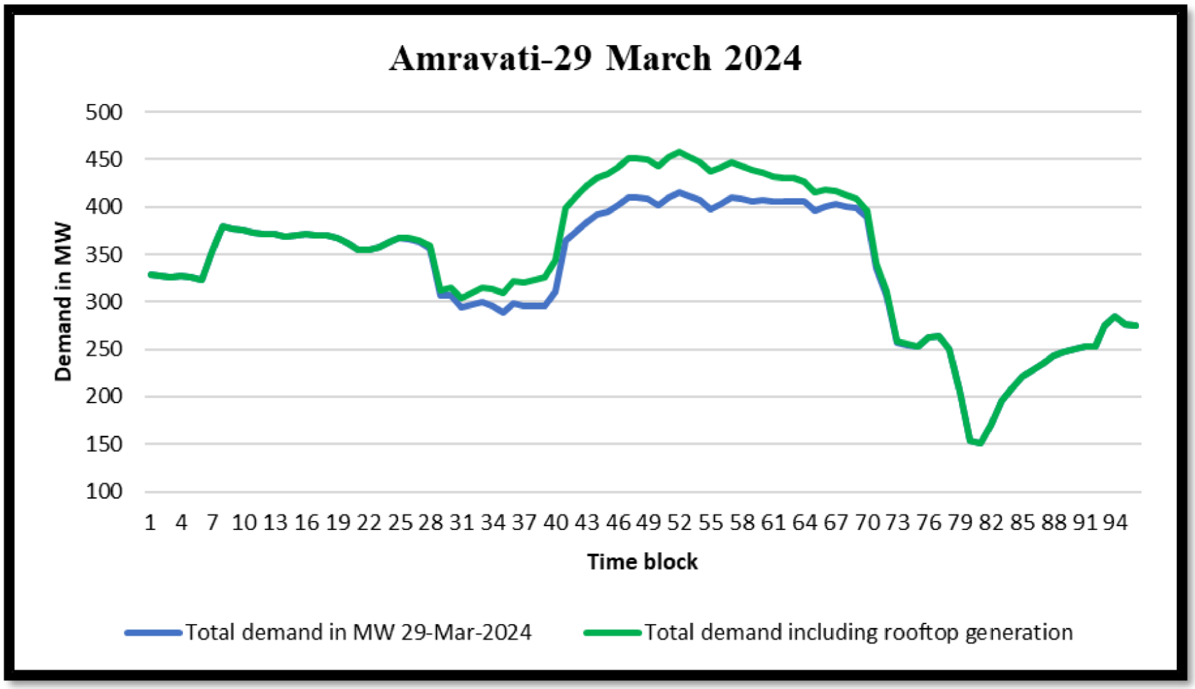


Figure 295: Rooftop Solar impact on Amravati peak demand day 29 March 2024

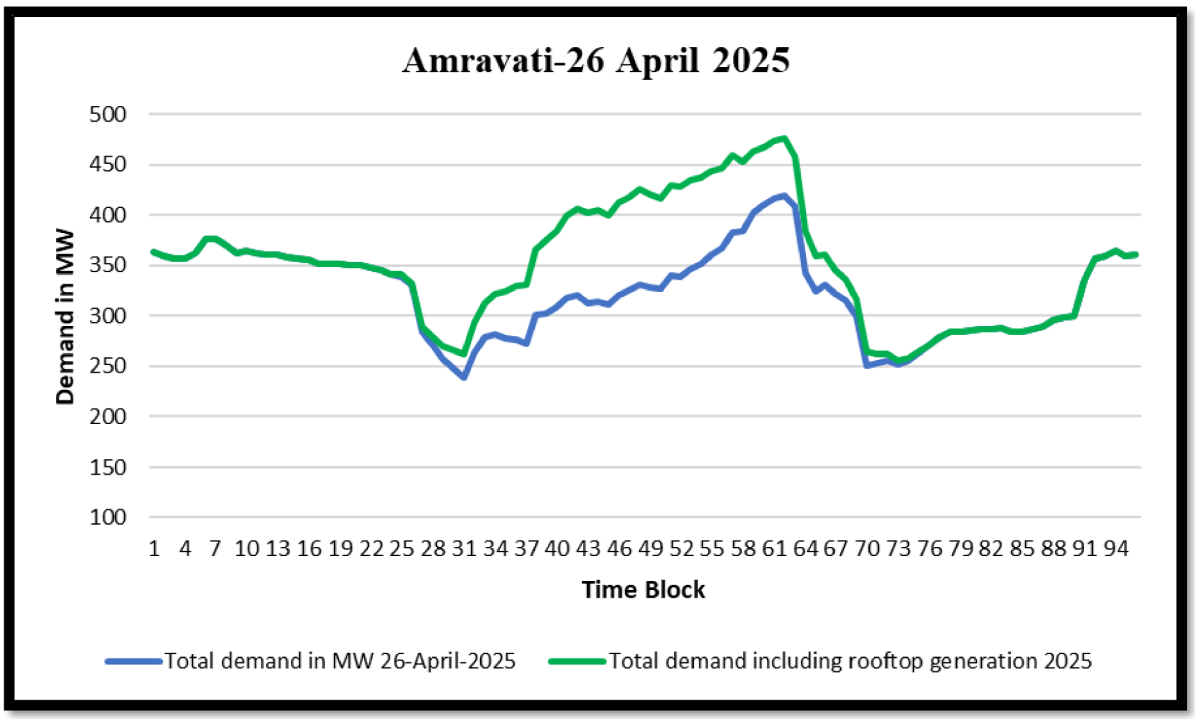


Figure 296: Rooftop Solar impact on Amravati peak demand day 26 April 2025

Summary

The above plots show the Peak demand days for Amravati over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 63: Rooftop Solar Impact on Peak Demand Days – Amravati

Parameter	2022	2023	2024	2025
Peak Demand Day	8th April 2022	3rd November 2023	29th March 2024	26th April 2025
Time Blocks with Rooftop Impact	Blocks 39–60 (09:45 AM to 03:00 PM)	Blocks 30–67 (07:30 AM to 04:15 PM)	Blocks 31–70 (07:45 AM to 05:00 PM)	Blocks 31–70 (07:45 AM to 05:00 PM)
Peak	Peak of the day:430.15 MW at Block 63 (03:45 PM)	Peak of the day:414.47 MW at Block 47 (11:45 AM)	Peak of the day:418.84 MW at Block 62 (02:00 PM)	Peak of the day:415.98 MW at Block 52 (01:00 PM)
	Rooftop Contribution: 9.89 MW	Rooftop Contribution: 34.31 MW	Rooftop Contribution: 41.77 MW	Rooftop Contribution: 57.39 MW
Max Rooftop Generation	20.05 MW at Block 50 (12:30 PM), when demand was 402 MW	34.86 MW at Block 50 (12:30 PM), when demand was 397.81 MW	42.18 MW at Block 51 (12:45 PM), when demand was 410.22 MW	95.84 MW at Block 48 (12:00 PM), when demand was 330.44 MW
Peak value (Demand +Rooftop generation)	Peak:440.05 MW	Peak:448.78 MW	Peak:457.75 MW	Peak:476.24 MW
	Time block:63	Time block:47	Time block:52	Time block:62
	Rooftop contribution:9.89 MW	Rooftop contribution:34.31 MW	Rooftop contribution: 41.77 MW	Rooftop contribution: 57.39 MW
Average Demand (MW)	337.78 MW	327.56 MW	332.82 MW	324.70 MW
Average Rooftop Generation (MW)	5.50 MW	9.77 MW	12.42 MW	26.96 MW
Observation Summary	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 63, which	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 47, which is the same time	The peak value of peak demand day occurs at Time Block 62, while the combined peak (demand	The peak value of peak demand day occurs at Time Block 52, while the combined peak (demand and rooftop solar

Parameter	2022	2023	2024	2025
	is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.	block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.	and rooftop solar generation) occurs at Time Block 52 and max rooftop generation at time block 51 indicating a shift in the time block of the peak value due to rooftop solar impact.	generation) occurs at Time Block 62 and max rooftop generation at time block 48 indicating a shift in the time block of the peak value due to rooftop solar impact.

24.5.9 Solapur

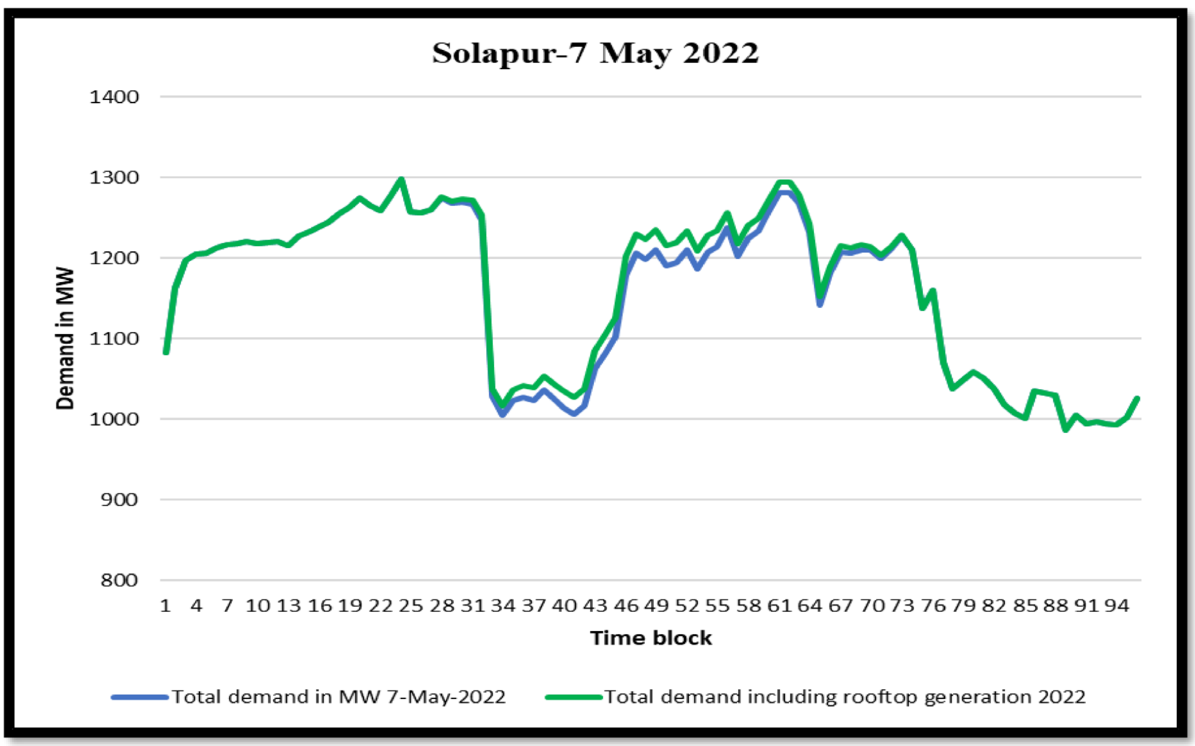


Figure 297: Rooftop Solar impact on Solapur peak demand day 7 May 2022

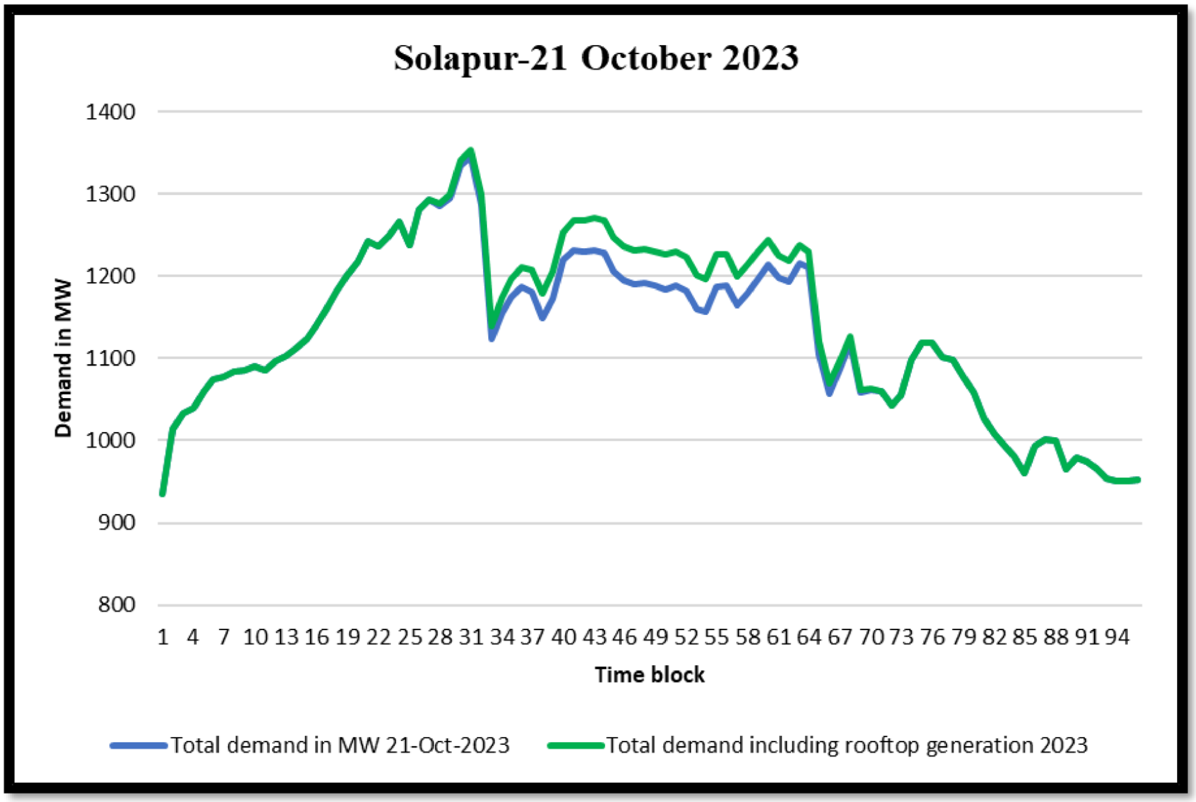


Figure 298: Rooftop Solar impact on Solapur peak demand day 21 October 2023

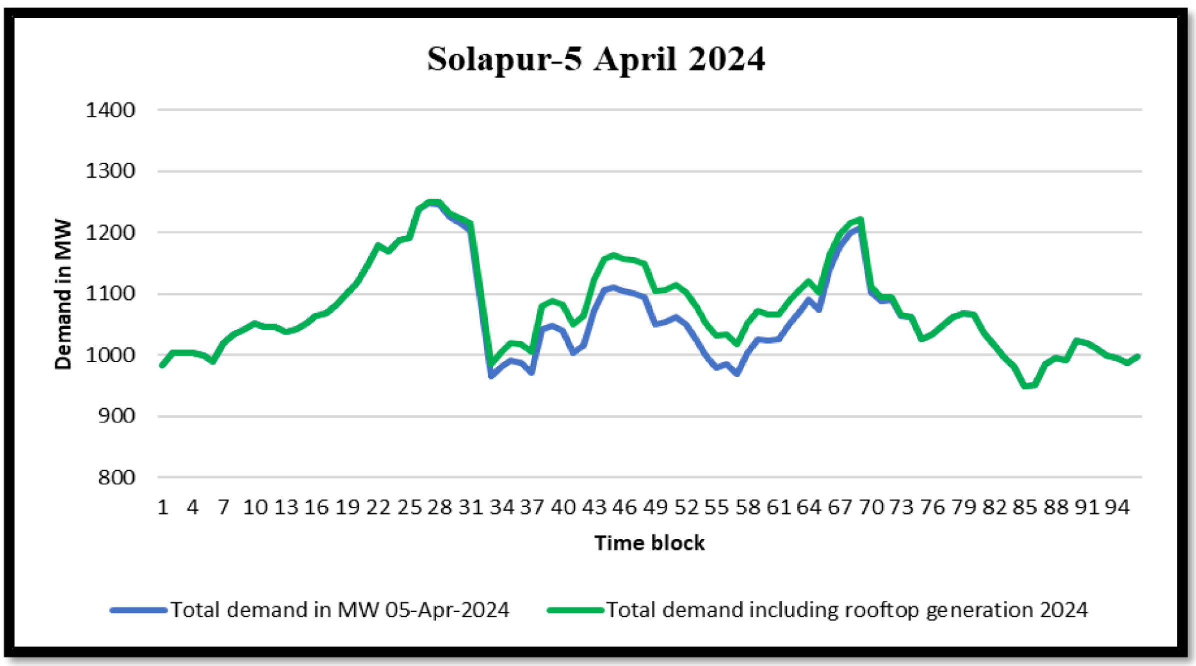


Figure 299: Rooftop Solar impact on Solapur peak demand day 5 April 2024

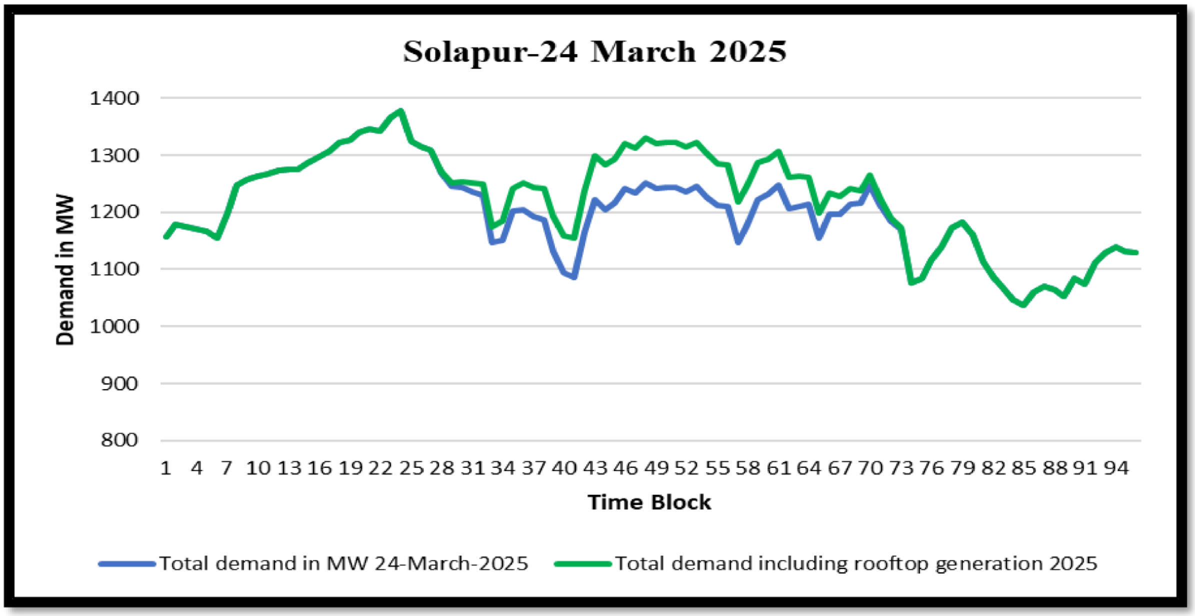


Figure 300: Rooftop Solar impact on Solapur peak demand day 24 March 2025

Summary

The above plots show the Peak demand days for Solapur over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 64: Rooftop Solar Impact on Peak Demand Days – Solapur

Parameter	2022	2023	2024	2025
Peak Demand Day	7th May 2022	21st October 2023	5th April 2024	24th March 2025
Time Blocks with Rooftop Impact	Blocks 34–62 (≈ 08:30 AM to03:30 PM)	Blocks 33–64 (≈ 08:15 AM to 09:00 PM)	Blocks 33–65 (≈ 08:15 AM to 04:00 PM)	Blocks 33–65 (≈ 08:15 AM to 04:00 PM)
Peak	Peak of the day: **1297.65 MW** at Block 24 (06:00 AM)	Peak of the day: **1345.18 MW** at Block 31 (07:45 AM)	Peak of the day: **1248.94 MW** at Block 27 (07:15 AM)	Peak of the day: **1377.12 MW** at Block 24 (06:00 AM)
	Rooftop Contribution: 0 MW	**Rooftop Contribution:** 9.11 MW	**Rooftop Contribution: 1.27 MW**	**Rooftop Contribution: 0 MW**
Max Rooftop Generation	24.70 MW at Block 48 (12:00 PM), when	42.20 MW at Block 49 (12:15 PM), when	54.31 MW at Block 49 (12:15 PM	79.02 MW at Block 48 (12:00 PM), when

Parameter	2022	2023	2024	2025
	demand was 1198.07 M W	demand was 1187.94 M W	), when demand was 1049.793 MW	demand was 1251.45 MW
Peak value (Demand +Rooftop generation)	Peak:1297.68 MW	Peak:1354.29 MW	Peak:1250.22 MW	Peak: 1377.12 MW
	Time block:24	Time block:31	Time block:27	Time block:24
	Rooftop contribution:0 MW	Rooftop contribution:9.1 1 MW	Rooftop contribution: 1.27 MW	Rooftop contribution: 0 MW
Average Demand (MW)	1155.48 MW	1128.44 MW	1059.08 MW	1199.09 MW
Average Rooftop Generation (MW)	6.93 MW	12.09 MW	16.63 MW	24.47 MW
Observation Summary	The peak value of peak demand day occurs at Time Block 24 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 48, and the combined peak of demand and rooftop generation occurs at Time Block 24, indicating a potential shift in the peak	The peak value of peak demand day occurs at Time Block 64, while the combined peak (demand and rooftop solar generation) occurs at Time Block 31 and max rooftop generation at time block 49, indicating a shift in the time block of the peak value due to rooftop solar impact.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 27 before actual solar generation starts, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 49 shows the possibility of a shift in the peak demand time block suggesting rooftop solar supported well during solar hours.	The peak value of peak demand day occurs at Time Block 24 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 48, and the combined peak of demand and rooftop generation occurs at Time

Parameter	2022	2023	2024	2025
	demand time block, with rooftop solar providing significant support during solar hours.			Block 48, indicating a potential shift in the peak demand time block, with rooftop solar providing significant support during solar hours.

24.5.10 Ahilyanagar

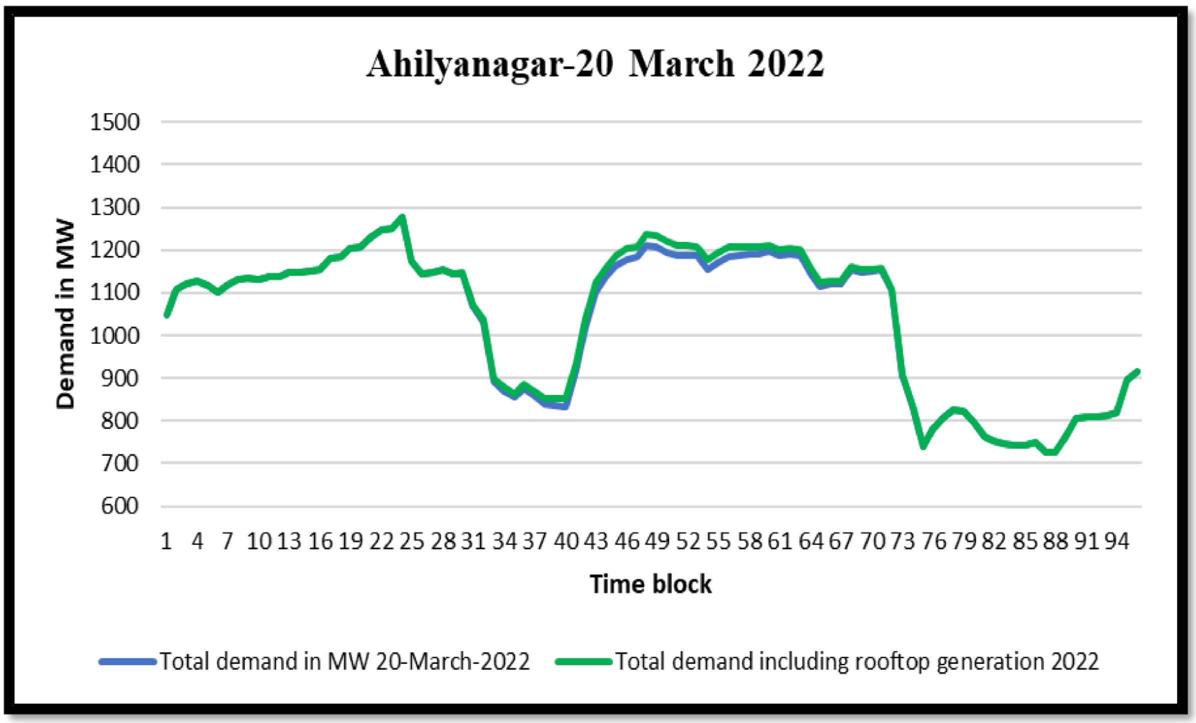


Figure 301: Rooftop Solar impact on Ahilyanagar peak demand day 20 March 2022

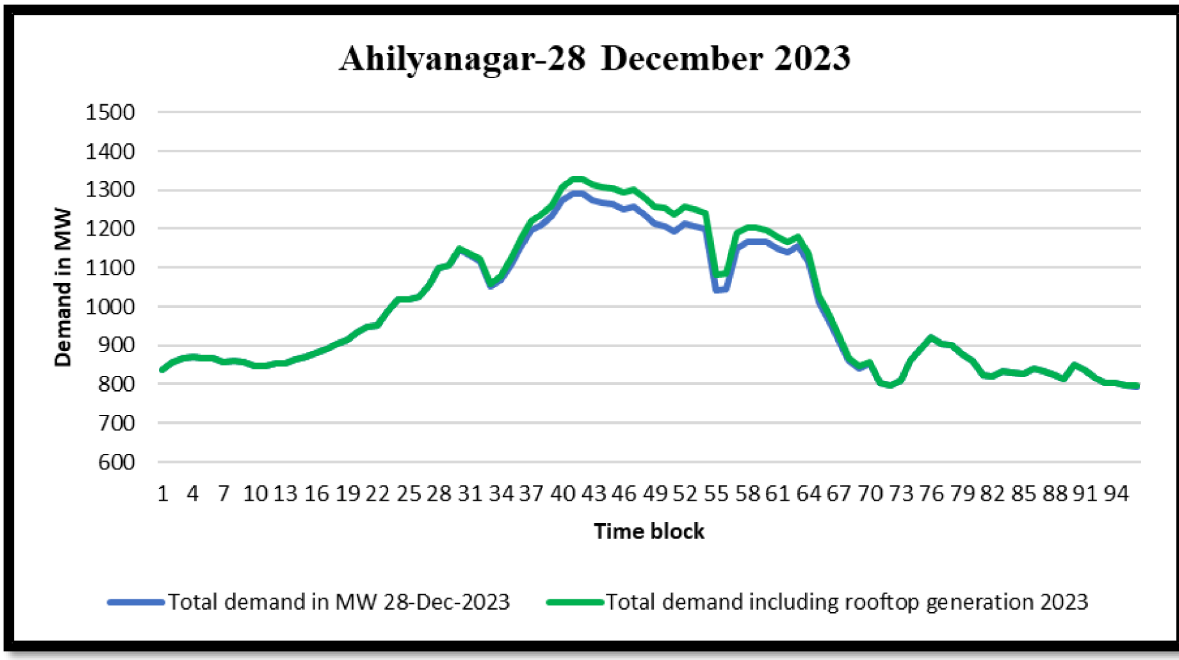


Figure 302: Rooftop Solar impact on Ahilyanagar peak demand day 28 December 2023

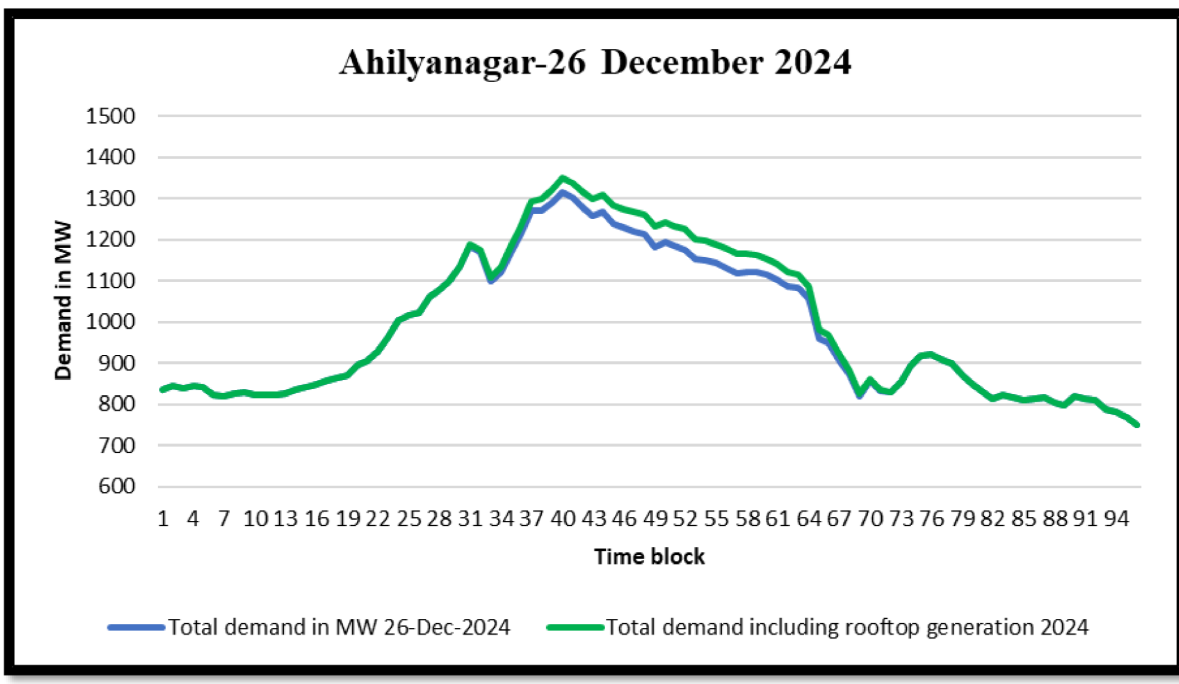


Figure 303: Rooftop Solar impact on Ahilyanagar peak demand day 26 December 2024

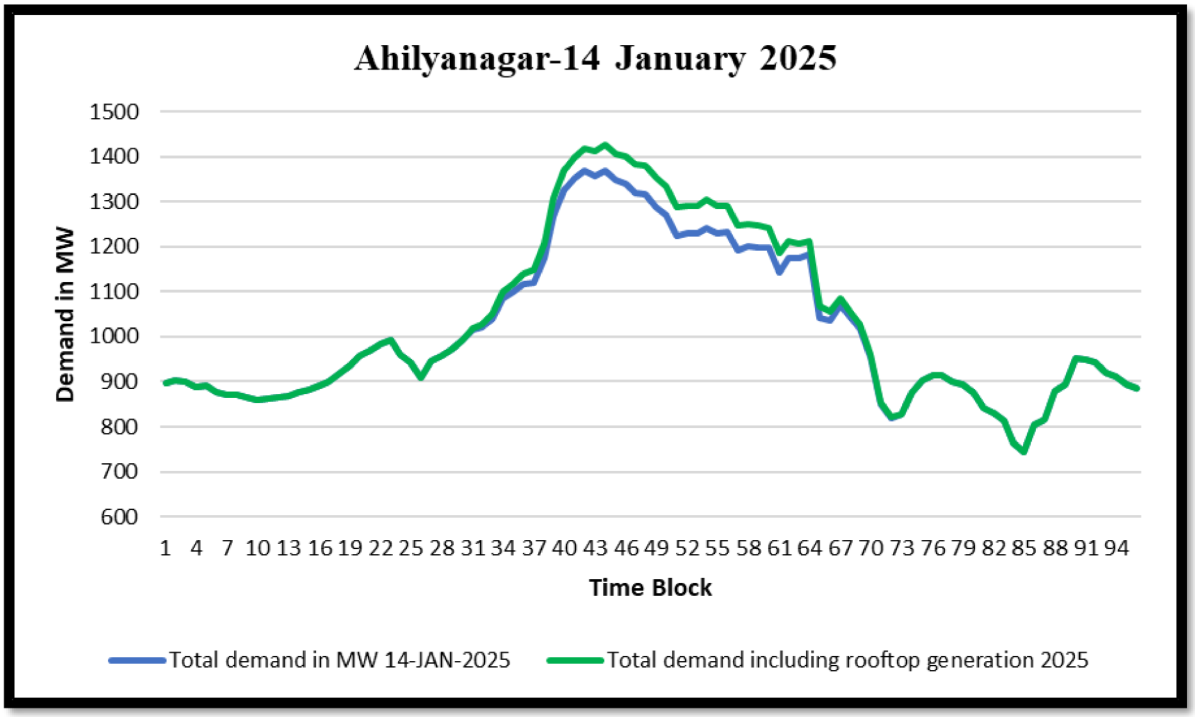


Figure 304: Rooftop Solar impact on Ahilyanagar peak demand day 14 January 2025

Summary

The above plots show the Peak demand days for Ahilyanagar over years 2022 to 2025. The table below gives statistical insights.

Observations:

Table 65: Rooftop Solar Impact on Peak Demand Days – Ahilyanagar

Parameter	2022	2023	2024	2025
Peak Demand Day	20th March 2022	28th December 2023	26th December 2024	14th January 2025
Time Blocks with Rooftop Impact	Blocks 40–65 (10:00 AM to 04:15 PM)	Blocks 38–64 (09:30 AM to 04:00 PM)	Blocks 37–66 (09:15 AM to 04:30 PM)	Blocks 40–65 (10:00 AM to 04:15 PM)
Peak	Peak of the day: 1275.91 MW at Block 24 (06:00 AM)	Peak of the day: 1291.66 MW at Block 41 (10:15 AM)	Peak of the day: 1316.07 MW at Block 40 (10:00 AM)	Peak of the day: 1369.99 MW at Block 44 (11:00 AM)
	Rooftop contribution: 0 MW	Rooftop contribution: 34.56 MW	Rooftop contribution: 33.26 MW	Rooftop contribution: 57.00 MW
Max Rooftop Generation	25.53 MW at Block 50 (12:30 PM),	44.25 MW at Block 50 (12:30 PM), when	50.09 MW at Block 48 (12:00 PM), when	65.11 MW at Block 50 (12:30 PM), when

Parameter	2022	2023	2024	2025
	when demand was1194.81 MW	demand was 1207.78 MW	demand was 1212.40 MW	demand was 1270.46 MW
Peak value (Demand +Rooftop generation)	Peak:1275 MW	Peak:1326.22 MW	Peak:1349.34 MW	Peak:1427.00 MW
	Time block:24	Time block:41	Time block:40	Time block:44
	Rooftop contribution:0 MW	Rooftop contribution: 34.56 MW	Rooftop contribution: 33.26 MW	Rooftop contribution: 57.00 MW
Average Demand (MW)	1038.16 MW	991.52 MW	981.65 MW	1016.98 MW
Average Rooftop Generation (MW)	6.63 MW	11.96 MW	13.59 MW	16.82 MW
Observation Summary	The peak value of peak demand day occurs at Time Block 24 during non-solar hours when rooftop solar contribution is zero. However, maximum rooftop generation is observed at Time Block 50, and the combined peak of demand and rooftop generation occurs at Time Block 24, indicating a potential shift in the peak demand time block, with rooftop solar providing significant support during solar hours.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 41, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 40, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 48 shows the possibility of a shift in the peak demand time block.	Rooftop solar has helped in peak shaving, as the peak value on the peak demand day occurs at Time Block 44, which is the same time block as the combined peak value (demand plus rooftop generation). Also, the maximum rooftop generation at Time Block 50 shows the possibility of a shift in the peak demand time block.

25. Hourly MSEDCL Energy and Distribution-Embedded Generation Impact

25.1 Introduction

This chapter illustrates the hourly MSEDCL energy profile and the impact of distribution-embedded generation. MSEDCL demand, including load-shedding quantum, is taken from the Daily System Report, and hourly energy is considered for the period from 1 January to 12 November for each year (2022–2025).

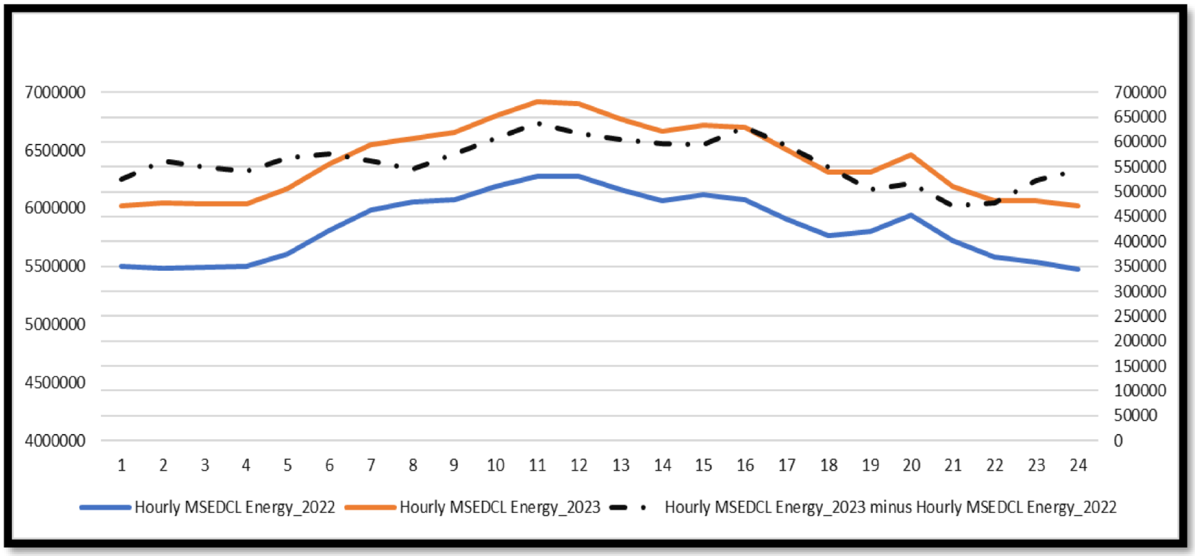


Figure 305: Hourly MSEDCL Energy (01.01.2022 to 12.11.2022) & (01.01.2023 to 12.11.2023)

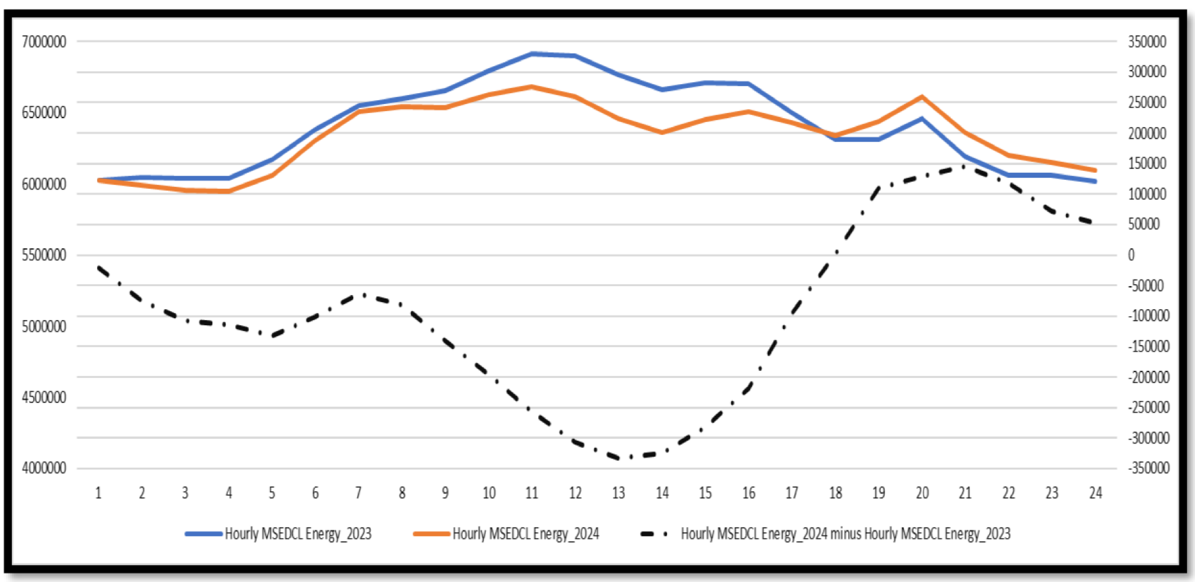


Figure 306: Hourly MSEDCL Energy (01.01.2023 to 12.11.2023) & (01.01.2024 to 12.11.2024)

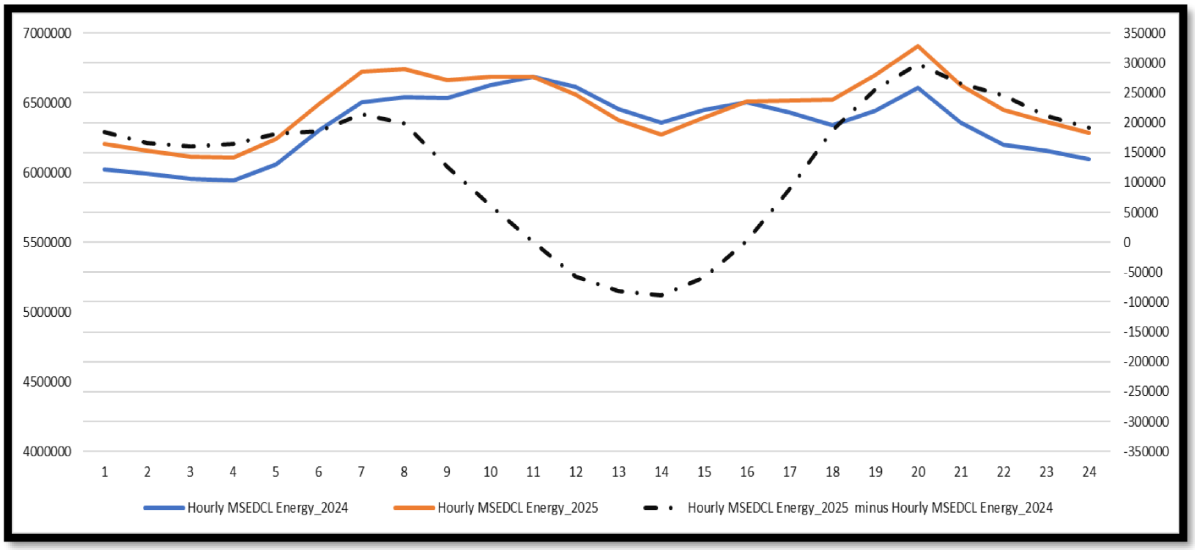


Figure 307: Hourly MSEDCL Energy (01.01.2024 to 12.11.2024) & (01.01.2025 to 12.11.2025)

Table 66: Hourly MSEDCL Energy in MWh (2022-2025)

Hours	Hourly MSEDCL Energy_2022 (MWh)	Hourly MSEDCL Energy_2023 (MWh)	Hourly MSEDCL Energy_2024 (MWh)	Hourly MSEDCL Energy_2025 (MWh)
1	5498499.52	6024112.96	6023941.23	6208281.17
2	5483445.21	6046158.01	5992017.20	6157782.34
3	5489186.96	6039581.23	5952726.56	6112905.92
4	5497650.97	6039249.19	5945682.57	6110139.66
5	5604896.46	6172970.54	6061797.64	6242914.49
6	5808507.36	6384628.48	6305906.53	6492154.40
7	5984966.91	6547758.36	6507041.66	6721573.73
8	6054038.17	6598830.99	6540217.26	6738938.93
9	6075451.53	6652341.68	6535946.14	6662600.44
10	6189914.05	6796593.87	6624413.58	6685936.84
11	6278756.13	6916969.32	6685281.08	6686183.30
12	6279606.04	6896516.39	6614232.30	6556425.40
13	6161138.80	6767009.70	6457543.15	6376206.66
14	6064517.91	6661810.70	6358817.61	6270424.32
15	6116041.06	6711674.87	6451853.52	6392741.74
16	6071394.78	6700824.16	6505413.55	6508105.93
17	5909896.98	6502138.14	6428616.84	6518478.75
18	5763806.73	6313196.41	6337112.46	6525008.57
19	5804028.56	6309235.01	6440728.85	6696549.17
20	5941144.15	6457871.66	6609464.12	6908157.49

Hours	Hourly MSEDCL Energy_2022 (MWh)	Hourly MSEDCL Energy_2023 (MWh)	Hourly MSEDCL Energy_2024 (MWh)	Hourly MSEDCL Energy_2025 (MWh)
21	5718239.34	6190292.59	6357548.17	6623225.42
22	5583463.82	6061962.18	6200561.96	6446620.28
23	5537241.96	6060423.19	6153837.21	6365014.89
24	5478904.31	6021385.32	6094936.93	6285870.07

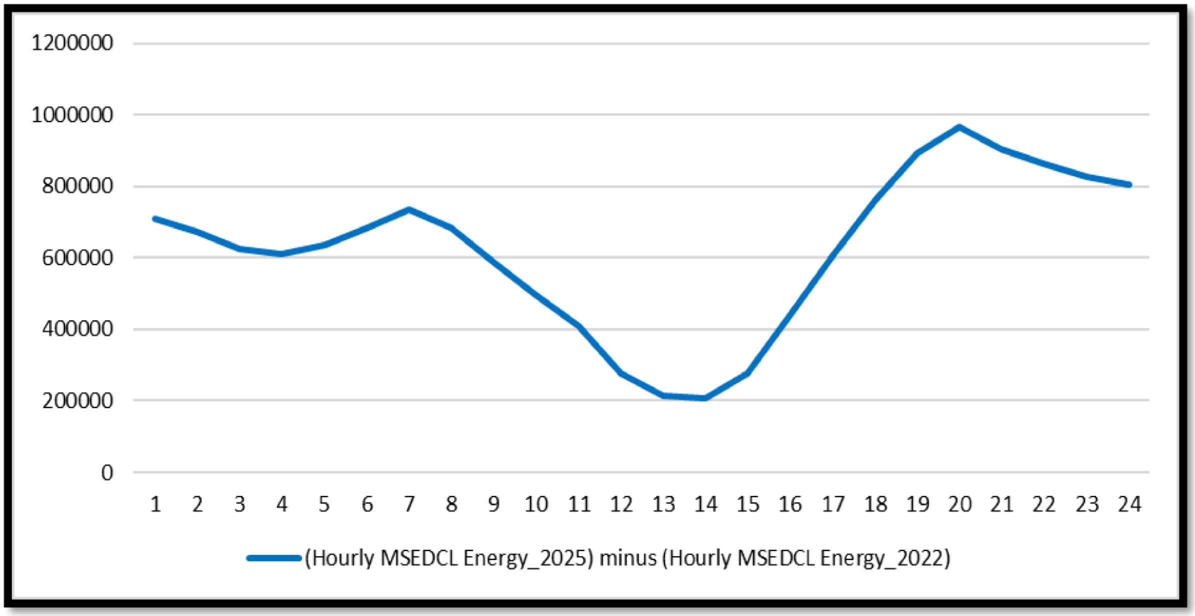


Figure 308: Difference profile of Hourly MSEDCL Energy_2025 and Hourly MSEDCL Energy_2022

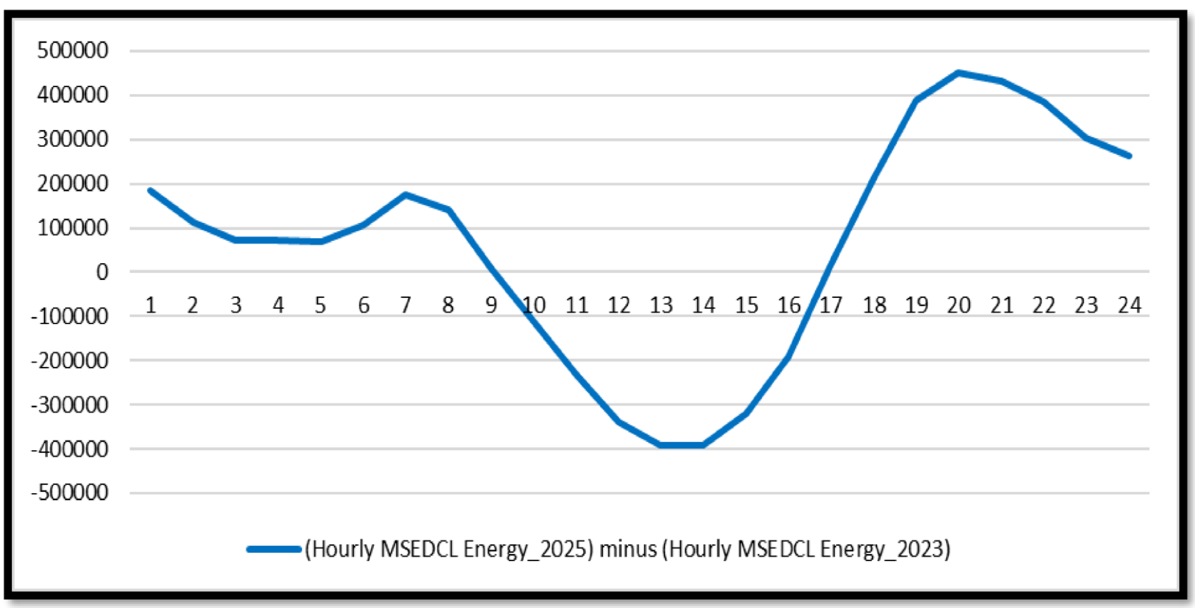


Figure 309: Difference profile of Hourly MSEDCL Energy_2025 and Hourly MSEDCL Energy_2023

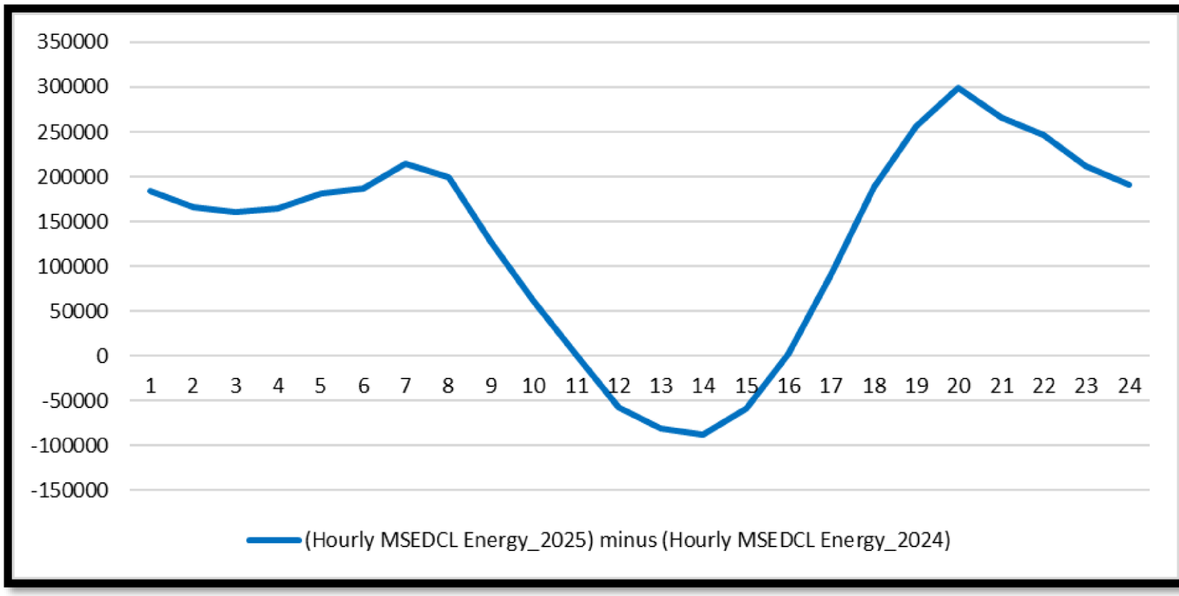


Figure 310: Difference profile of Hourly MSEDCL Energy_2025 and Hourly MSEDCL Energy_2024

25.2 Observations and Analysis

Analysis of hourly MSEDCL energy drawal for the period 2022–2025, as presented in Figures 305 to 310 and Table 66, highlights both sustained growth in electricity demand and emerging structural changes in the way this demand is supplied through the distribution network.

Overall, hourly energy supplied by MSEDCL shows an increasing trend across most hours of the day, indicating continued growth in underlying electricity demand. However, this growth is not uniform across the diurnal cycle. The increase in energy drawal is more pronounced during early morning, evening, and night-time hours, whereas daytime (solar-hour) growth is comparatively moderated.

The difference profiles comparing 2025 with earlier years reveal an important emerging feature. During several daytime hours, particularly in comparisons with 2022 and 2023, negative growth in grid-supplied energy is observed. This indicates that the energy drawn from the distribution system during these hours in 2025 is lower than in the corresponding hours of earlier years, despite overall growth in electricity consumption.

This behaviour is attributable to the increasing contribution of distribution-embedded generation, which supplies a portion of daytime demand locally and reduces the requirement for grid drawal. During the period of observation, rooftop solar constituted the dominant share of distribution-embedded generation, and therefore its impact is most clearly reflected in the hourly energy profiles. In parallel, agricultural solar feeder schemes such as **MSKVY 2.0** have also begun contributing to daytime energy supply at the distribution level. Although the volume of MSKVY 2.0 generation during the study period was lower than rooftop solar, its emerging presence forms part of the broader moderation observed during solar hours.

The presence of negative growth during solar hours does not indicate a reduction in actual electricity consumption. Instead, it reflects a shift in the source of supply, with a growing share of demand being met within the distribution network rather than through grid drawal. This interpretation is supported by the continued positive growth during non-solar hours, particularly in the evening and night-time periods, when distribution-embedded solar generation is unavailable.

Despite the increasing contribution from distribution-embedded generation, the total daily energy supplied through MSEDCL continues to increase, indicating that embedded generation is offsetting only a part of the underlying demand growth rather than reversing it. This coexistence of rising overall energy consumption with moderated or negative growth during solar hours highlights a structural change in demand visibility at the distribution and transmission interfaces.

This points to a gradual reshaping of the hourly demand profile, with flatter daytime drawal and increasing contrast between solar and non-solar hours. As the scale of rooftop solar and agricultural solar feeder generation under MSKVY 2.0 increases in future years, these effects are expected to become more pronounced. This underscores the importance of continued, consistent hourly and time-block-based monitoring to track evolving demand behaviour and to support informed decisions in both distribution and transmission system planning.

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26. 3-D Surface plots of 12 districts (2022-2025)

26.1 Introduction

The energy consumption analysis for the period 2022–2024 identifies **Pune, Thane, Mumbai Suburban, Raigad, and Nashik as the five districts with highest energy consumption (measured in MUs)**.

Additionally, the **10 districts in terms of highest rooftop solar adoption** include: **Pune, Nagpur, Nashik, Chhatrapati Sambhajinagar, Jalgaon, Thane, Kolhapur, Amravati, Solapur, and Ahilyanagar**.

To visualize these trends, **3D surfaces plots have been generated**, showcasing time-block-wise energy consumption patterns and demand variations across these districts. These plots provide a clear representation of peak load behaviour, demand intensity, and the impact of distributed solar generation over time.

The table below shows the 10 districts in terms of highest energy consumption and rooftop solar capacity, along with the districts that are common in both categories.

Table 67: 10 districts in terms of highest energy consumption & rooftop solar capacity

Ten districts with the highest energy consumption	Ten districts with the highest rooftop solar capacity	Common districts in both categories
Pune	Pune	Pune
Thane	Nagpur	Nagpur
Mumbai suburban	Nashik	Nashik
Raigad	Chhatrapati Sambhajinagar	Chhatrapati Sambhajinagar
Nashik	Jalgaon	Thane
Solapur	Thane	Solapur
Ahilyanagar	Kolhapur	Ahilyanagar
Palghar	Amravati	
Nagpur	Solapur	
Chhatrapati Sambhajinagar	Ahilyanagar	

26.2 Pune

26.2.1 Pune- Annual Energy Consumption Profile 2022

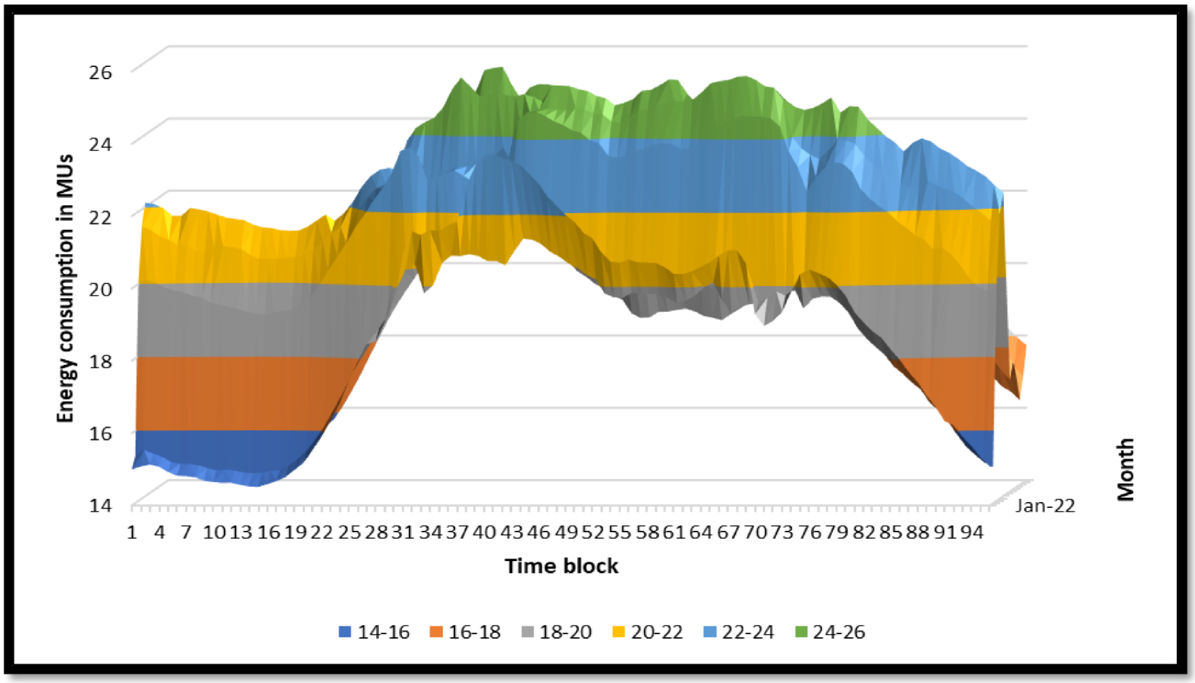

Figure 311: Annual Energy Consumption Profile – Pune 2022

26.2.2 Pune- Annual Energy Consumption Profile 2023

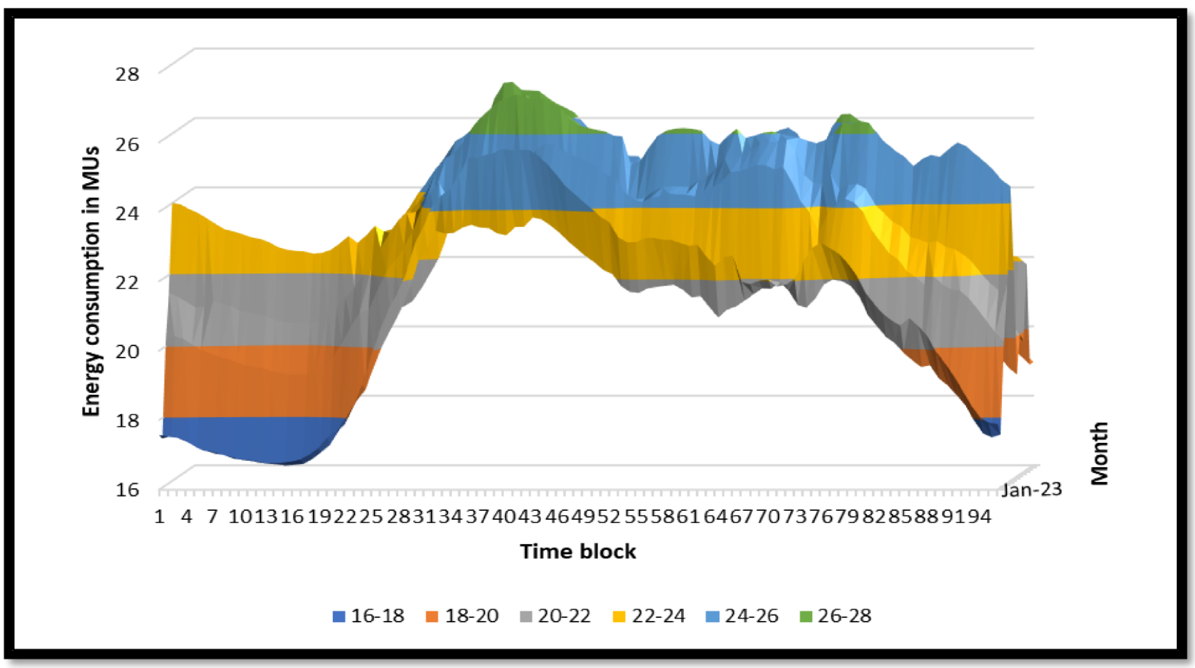

Figure 312: Annual Energy Consumption Profile – Pune 2023

26.2.3 Pune- Annual Energy Consumption Profile 2024

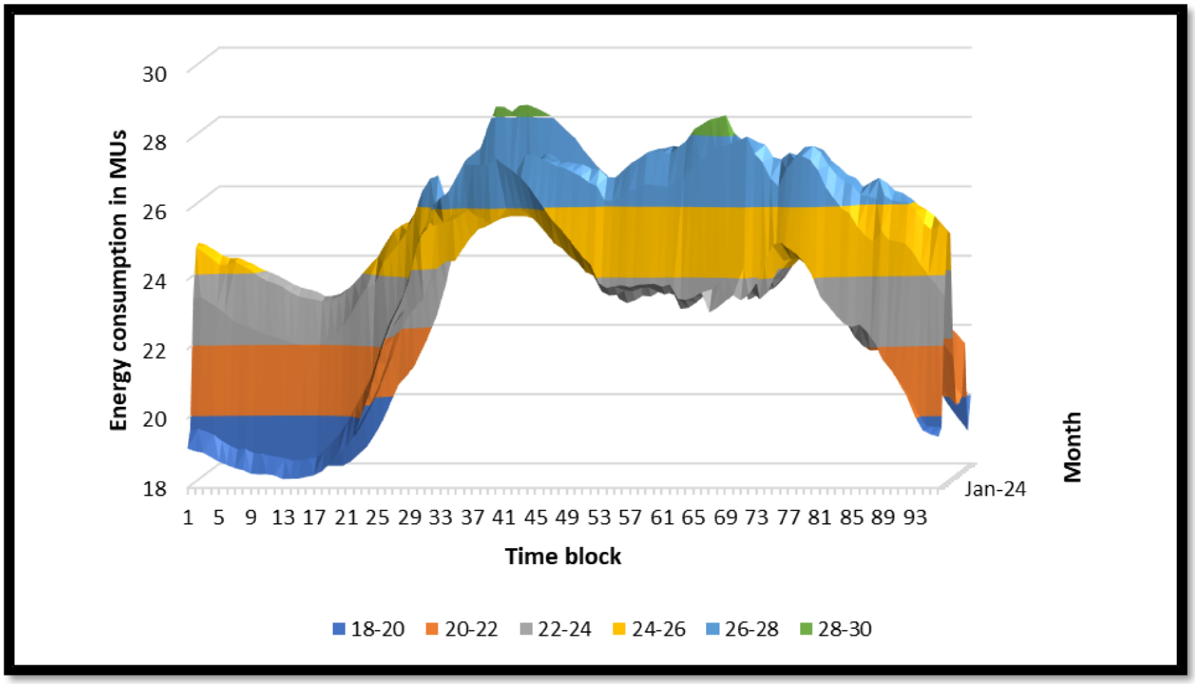

Figure 313: Annual Energy Consumption Profile – Pune 2024

26.3 Nashik

26.3.1 Nashik- Annual Energy Consumption Profile 2022

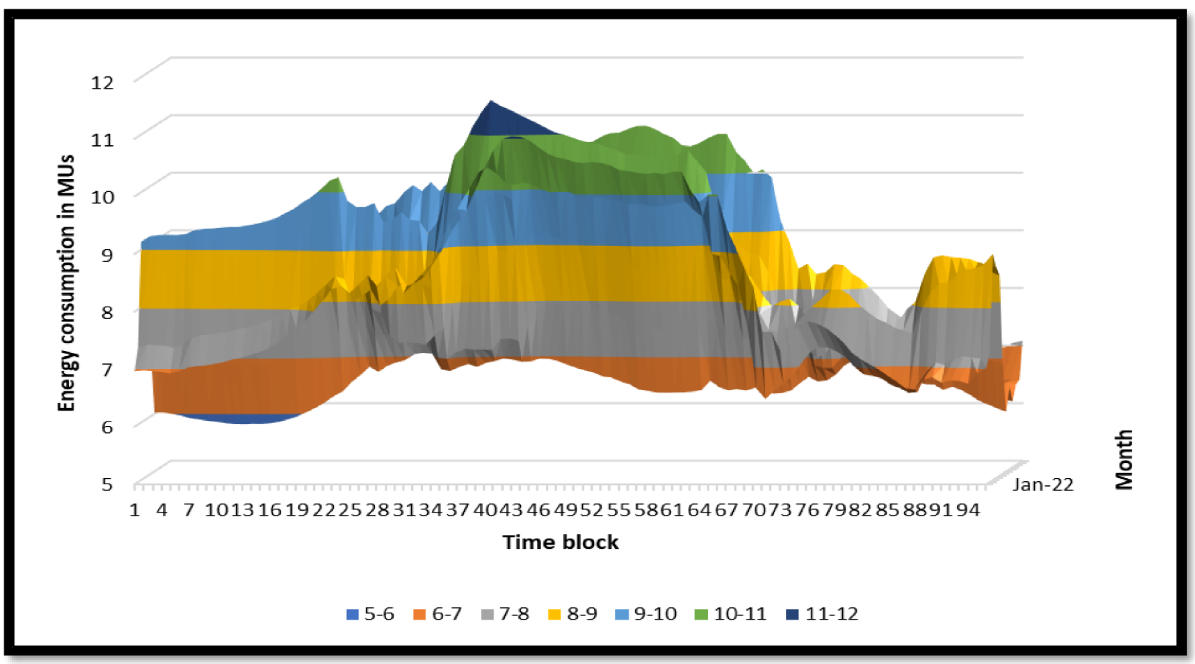

Figure 314: Annual Energy Consumption Profile – Nashik 2022

26.3.2 Nashik- Annual Energy Consumption Profile 2023

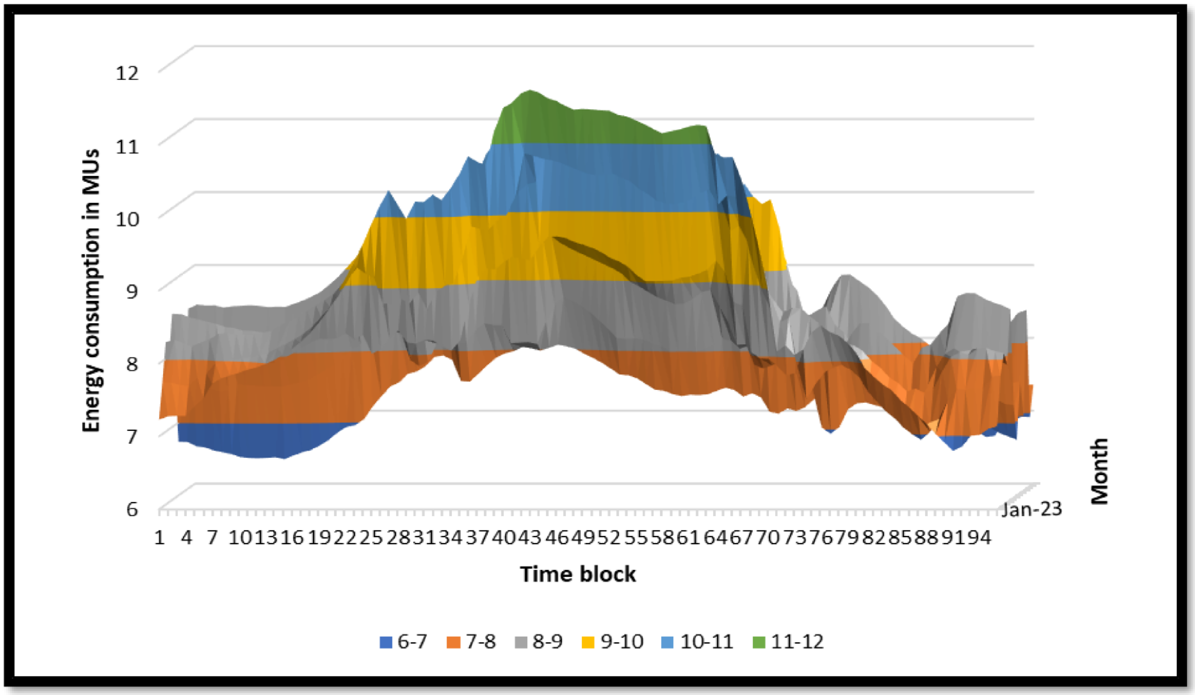

Figure 315: Annual Energy Consumption Profile – Nashik 2023

26.3.3 Nashik- Annual Energy Consumption Profile 2024

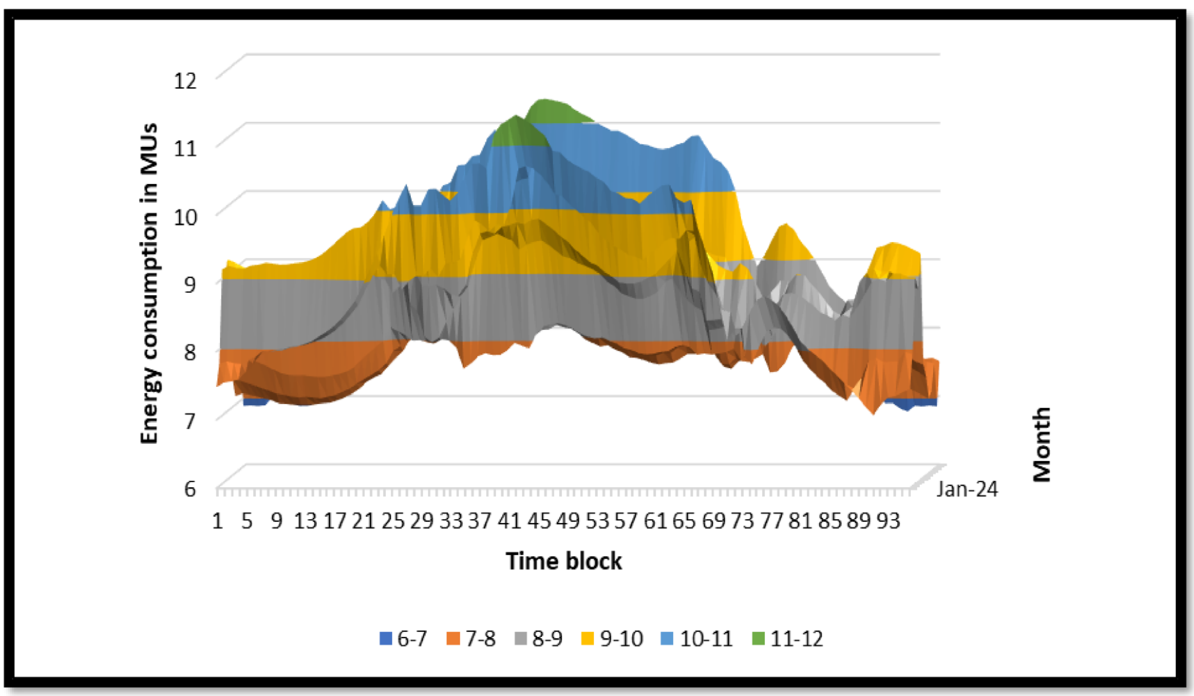

Figure 316: Annual Energy Consumption Profile – Nashik 2024

26.4 Thane

26.4.1 Thane- Annual Energy Consumption Profile 2022

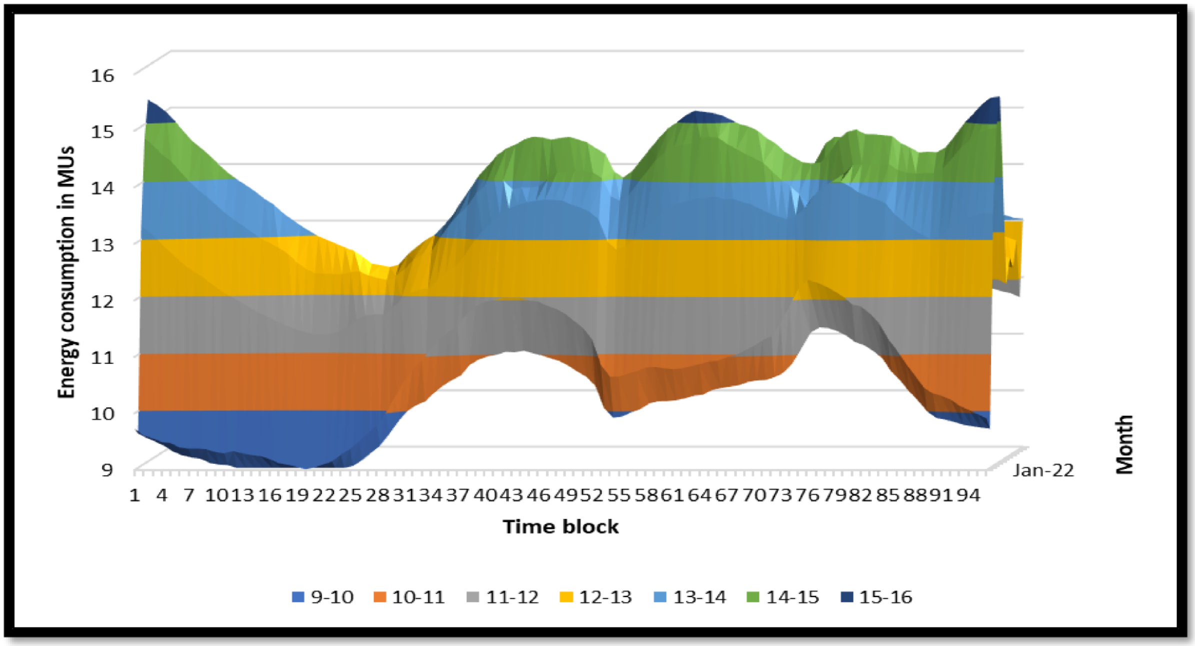

Figure 317: Annual Energy Consumption Profile – Thane 2022

26.4.2 Thane- Annual Energy Consumption Profile 2023

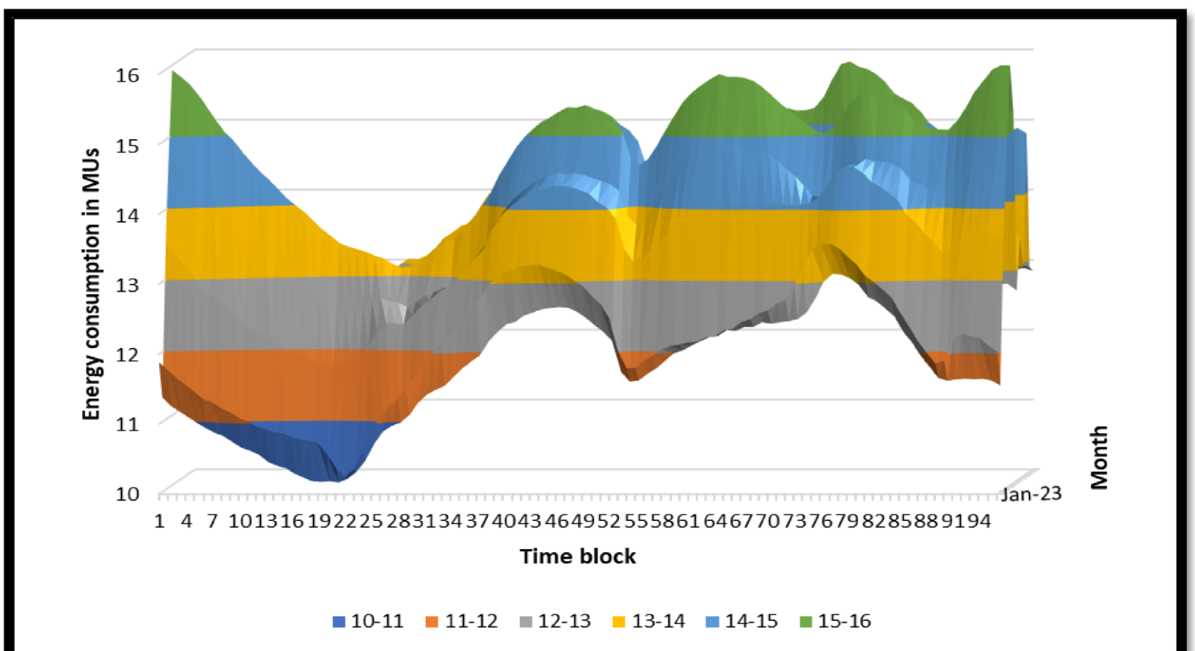

Figure 318: Annual Energy Consumption Profile – Thane 2023

26.4.3 Thane- Annual Energy Consumption Profile 2024

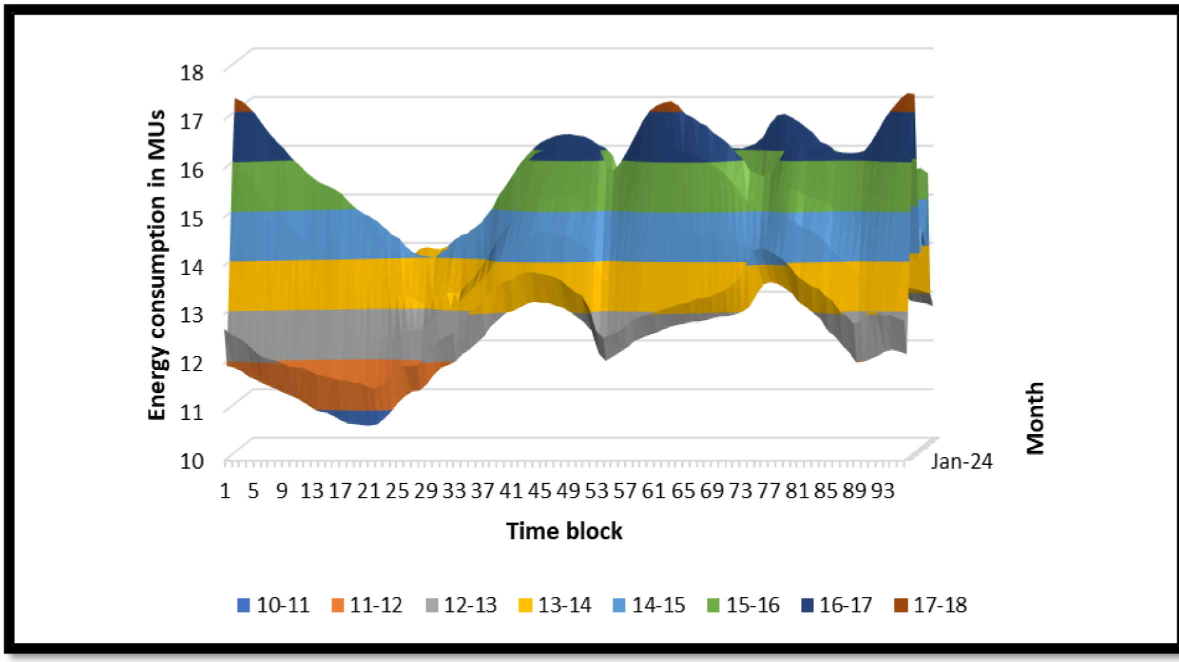

Figure 319: Annual Energy Consumption Profile – Thane 2024

26.5 Mumbai Suburban

26.5.1 Mumbai Suburban- Annual Energy Consumption Profile 2022

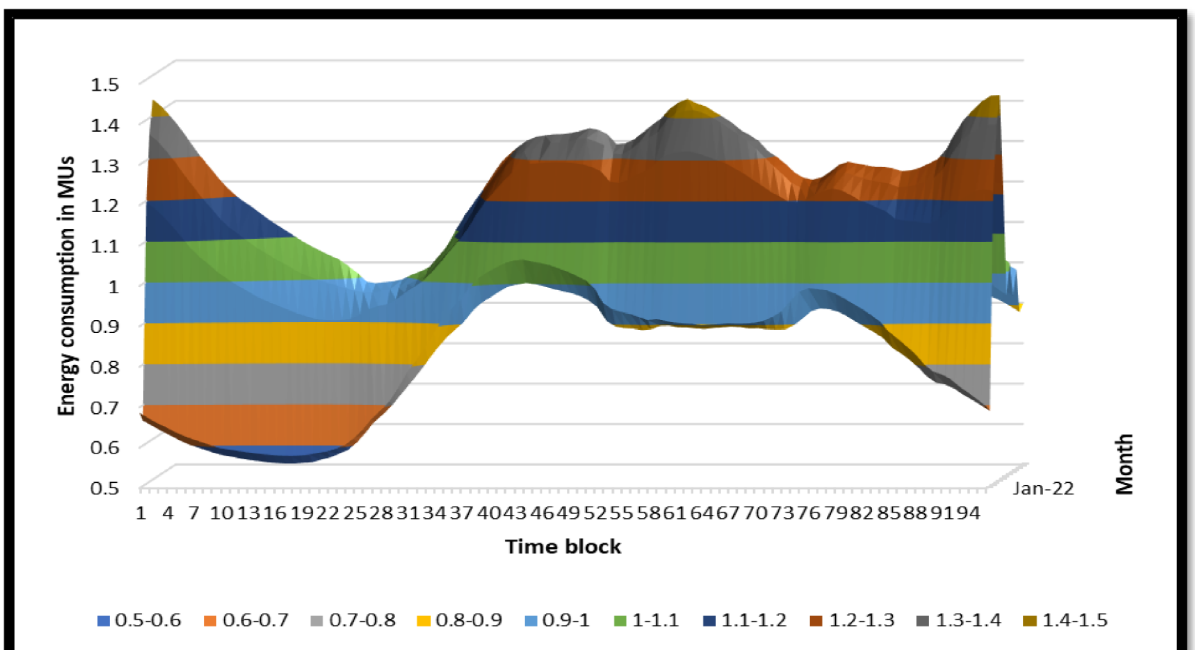

Figure 320: Annual Energy Consumption Profile – Mumbai suburban 2022

26.5.2 Mumbai Suburban - Annual Energy Consumption Profile 2023

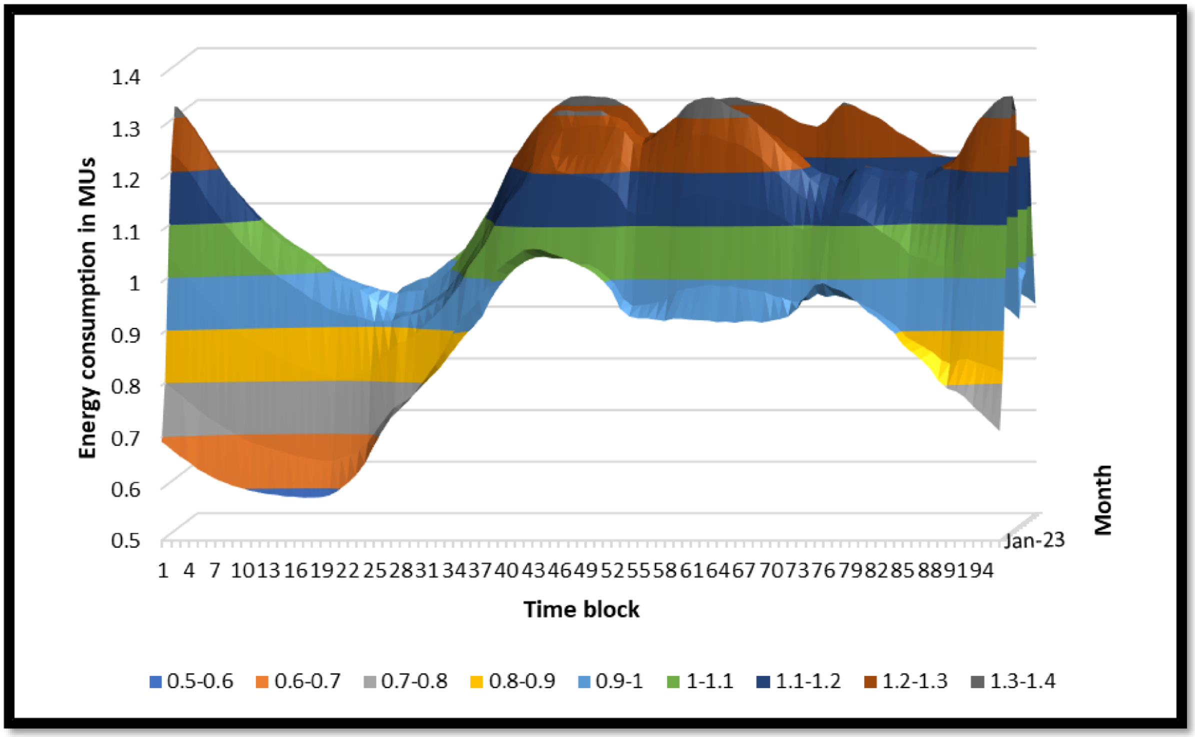

Figure 321: Annual Energy Consumption Profile – Mumbai suburban 2023

26.5.3 Mumbai Suburban - Annual Energy Consumption Profile 2024

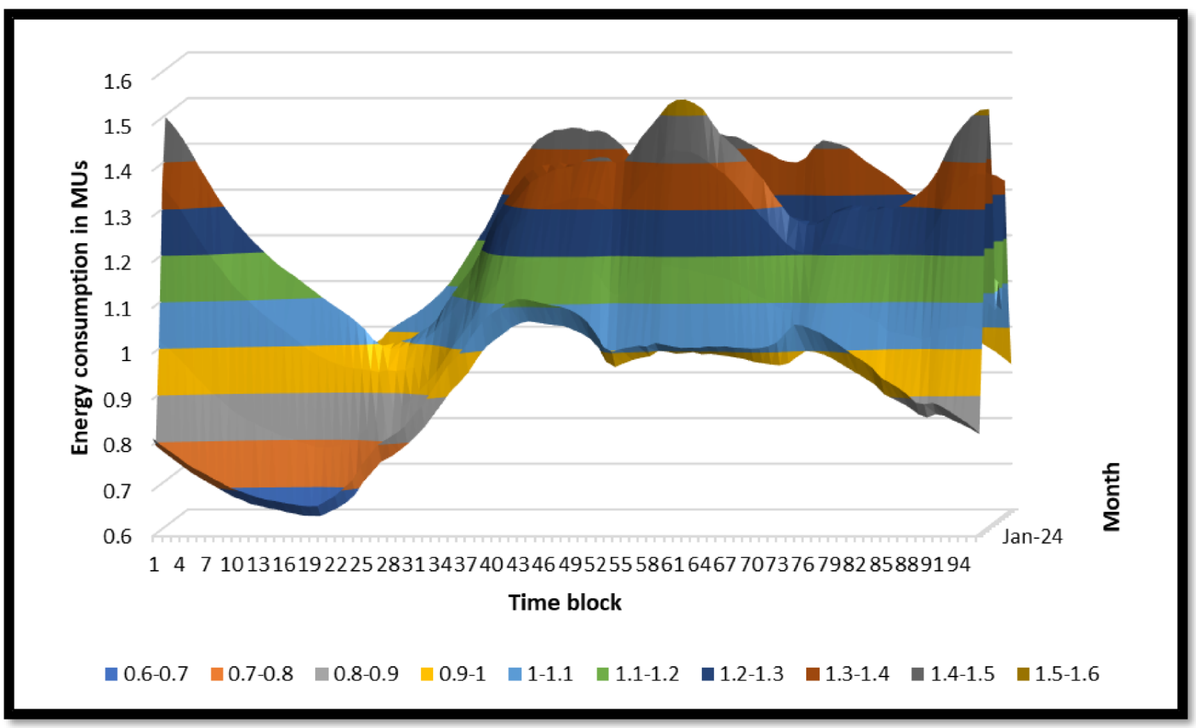

Figure 322: Annual Energy Consumption Profile – Mumbai suburban 2024

26.6 Raigad

26.6.1 Raigad- Annual Energy Consumption Profile 2022

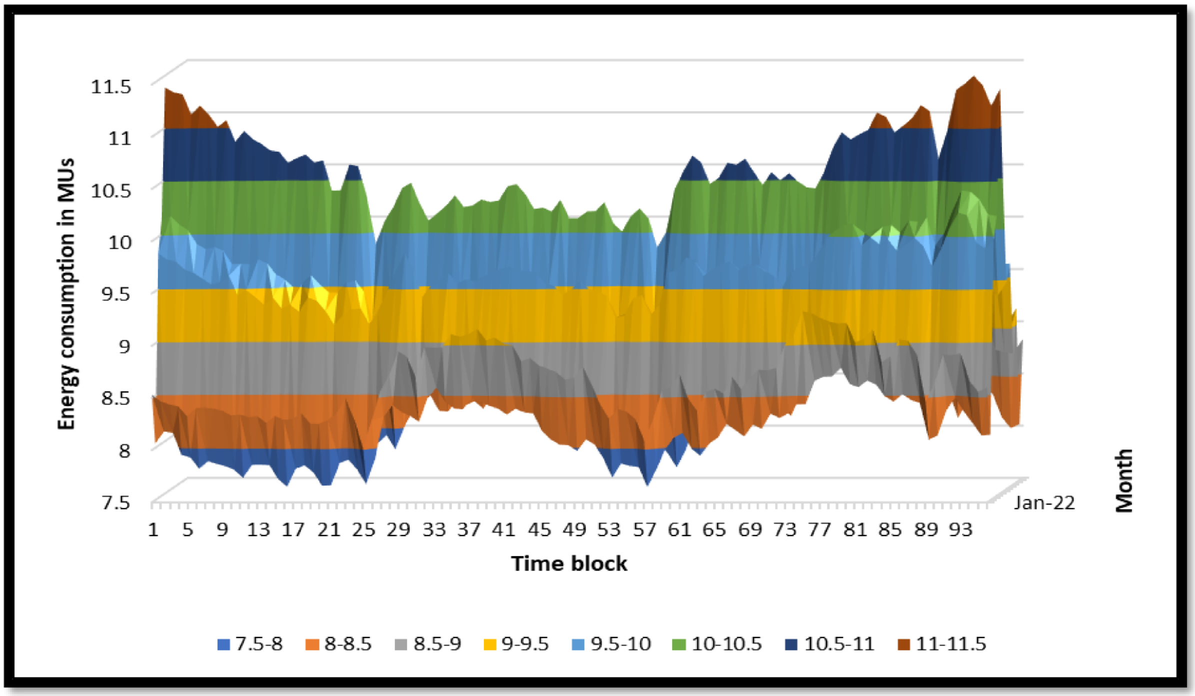

Figure 323: Annual Energy Consumption Profile – Raigad 2022

26.6.2 Raigad- Annual Energy Consumption Profile 2023

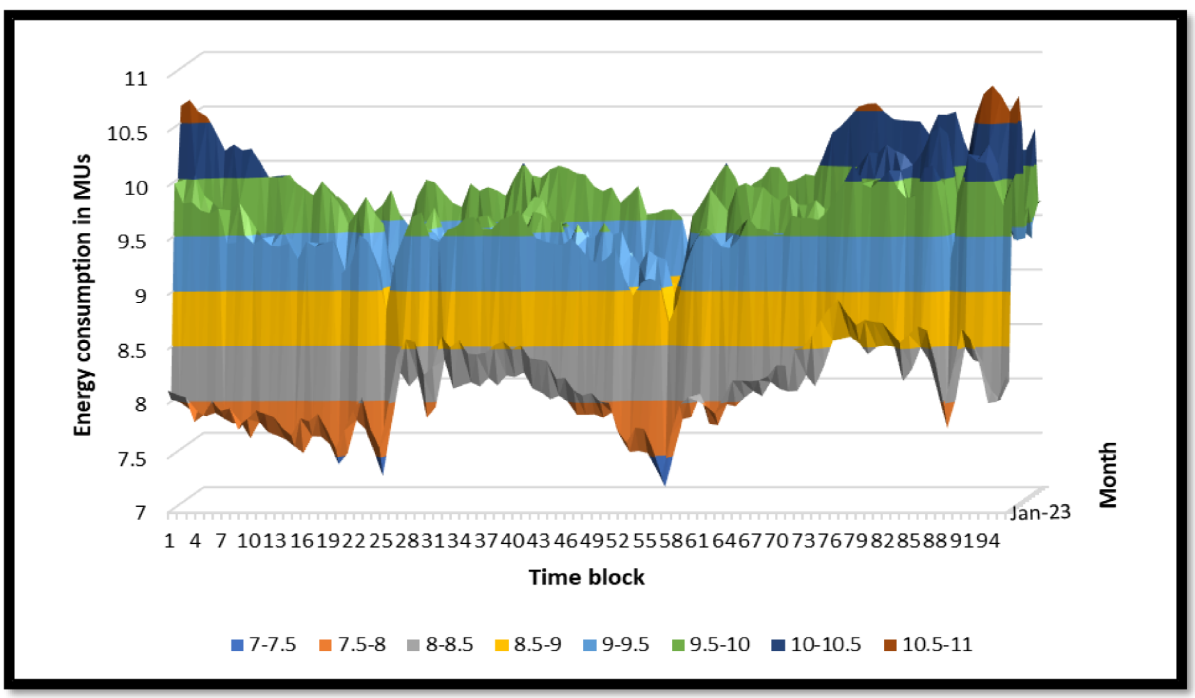

Figure 324: Annual Energy Consumption Profile – Raigad 2023

26.6.3 Raigad- Annual Energy Consumption Profile 2024

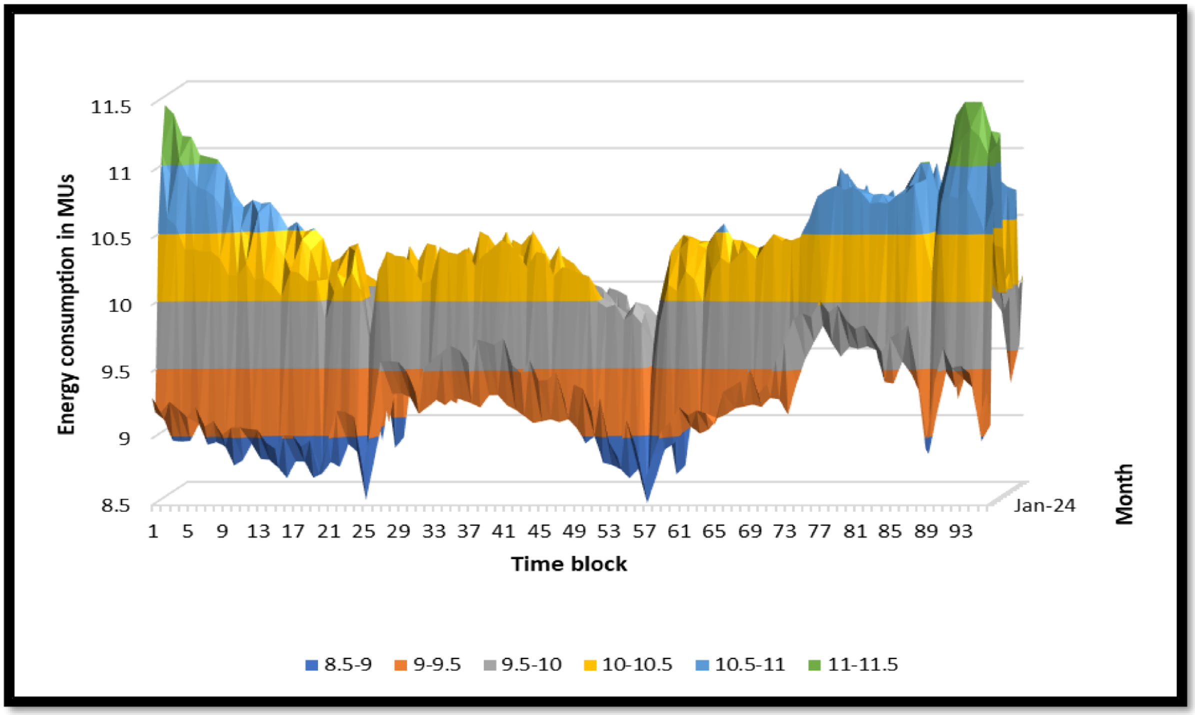

Figure 325: Annual Energy Consumption Profile – Raigad 2024

26.7 Ch. Sambhajinagar

26.7.1 Ch. Sambhajinagar- Annual Energy Consumption Profile 2022

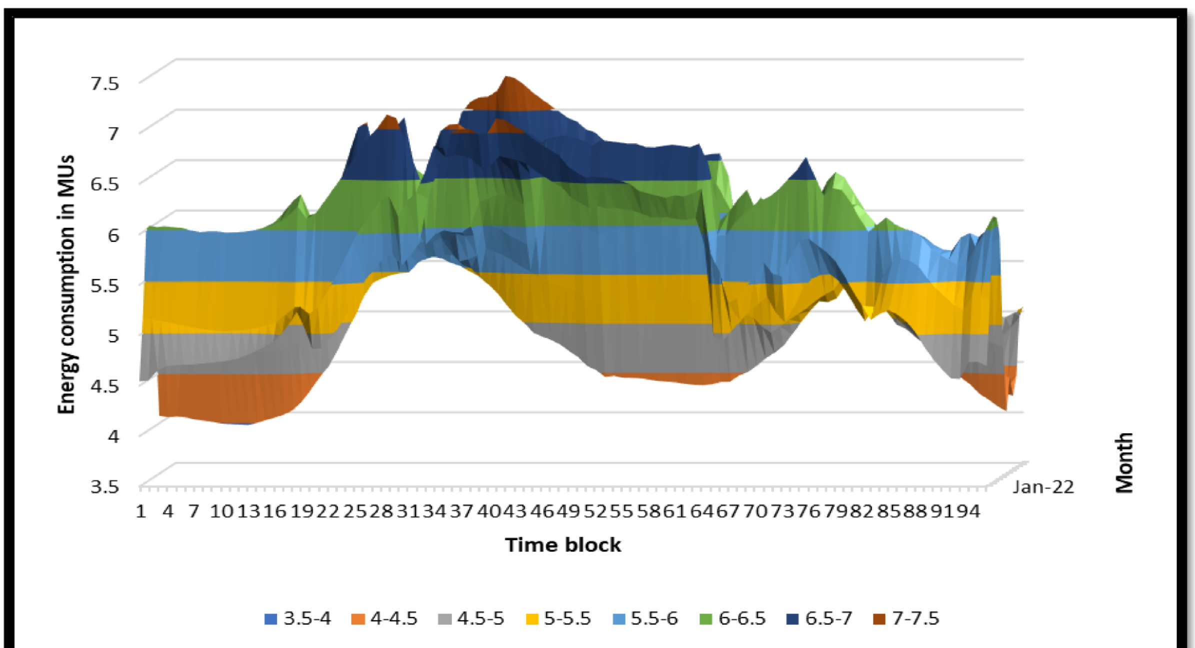

Figure 326: Annual Energy Consumption Profile – Ch. Sambhajinagar 2022

26.7.2 Ch. Sambhajinagar - Annual Energy Consumption Profile 2023

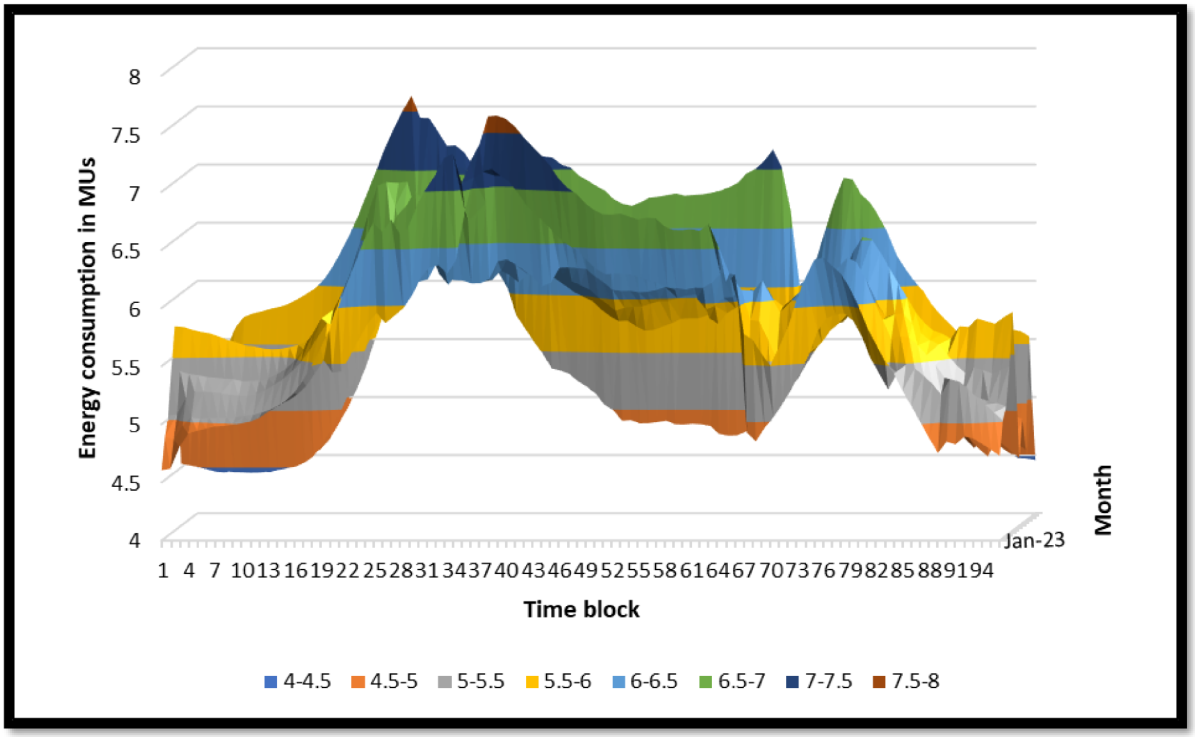

Figure 327: Annual Energy Consumption Profile – Ch. Sambhajinagar 2023

26.7.3 Ch. Sambhajinagar - Annual Energy Consumption Profile 2024

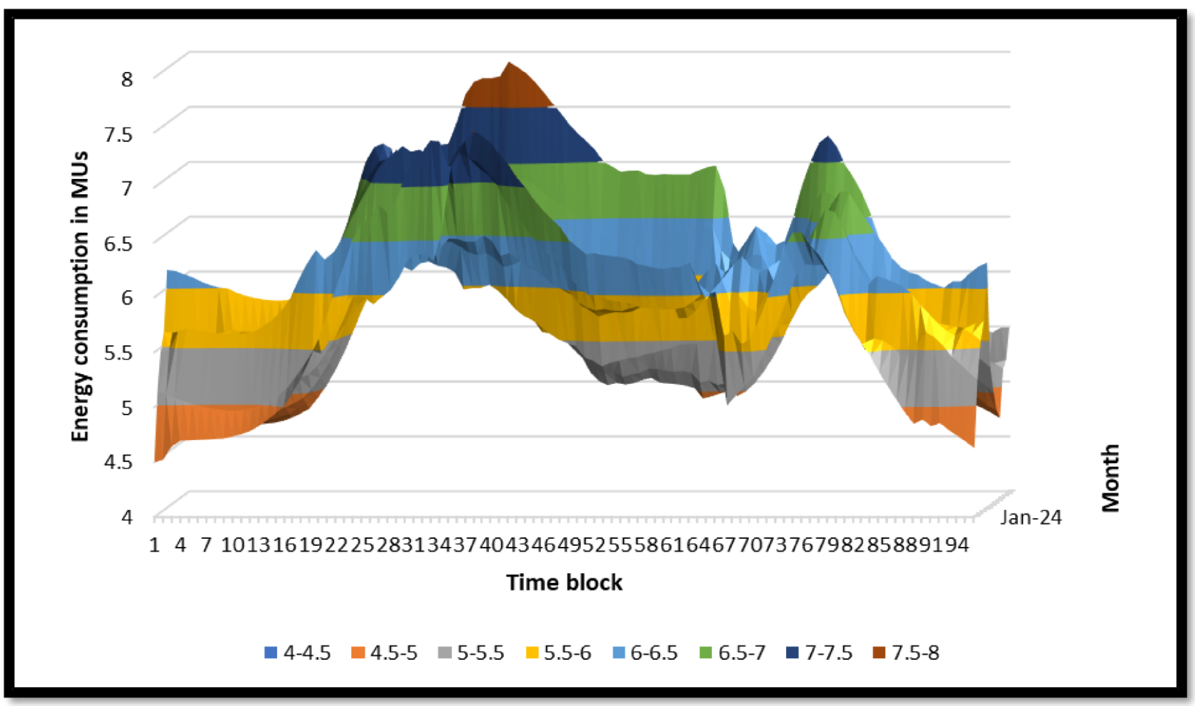

Figure 328: Annual Energy Consumption Profile – Ch. Sambhajinagar 2024

26.8 Jalgaon

26.8.1 Jalgaon- Annual Energy Consumption Profile 2022

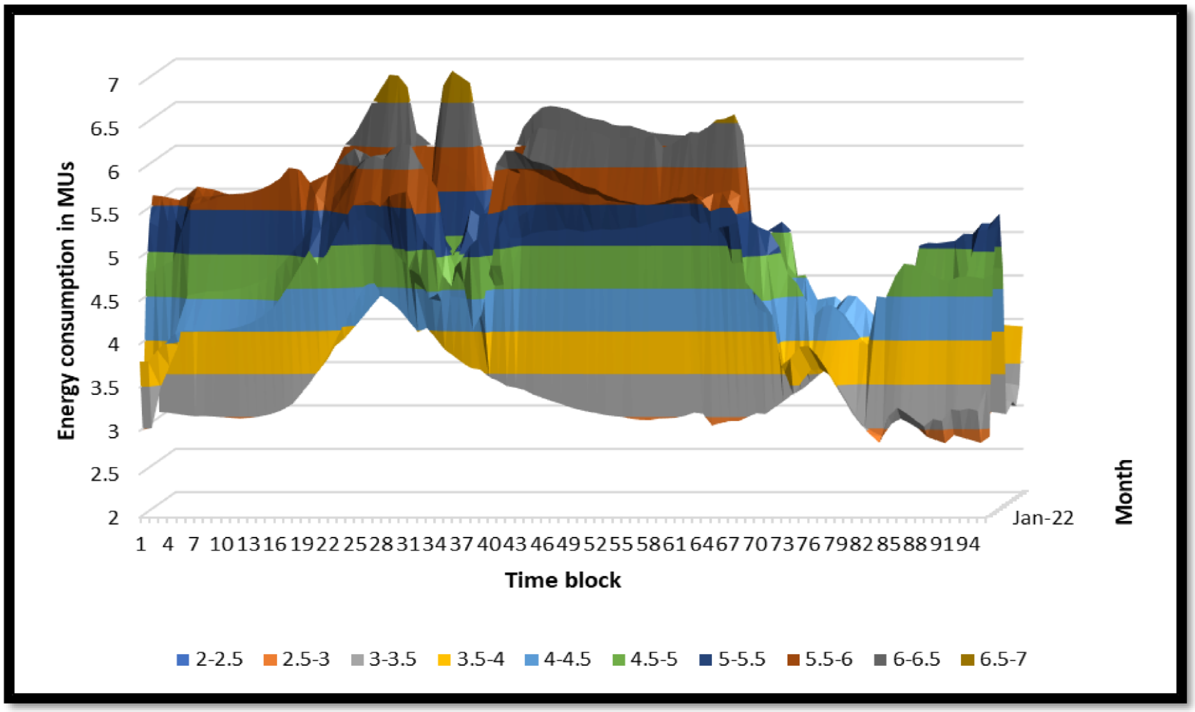

Figure 329: Annual Energy Consumption Profile – Jalgaon 2022

26.8.2 Jalgaon - Annual Energy Consumption Profile 2023

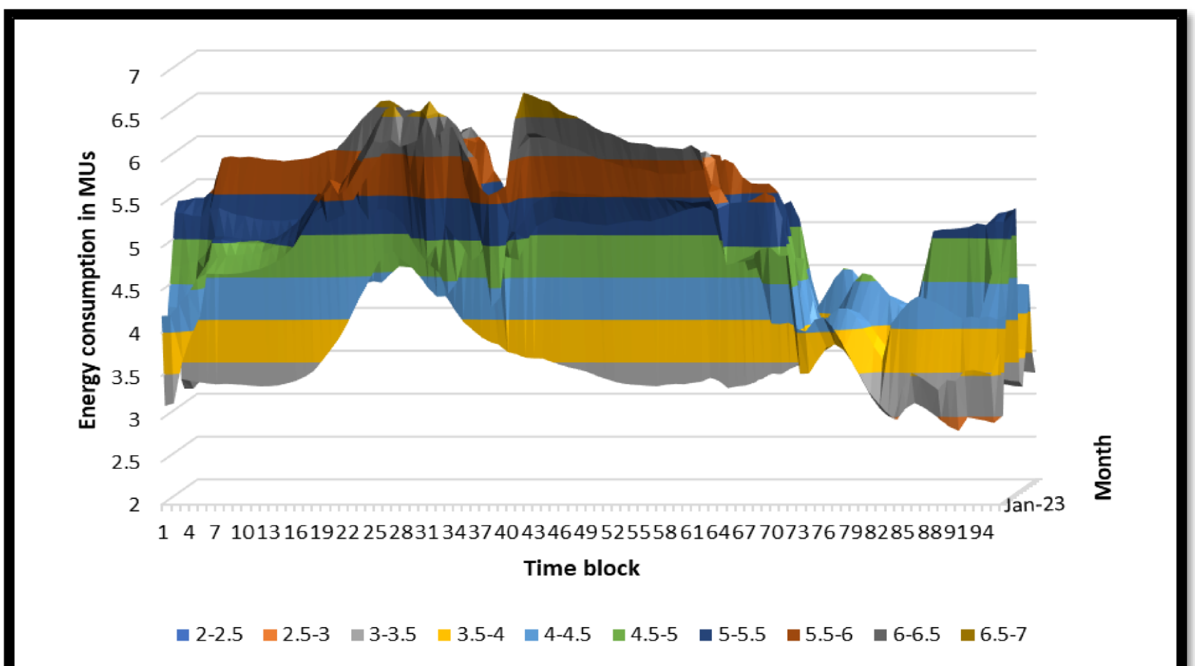

Figure 330: Annual Energy Consumption Profile – Jalgaon 2023

26.8.3 Jalgaon - Annual Energy Consumption Profile 2024

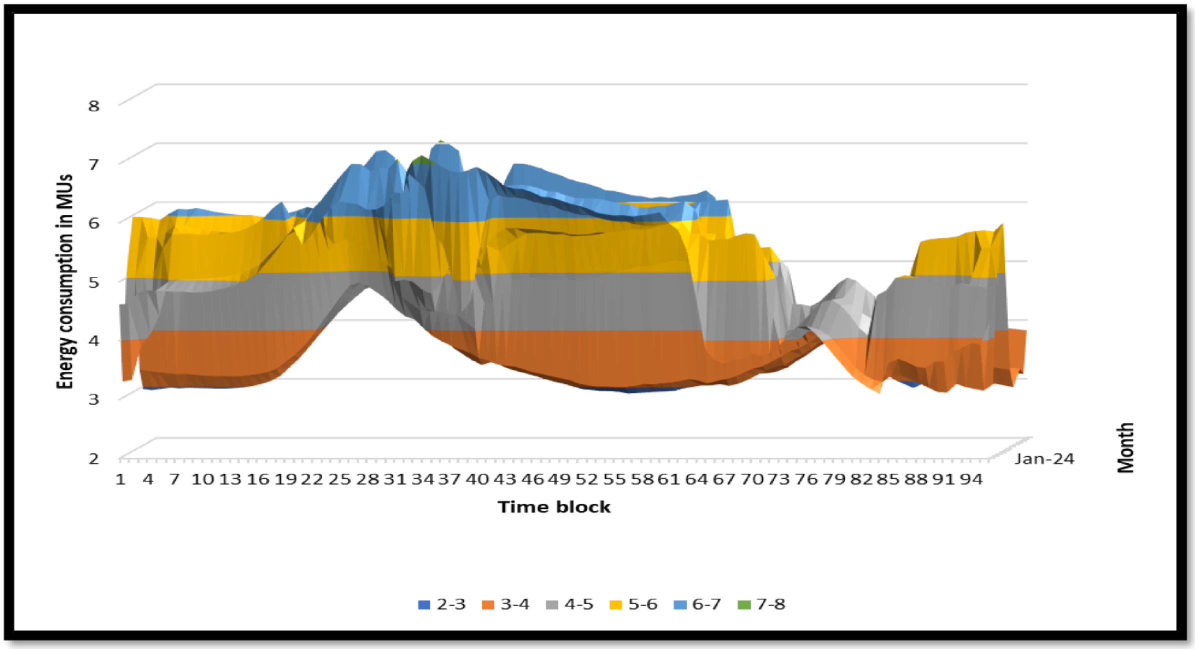

Figure 331: Annual Energy Consumption Profile – Jalgaon 2024

26.9 Kolhapur

26.9.1 Kolhapur- Annual Energy Consumption Profile 2022

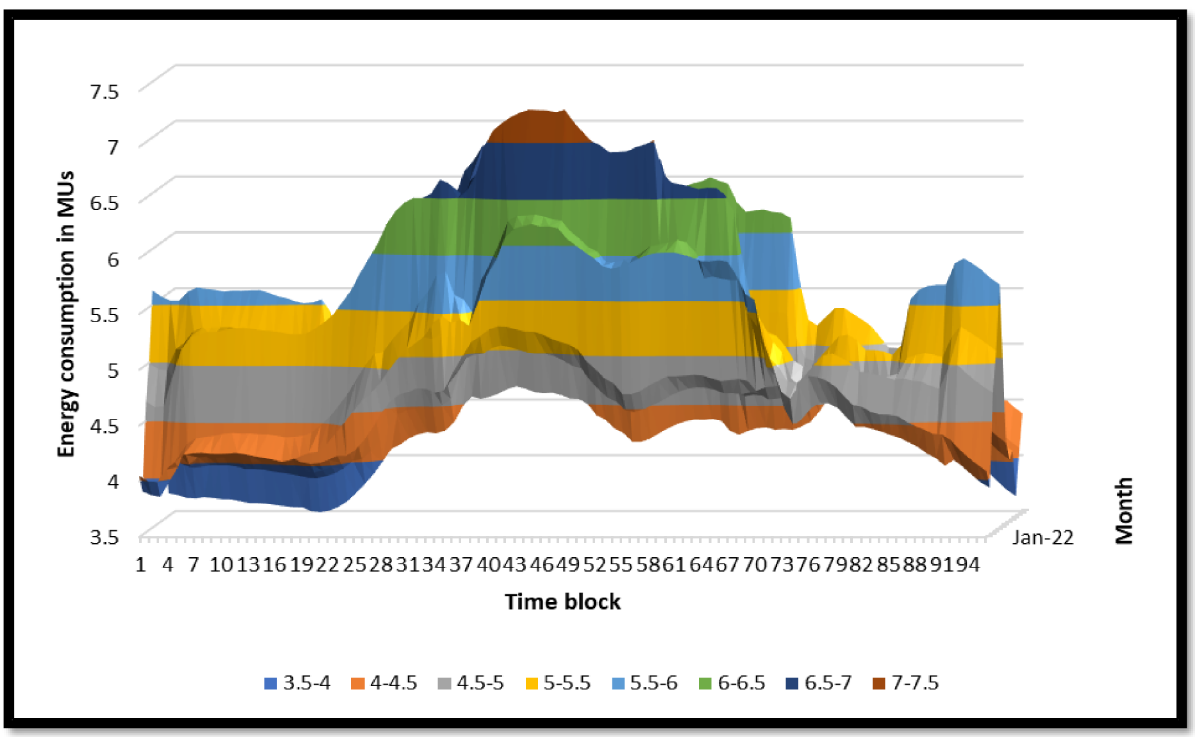

Figure 332: Annual Energy Consumption Profile – Kolhapur 2022

26.9.2 Kolhapur - Annual Energy Consumption Profile 2023

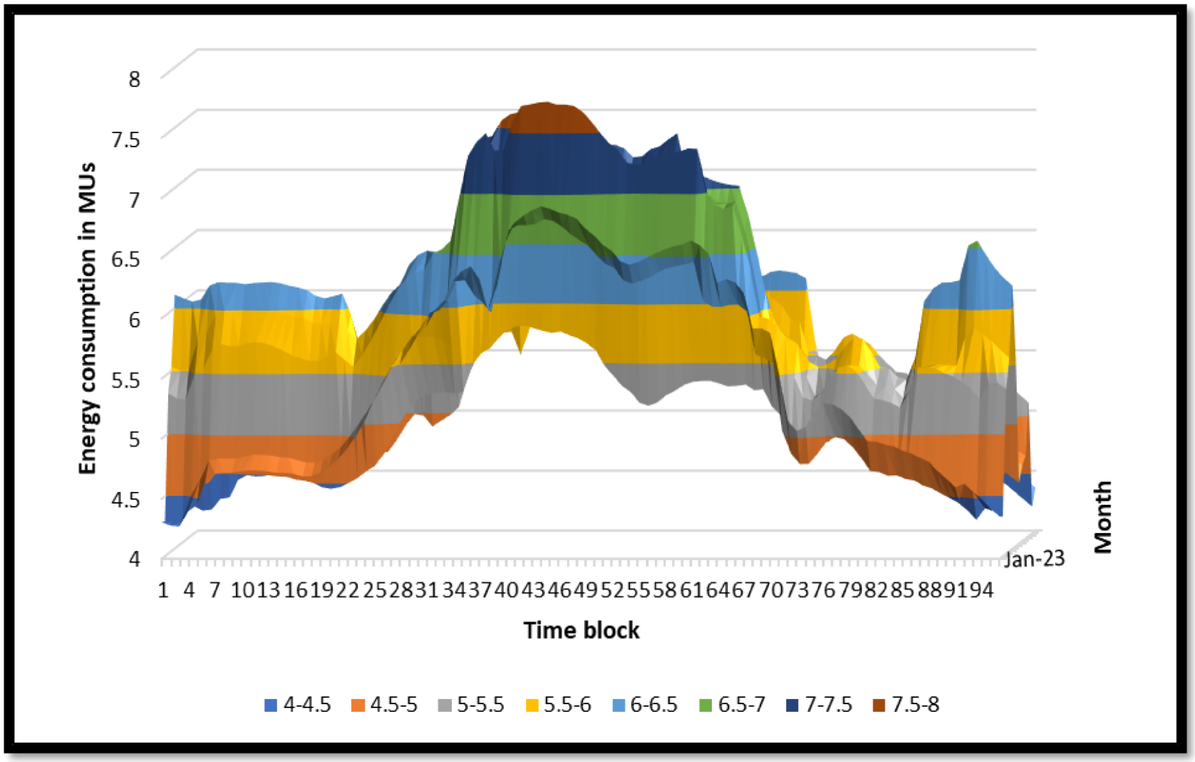

Figure 333: Annual Energy Consumption Profile – Kolhapur 2023

26.9.3 Kolhapur - Annual Energy Consumption Profile 2024

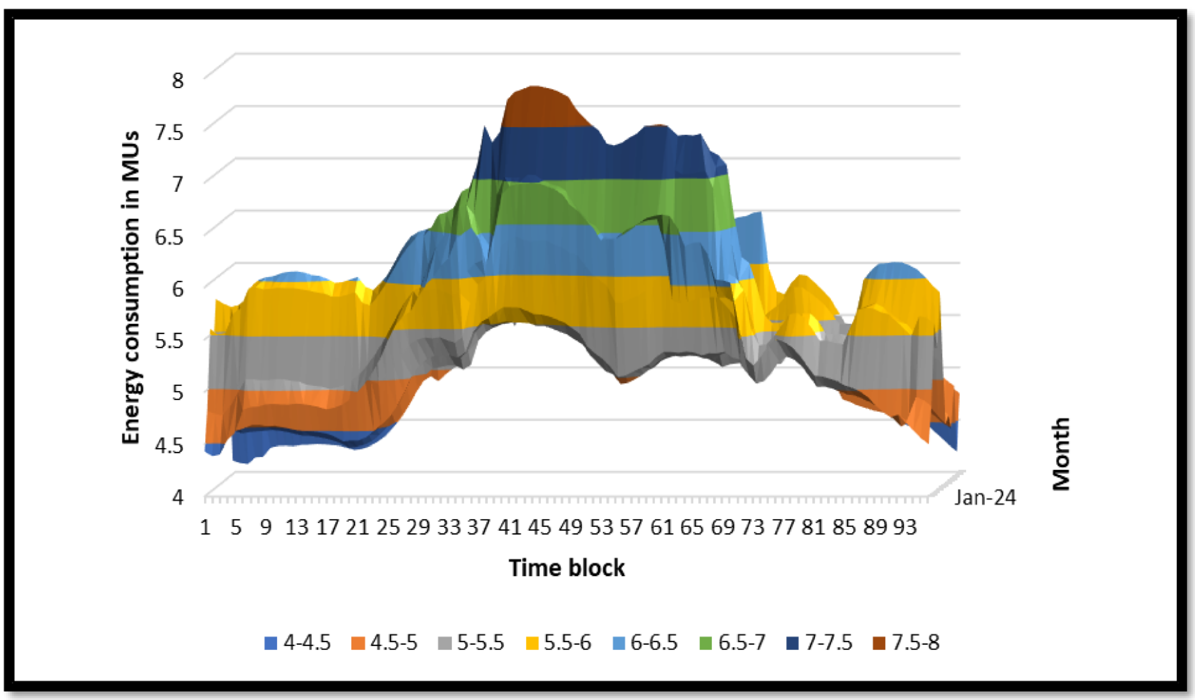

Figure 334: Annual Energy Consumption Profile – Kolhapur 2024

26.10 Amravati

26.10.1 Amravati- Annual Energy Consumption Profile 2022

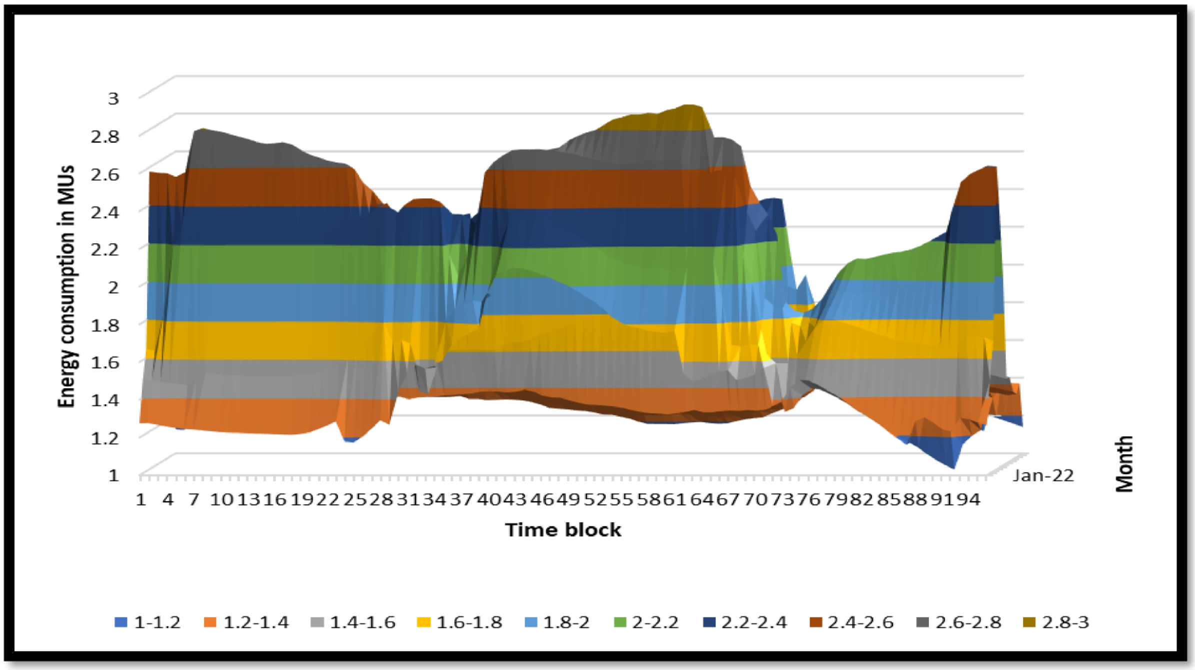

Figure 335: Annual Energy Consumption Profile – Amravati 2022

26.10.2 Amravati - Annual Energy Consumption Profile 2023

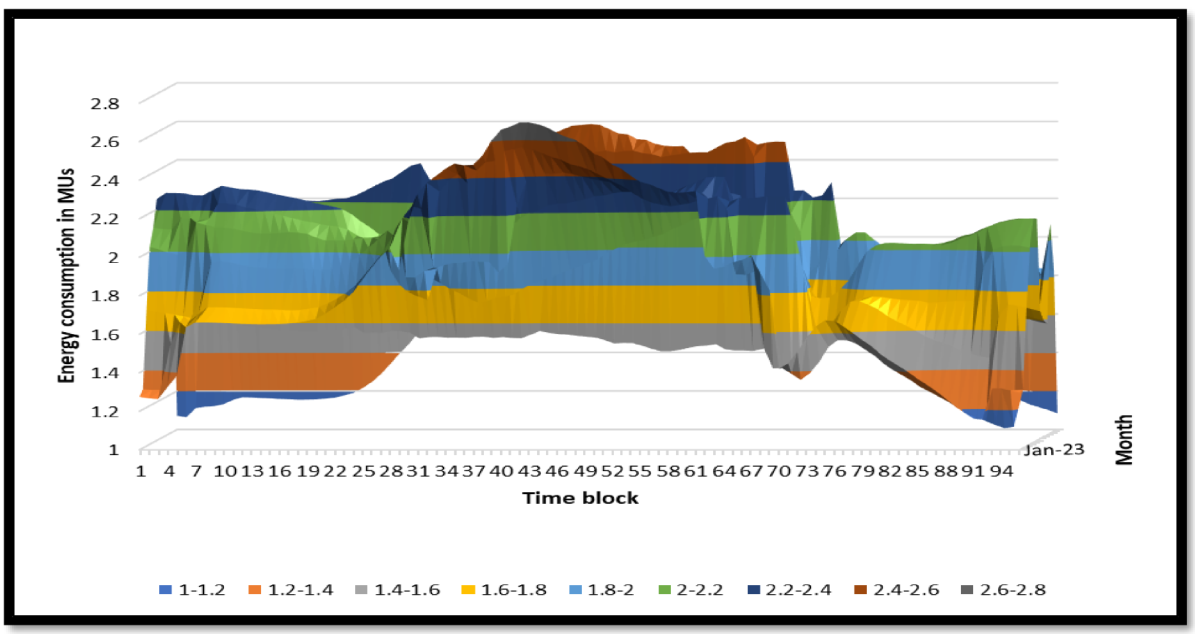

Figure 336: Annual Energy Consumption Profile – Amravati 2023

26.10.3 Amravati - Annual Energy Consumption Profile 2024

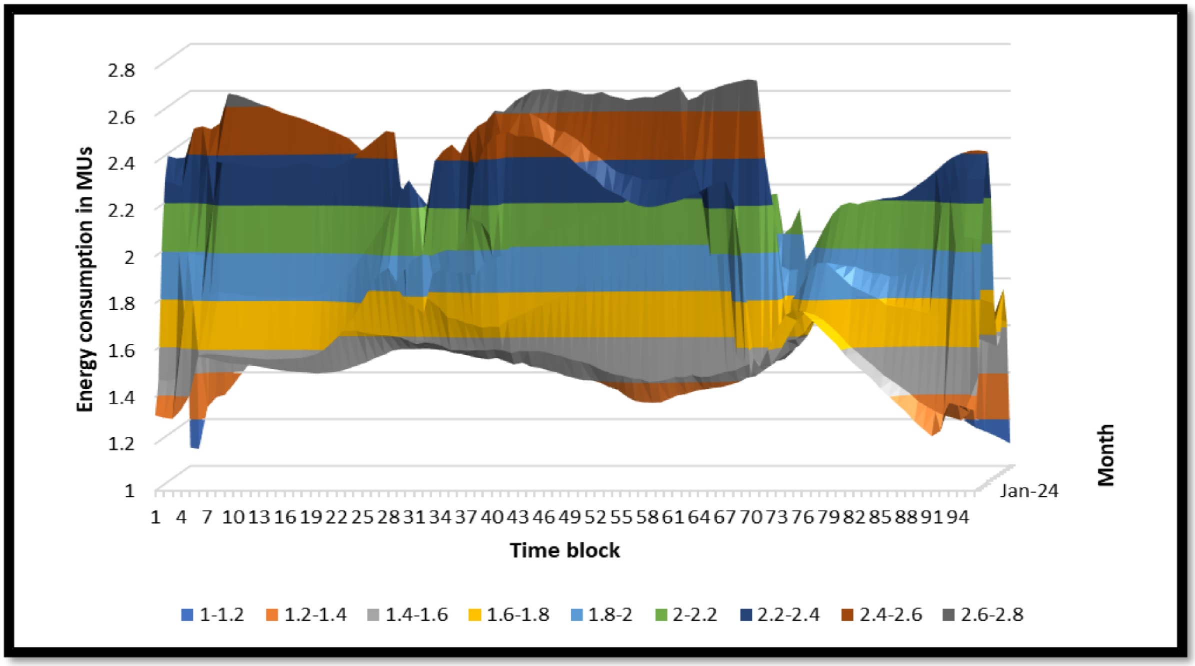

Figure 337: Annual Energy Consumption Profile – Amravati 2024

26.11 Solapur

26.11.1 Solapur- Annual Energy Consumption Profile 2022

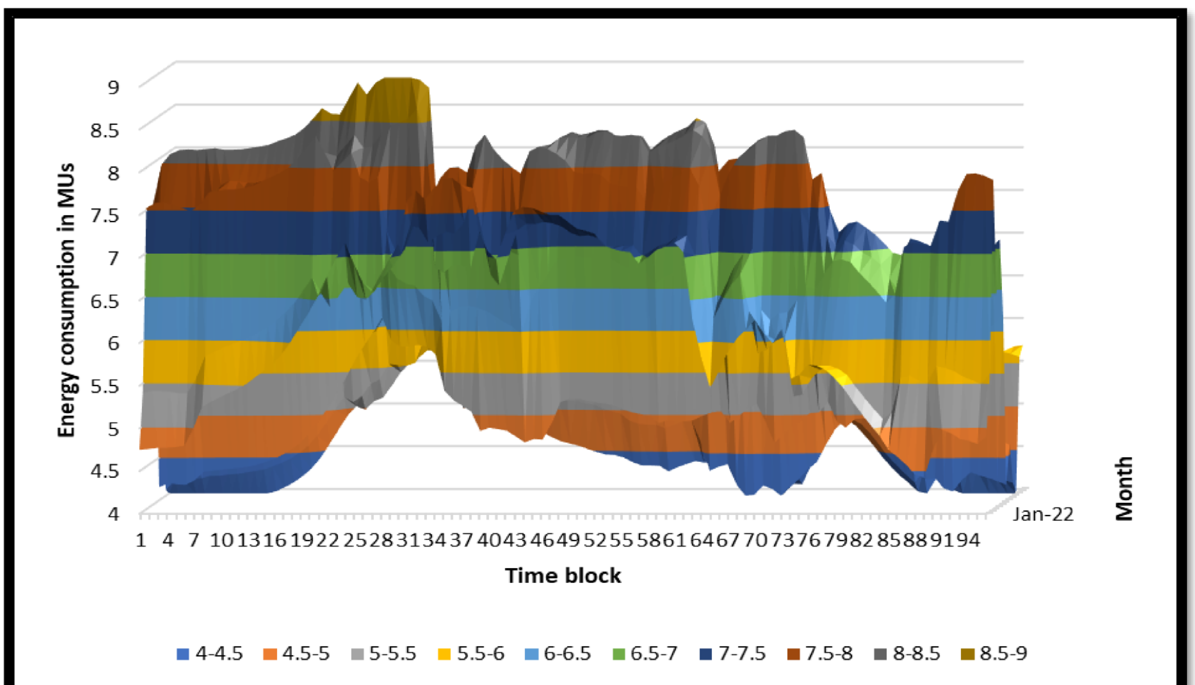

Figure 338: Annual Energy Consumption Profile – Solapur 2022

26.11.2 Solapur- Annual Energy Consumption Profile 2023

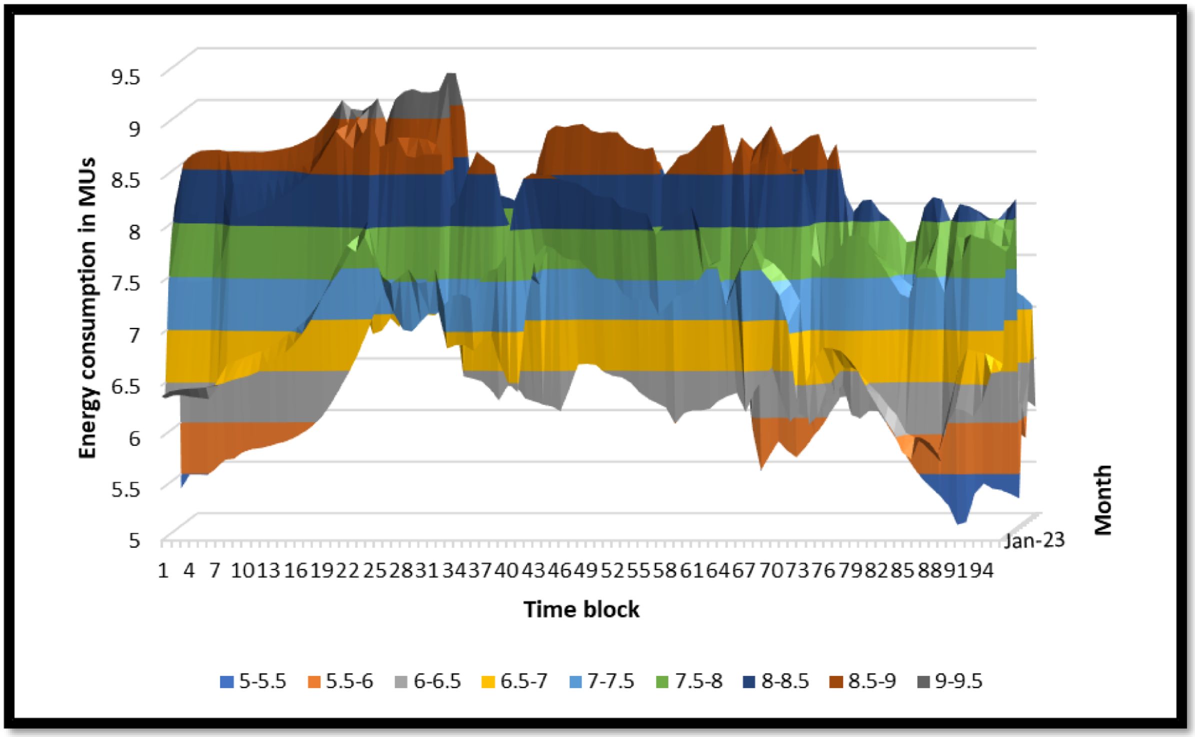

Figure 339: Annual Energy Consumption Profile – Solapur 2023

26.11.3 Solapur- Annual Energy Consumption Profile 2024

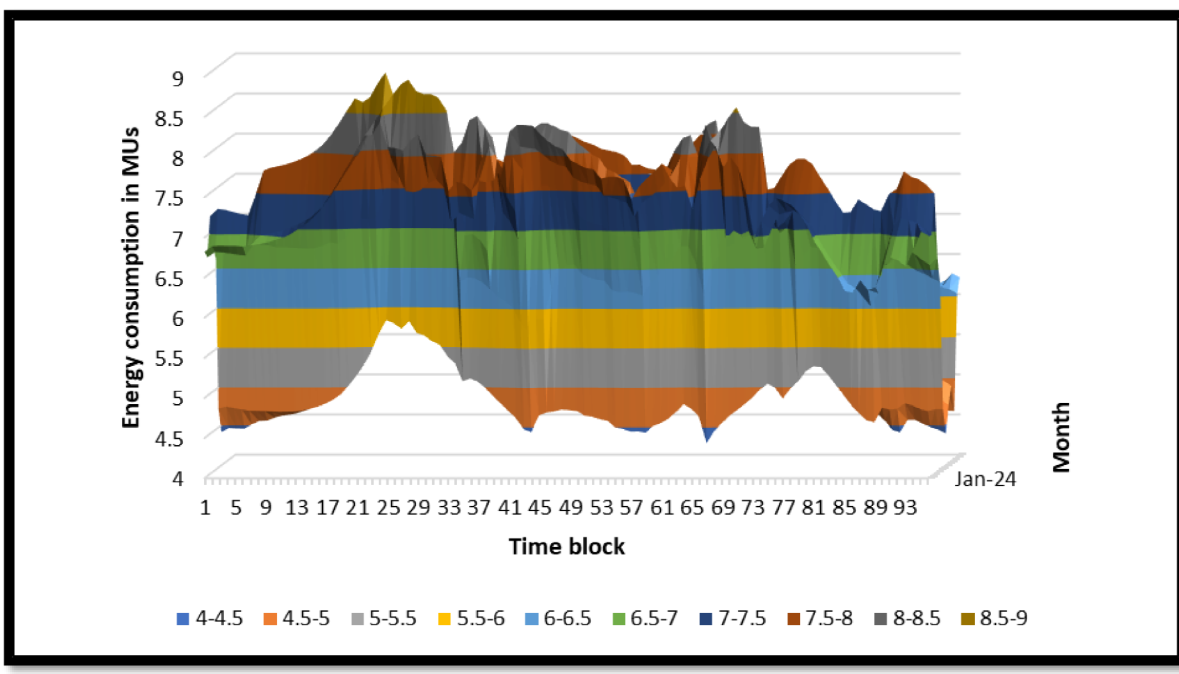

Figure 340: Annual Energy Consumption Profile – Solapur 2024

26.12 Ahilyanagar

26.12.1 Ahilyanagar- Annual Energy Consumption Profile 2022

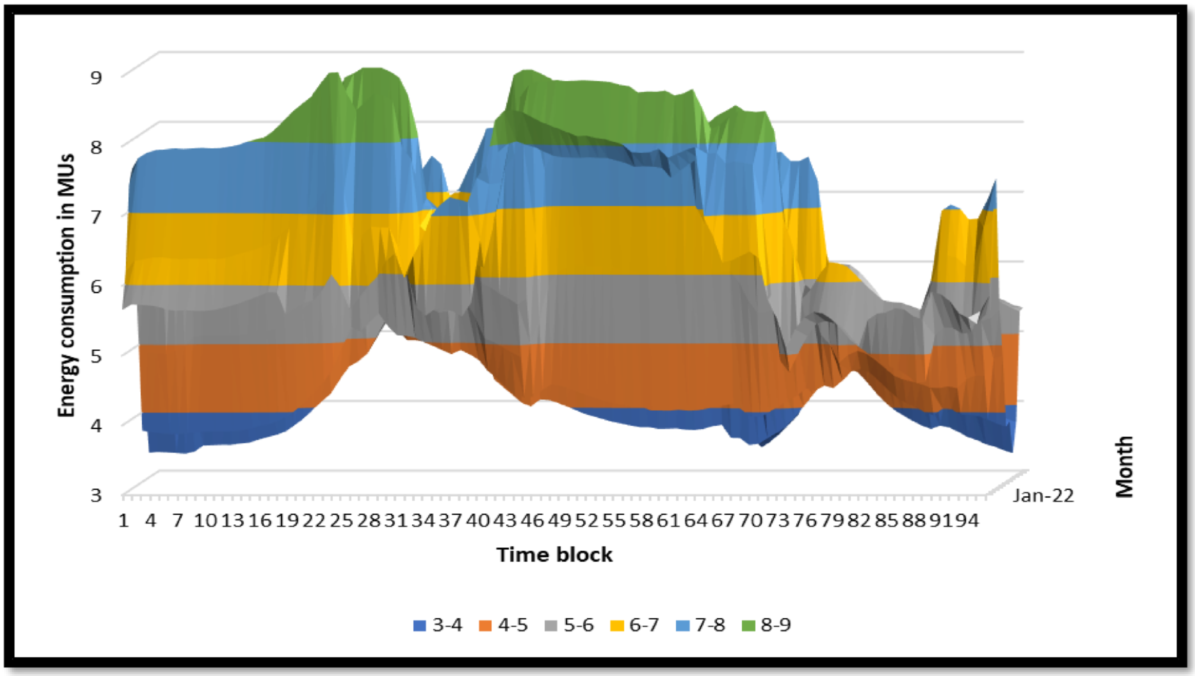

Figure 341: Annual Energy Consumption Profile – Ahilyanagar 2022

26.12.2 Ahilyanagar - Annual Energy Consumption Profile 2023

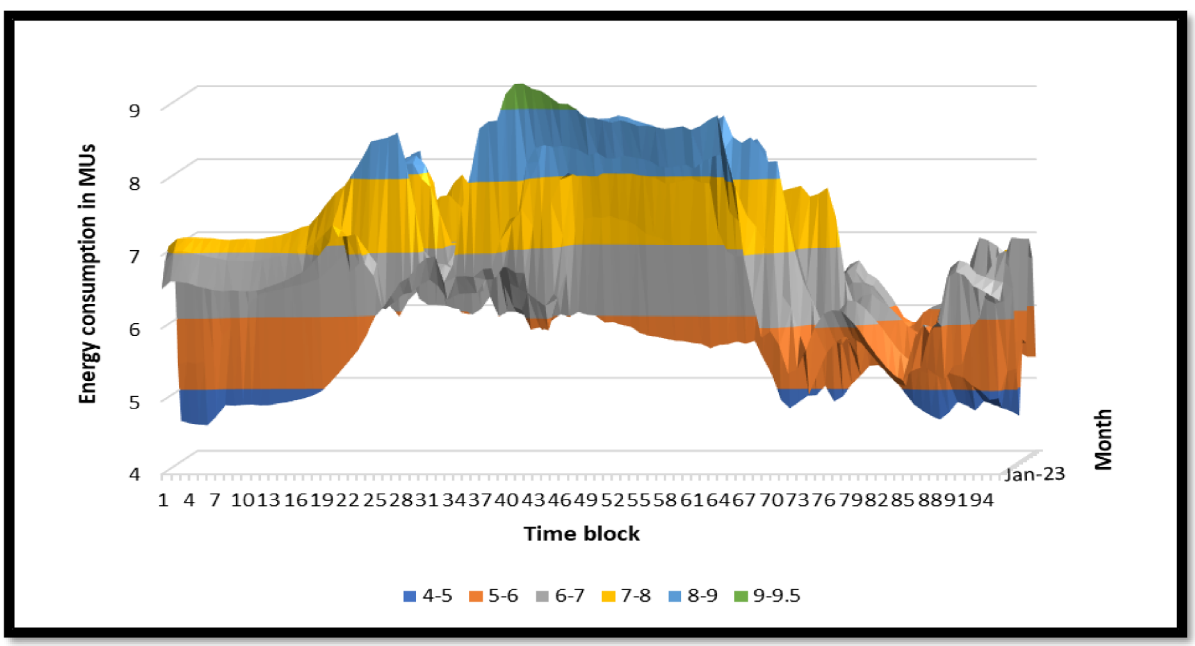

Figure 342: Annual Energy Consumption Profile – Ahilyanagar 2023

26.12.3 Ahilyanagar - Annual Energy Consumption Profile 2024

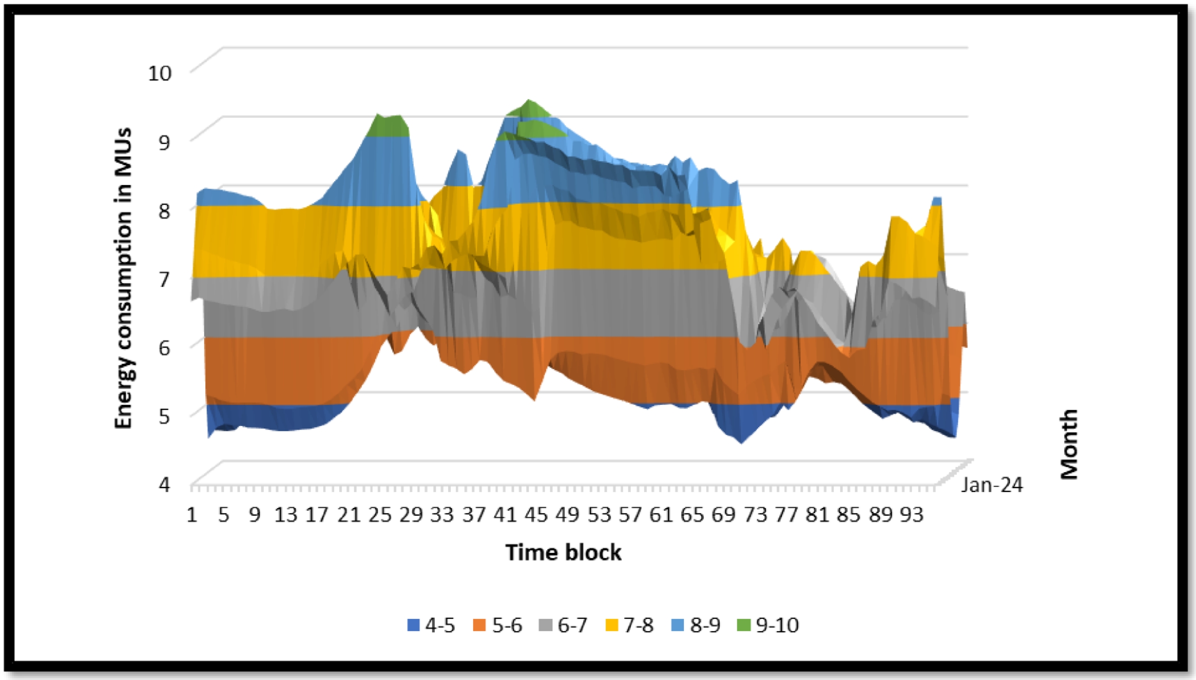

Figure 343: Annual Energy Consumption Profile – Ahilyanagar 2024

26.13 Nagpur

26.13.1 Nagpur- Annual Energy Consumption Profile 2022

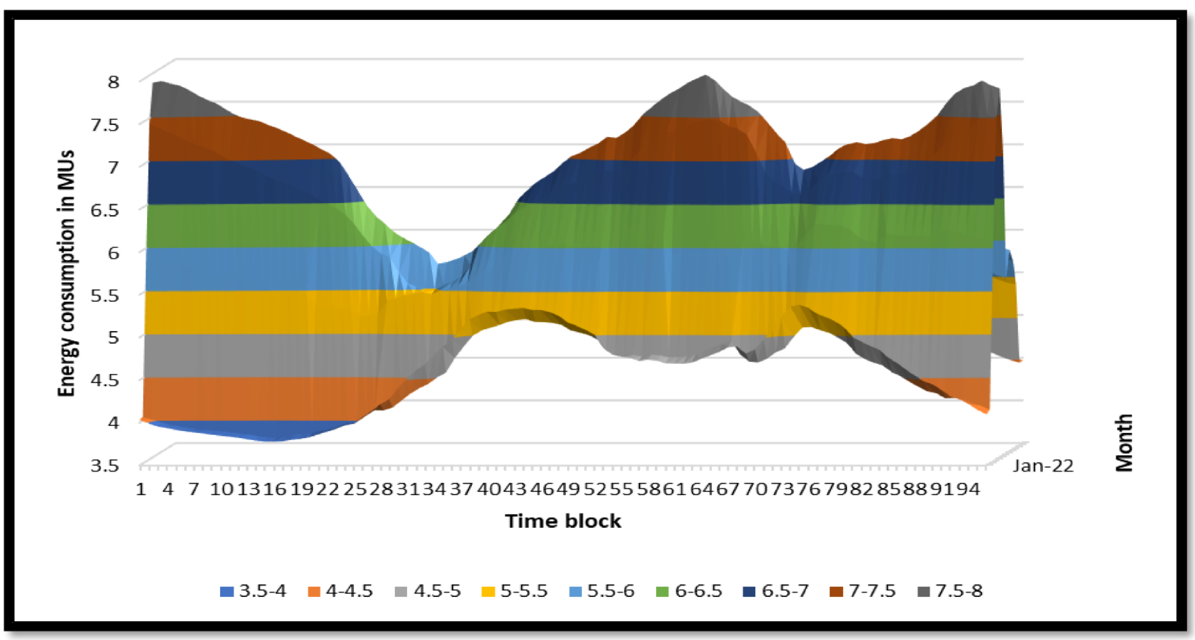

Figure 344: Annual Energy Consumption Profile – Nagpur 2022

26.13.2 Nagpur- Annual Energy Consumption Profile 2023

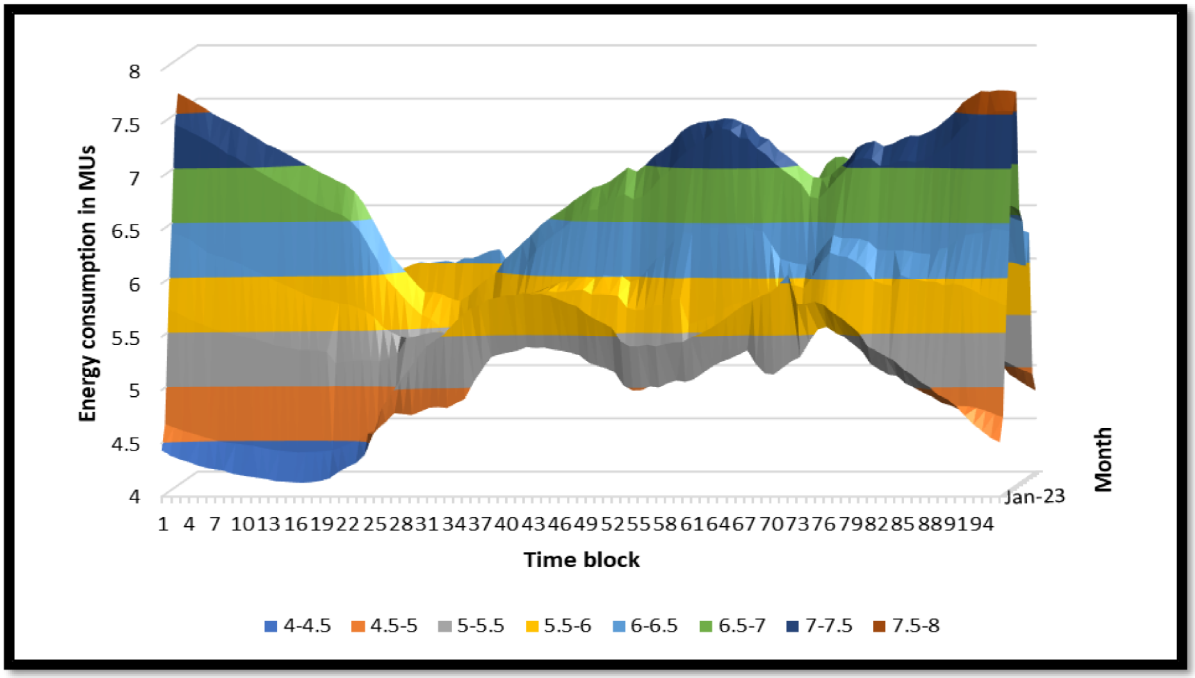

Figure 345: Annual Energy Consumption Profile – Nagpur 2023

26.13.3 Nagpur- Annual Energy Consumption Profile 2024

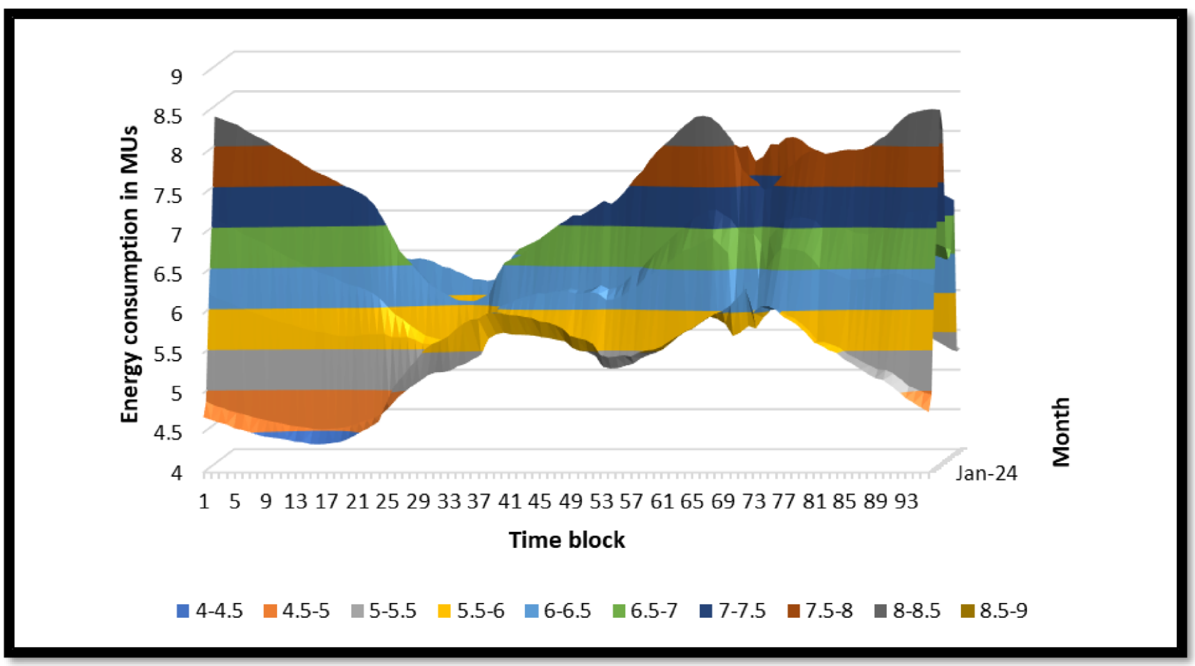

Figure 346: Annual Energy Consumption Profile – Nagpur 2024

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27. Plot of Peak Energy Consumption time (2022-2024)

Introduction

This chapter provides insights into the occurrence of peak energy consumption, including the time block at which the peak value occurs, monthly peak energy consumption values (in MUs), and their corresponding time blocks. It also presents a comparison of overall peak value trends and examines how the time block of peak demand shifts across months and years (2022, 2023, and 2024) for the period January to December. The plots further depict a comparative analysis of peak demand trends over the study period.

27.1 Monthly peak energy consumption- Pune (2022-2024)

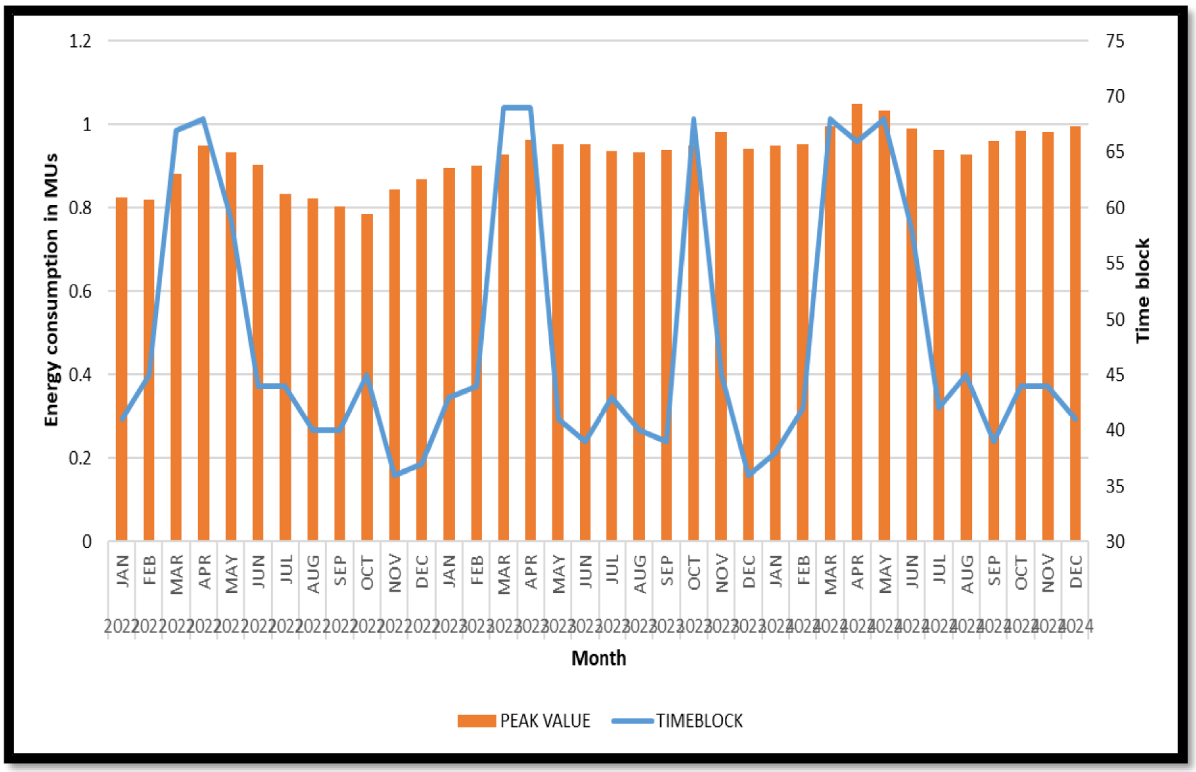

Figure 347: Monthly peak energy consumption- Pune (2022-2024)

Summary

The plot illustrates the peak energy consumption recorded on the monthly peak day for each month over the three-year period, along with the corresponding time block at which the peak demand occurs.

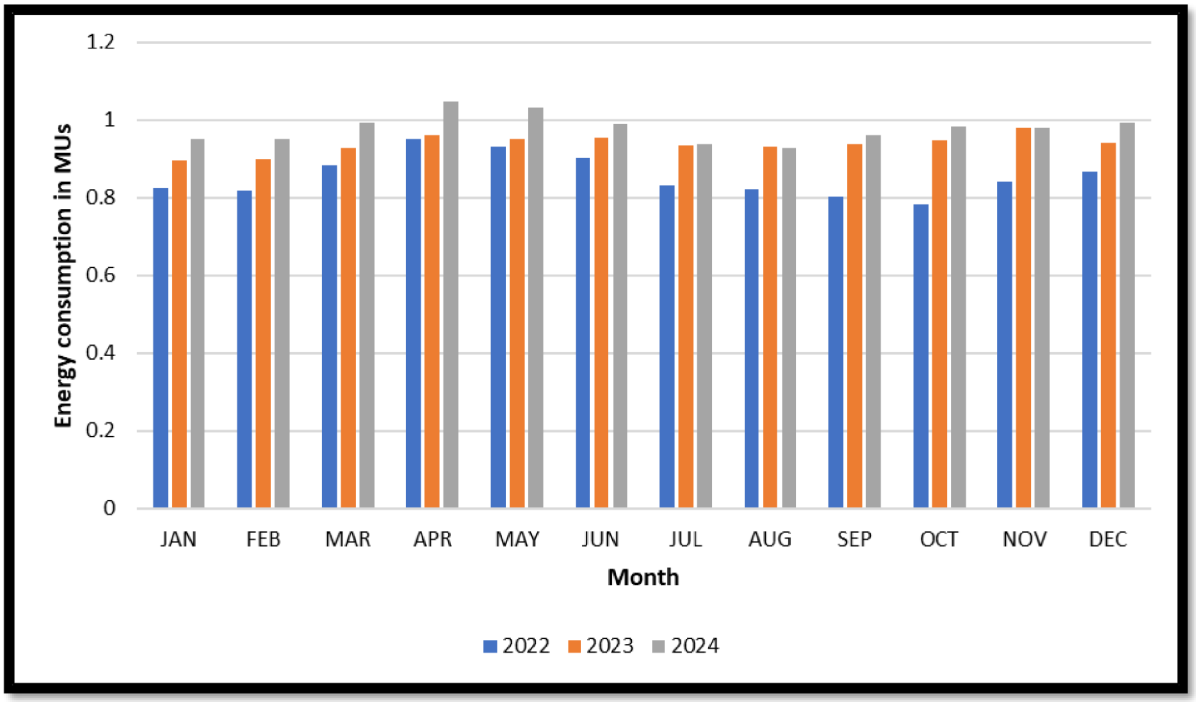

Figure 348: Peak variation over years in MUs – Pune (2022-2024)

Summary

The plot shows a monthly comparison of peak energy consumption values across three years.

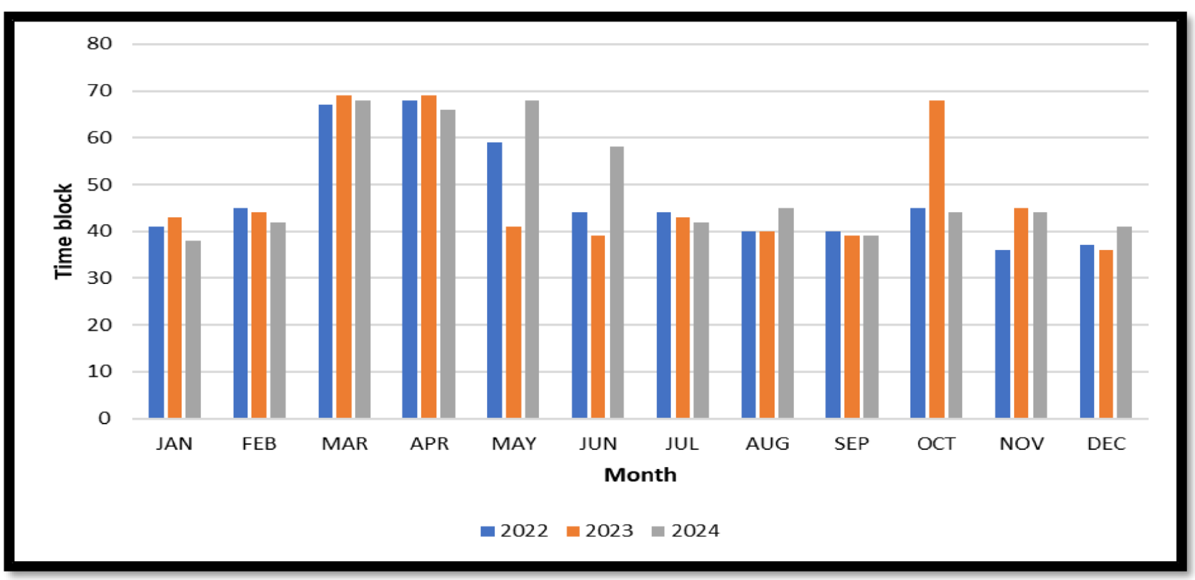

Figure 349: Time blocks of peak – Pune (2022-2024)

Summary

The plot illustrates month-wise shifts in the time block of peak energy consumption across the years 2022–2024.

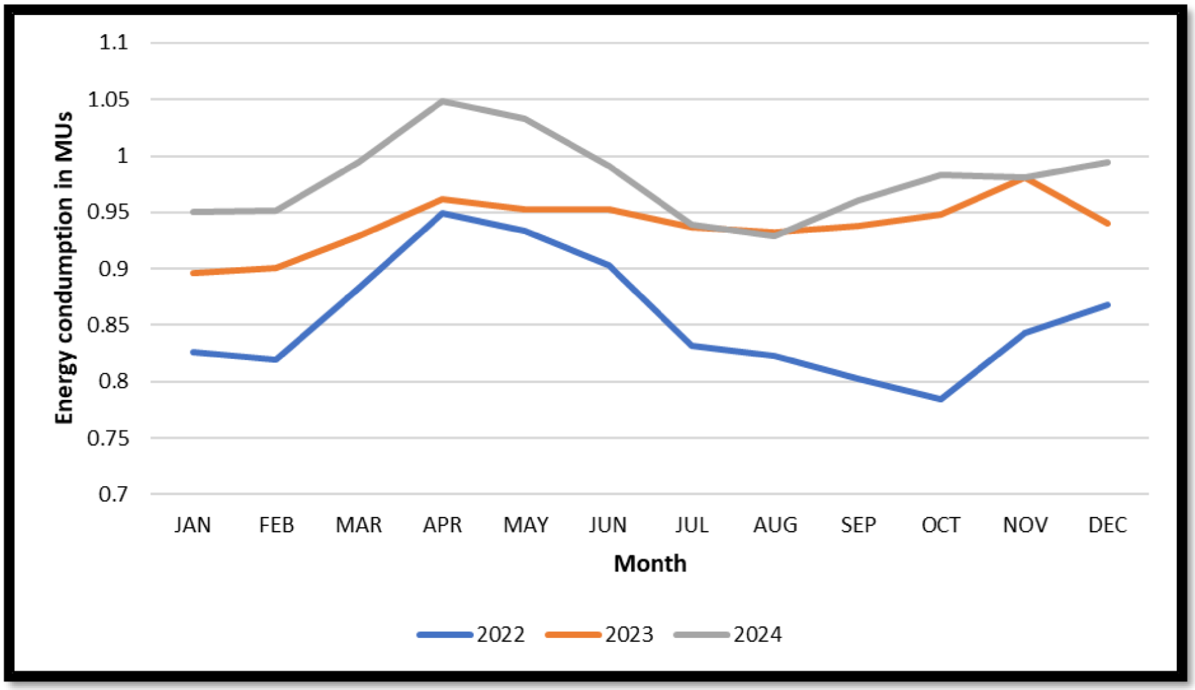

Figure 350: Peak comparison- Pune (2022-2024)

Summary

The plot depicts peak values on monthly peak days for the period 2022–2024.

27.2 Monthly peak energy consumption – Thane (2022-2024)

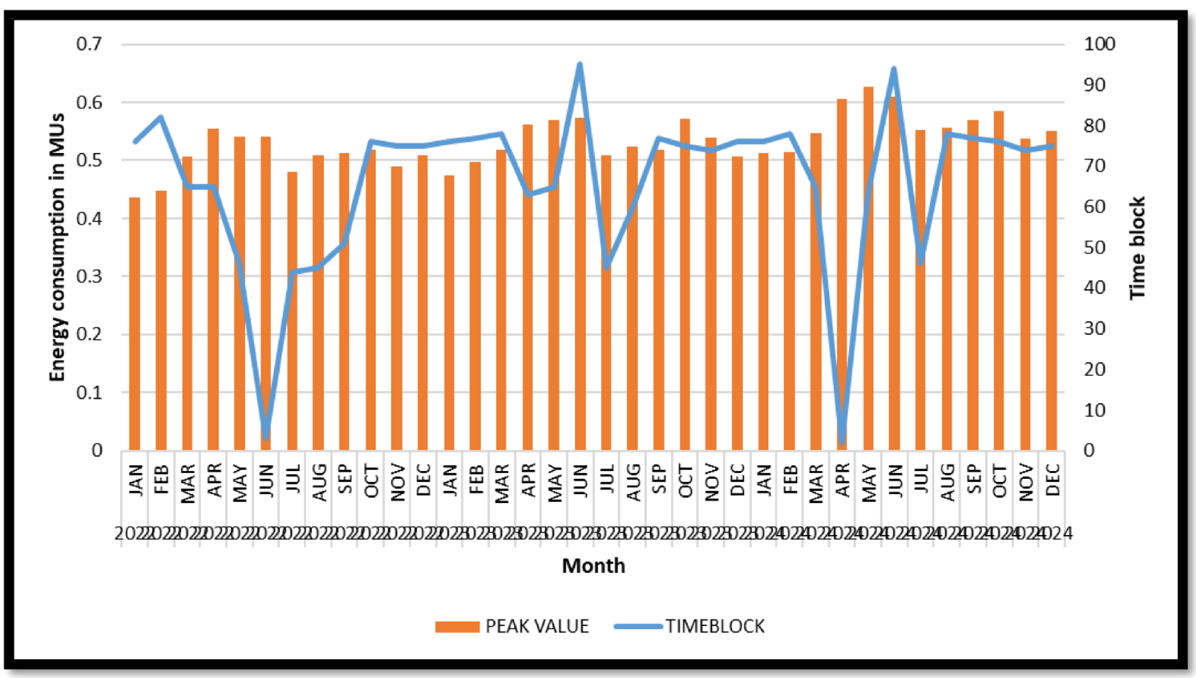

Figure 351: Monthly peak energy consumption – Thane (2022-2024)

Summary

The plot illustrates the peak energy consumption recorded on the monthly peak day for each month over the three-year period, along with the corresponding time block at which the peak demand occurs.

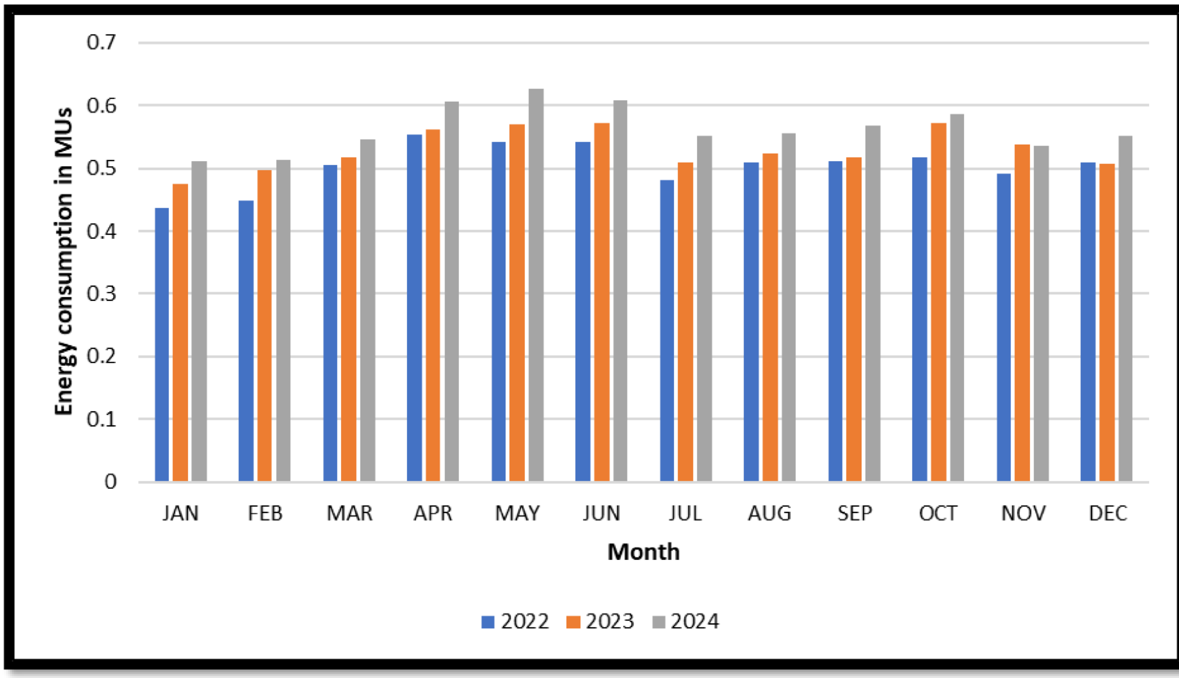

Figure 352: Peak variation over years in MUs – Thane (2022-2024)

Summary

The plot shows a monthly comparison of peak energy consumption values across three years.

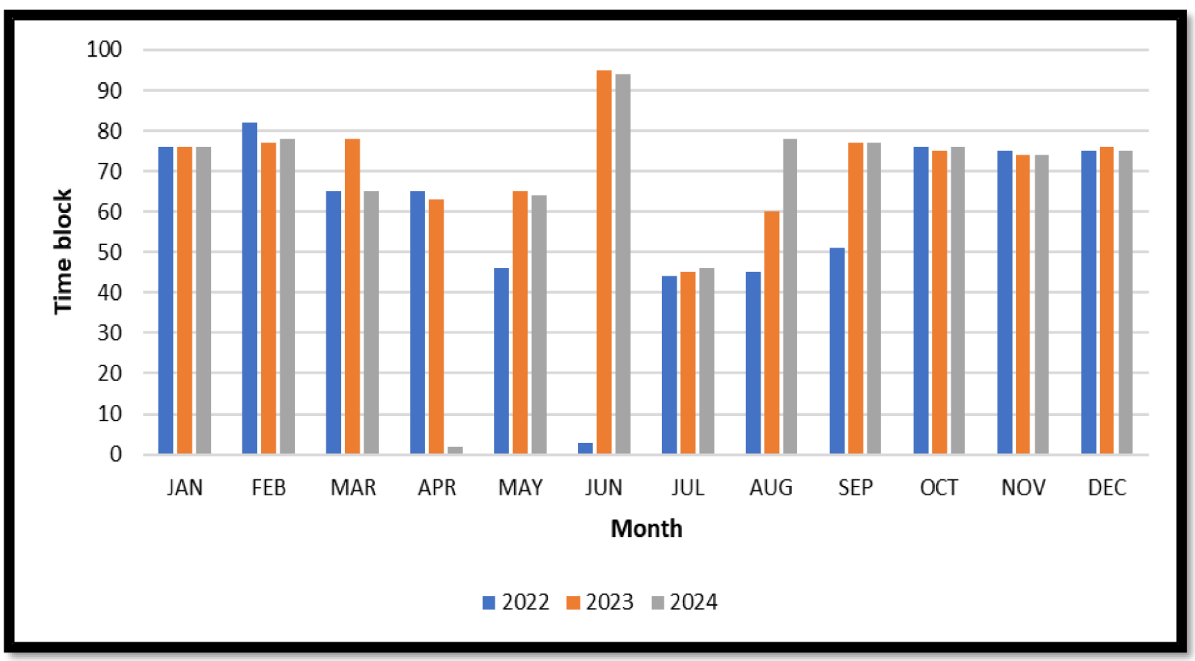

Figure 353: Time blocks of peak – Thane (2022-2024)

Summary

The plot illustrates month-wise shifts in the time block of peak energy consumption across the years 2022–2024.

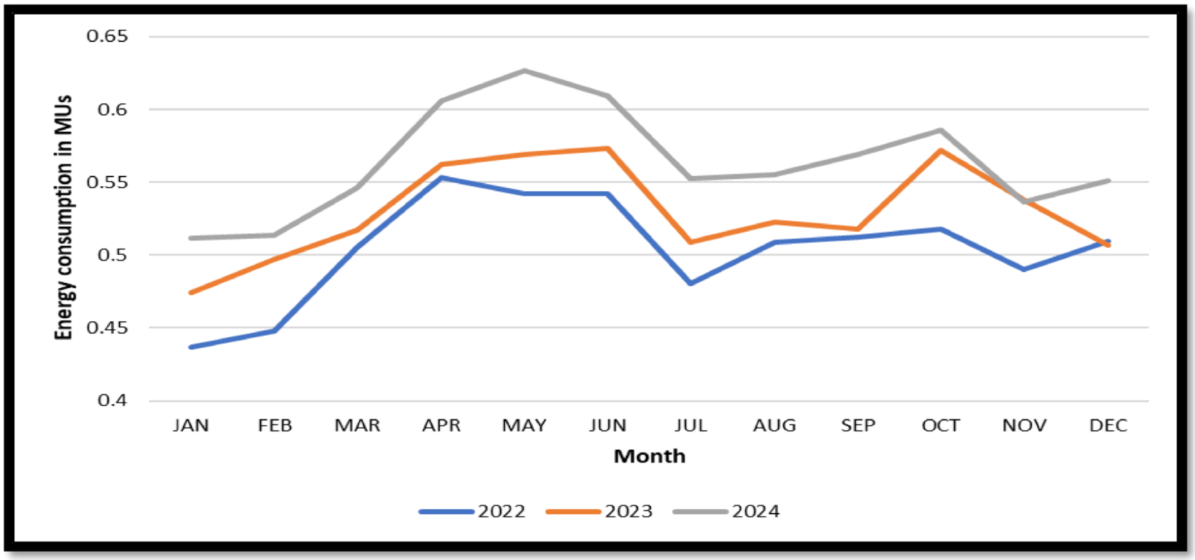

Figure 354: Peak comparison – Thane (2022-2024)

Summary

The plot depicts peak values on monthly peak days for the period 2022–2024.

27.3 Monthly peak energy consumption – Mumbai Suburban (2022-2024)

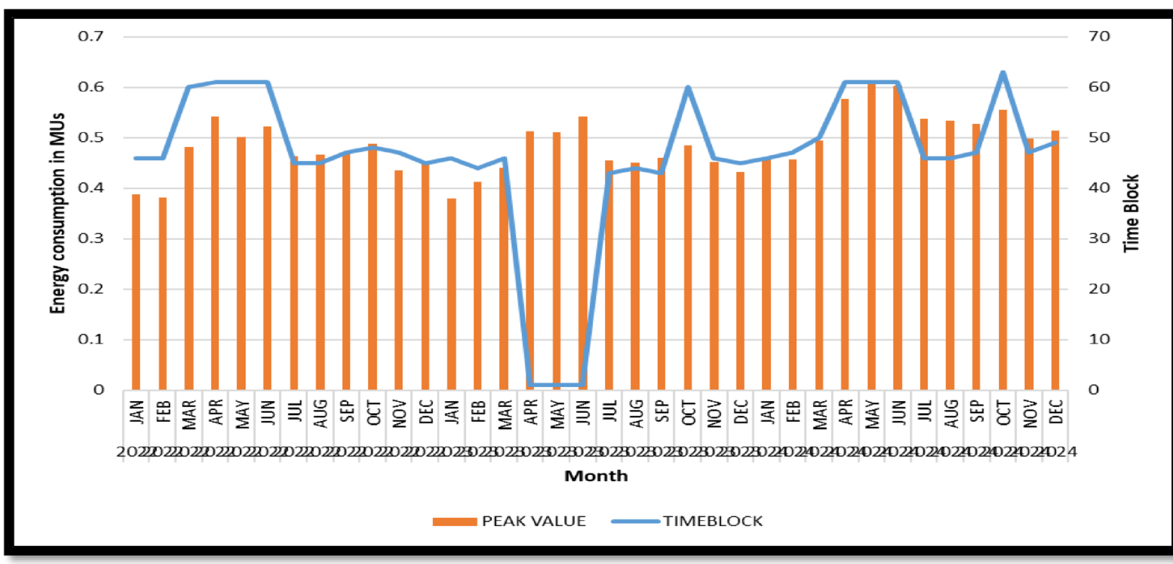

Figure 355: Monthly peak energy consumption – Mumbai Suburban (2022-2024)

Summary

The plot illustrates the peak energy consumption recorded on the monthly peak day for each month over the three-year period, along with the corresponding time block at which the peak demand occurs.

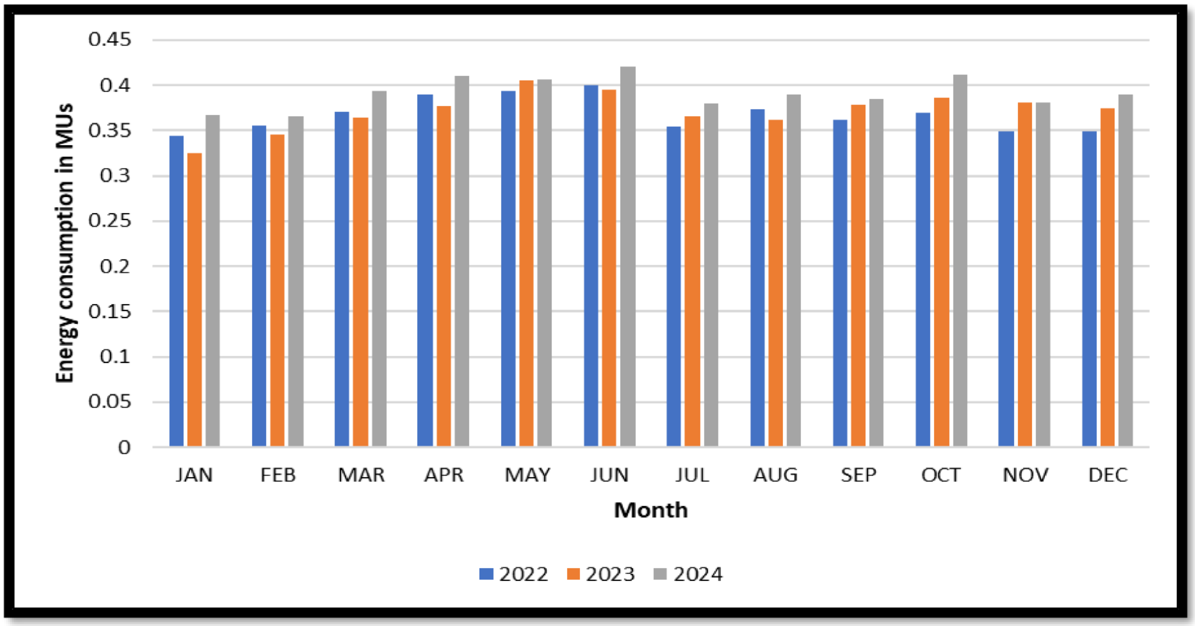

Figure 356: Peak variation over years in MUs – Mumbai Suburban (2022-2024)

Summary

The plot shows a monthly comparison of peak energy consumption values across three years.

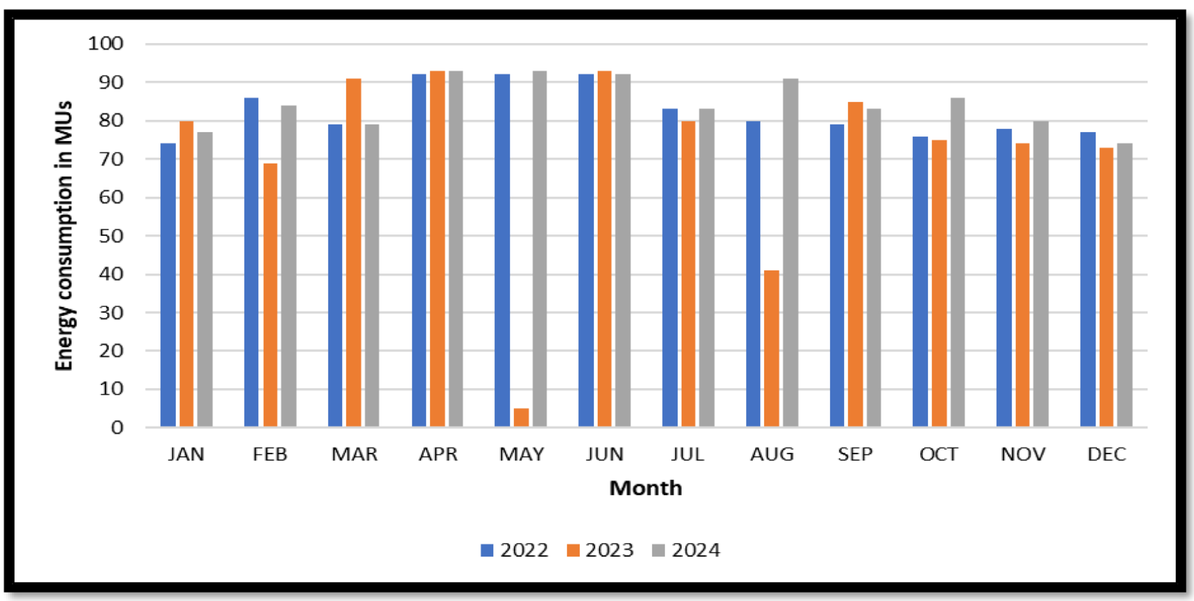

Figure 357: Time blocks of peak – Mumbai Suburban (2022-2024)

Summary

The plot illustrates month-wise shifts in the time block of peak energy consumption across the years 2022–2024.

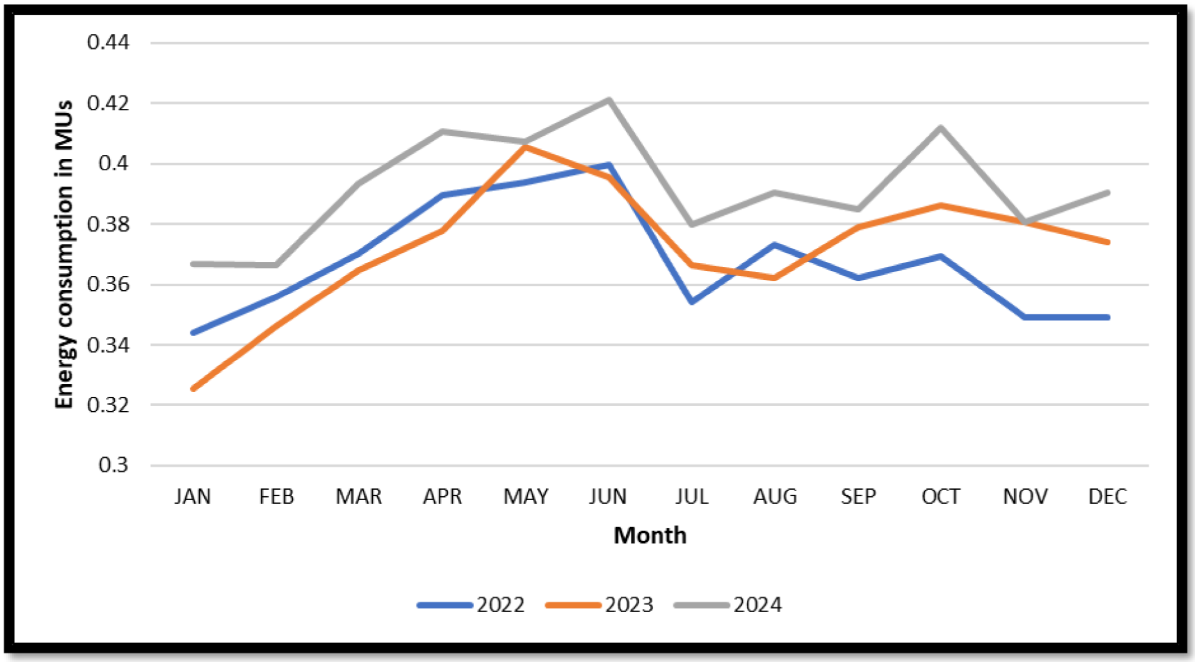

Figure 358: Peak comparison – Mumbai Suburban (2022-2024)

Summary

The plot depicts peak values on monthly peak days for the period 2022–2024.

27.4 Monthly peak energy consumption - Raigad (2022-2024)

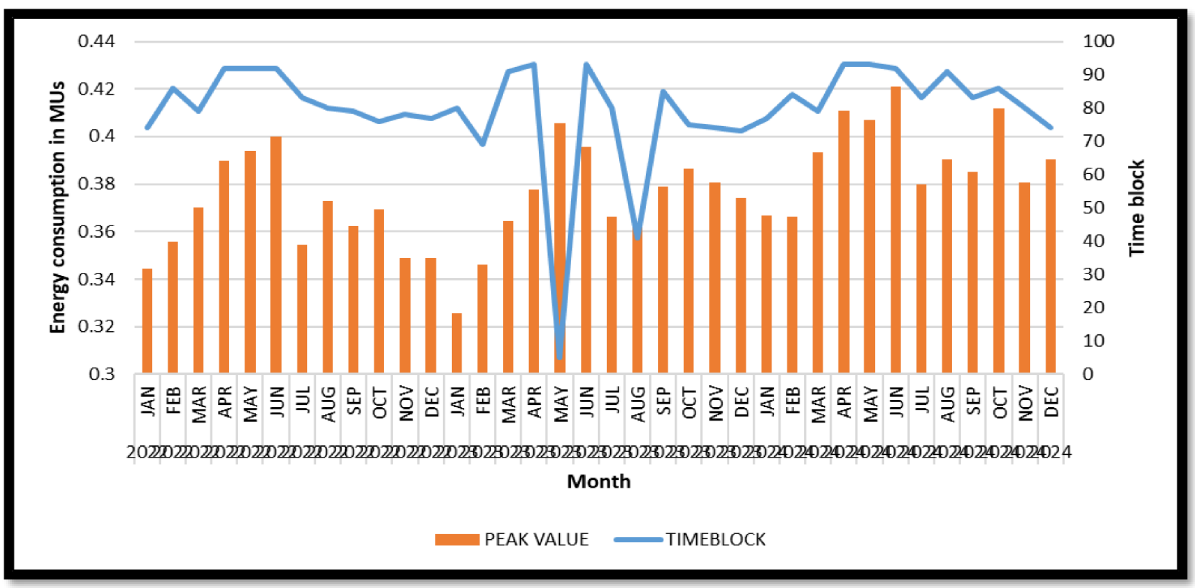

Figure 359: Monthly peak energy consumption – Raigad (2022-2024)

Summary

The plot illustrates the peak energy consumption recorded on the monthly peak day for each month over the three-year period, along with the corresponding time block at which the peak demand occurs.

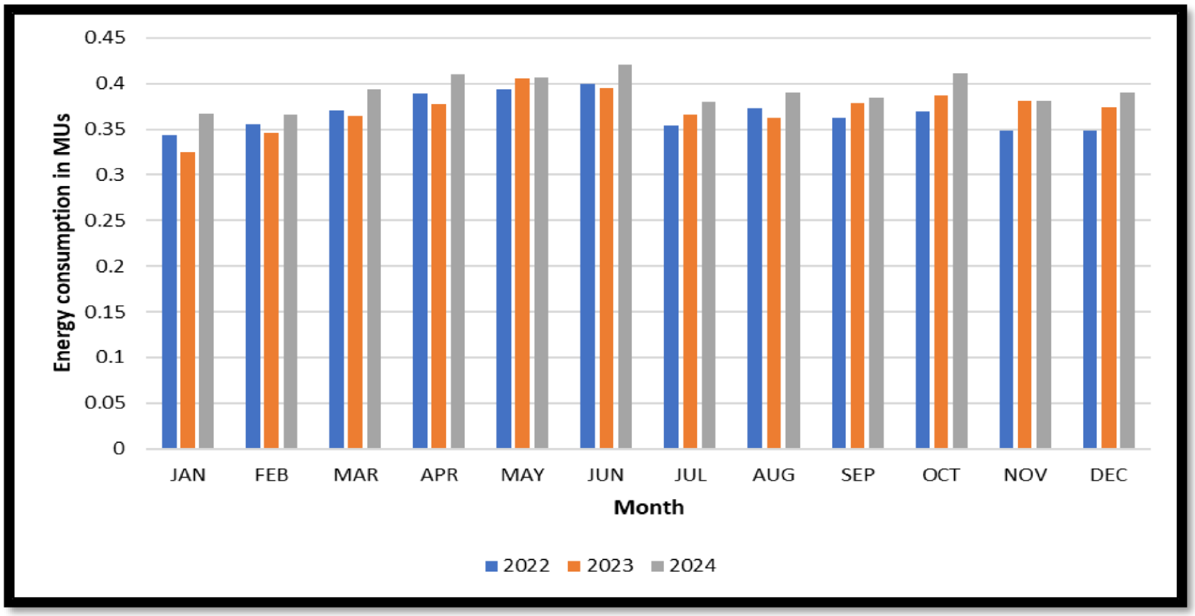

Figure 360: Peak variation over years in MUs – Raigad (2022-2024)

Summary

The plot shows a monthly comparison of peak energy consumption values across three years.

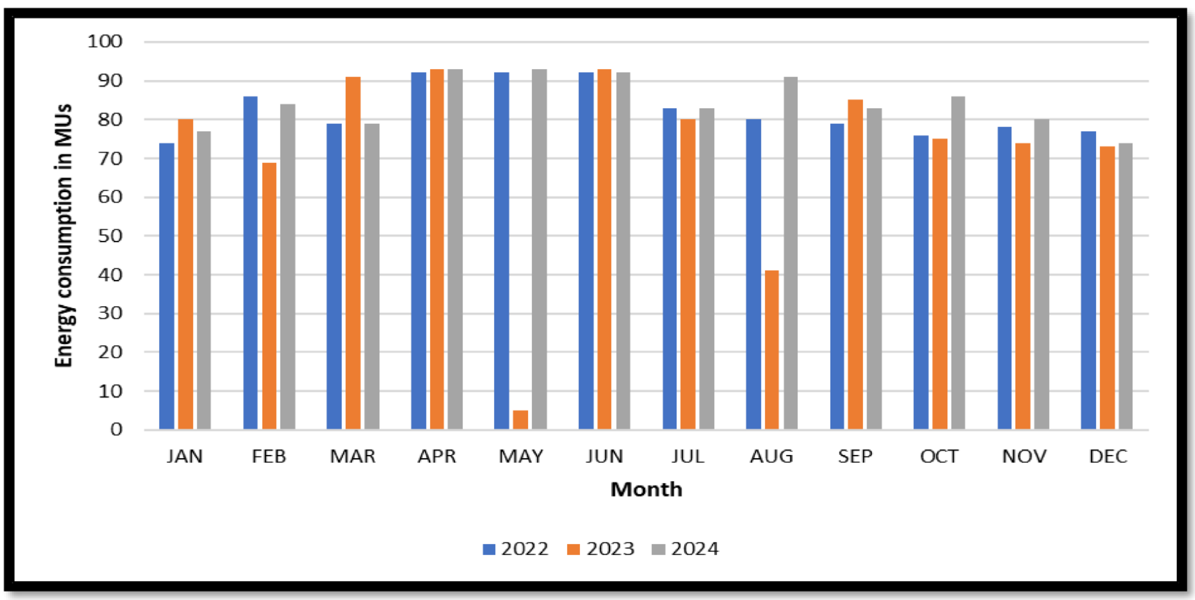

Figure 361: Time blocks of peak – Raigad (2022-2024)

Summary

The plot illustrates month-wise shifts in the time block of peak energy consumption across the years 2022–2024.

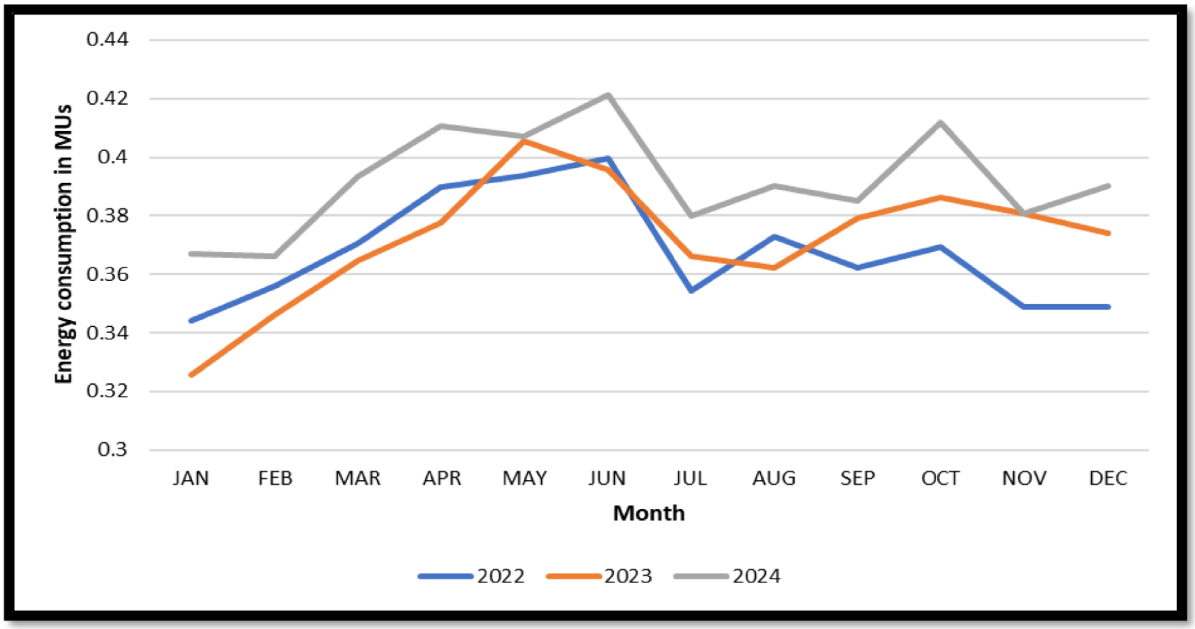

Figure 362: Peak comparison – Raigad (2022-2024)

Summary

The plot depicts peak values on monthly peak days for the period 2022–2024.

27.5 Monthly Peak energy consumption - Nashik (2022-2024)

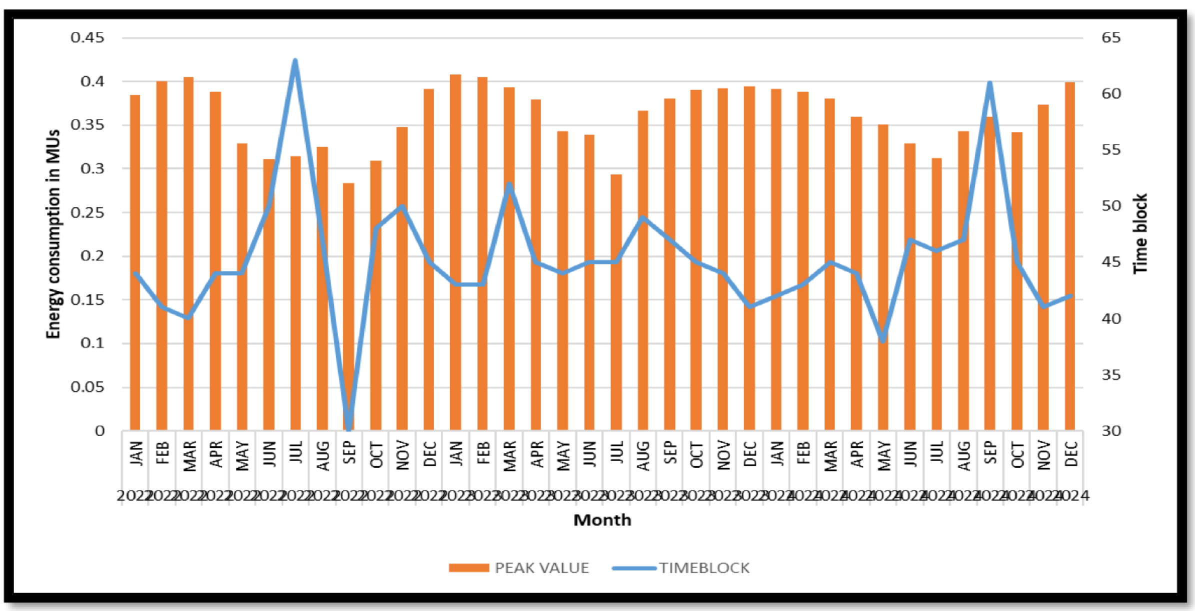

Figure 363: Monthly Peak energy consumption – Nashik (2022-2024)

Summary

The plot illustrates the peak energy consumption recorded on the monthly peak day for each month over the three-year period, along with the corresponding time block at which the peak demand occurs.

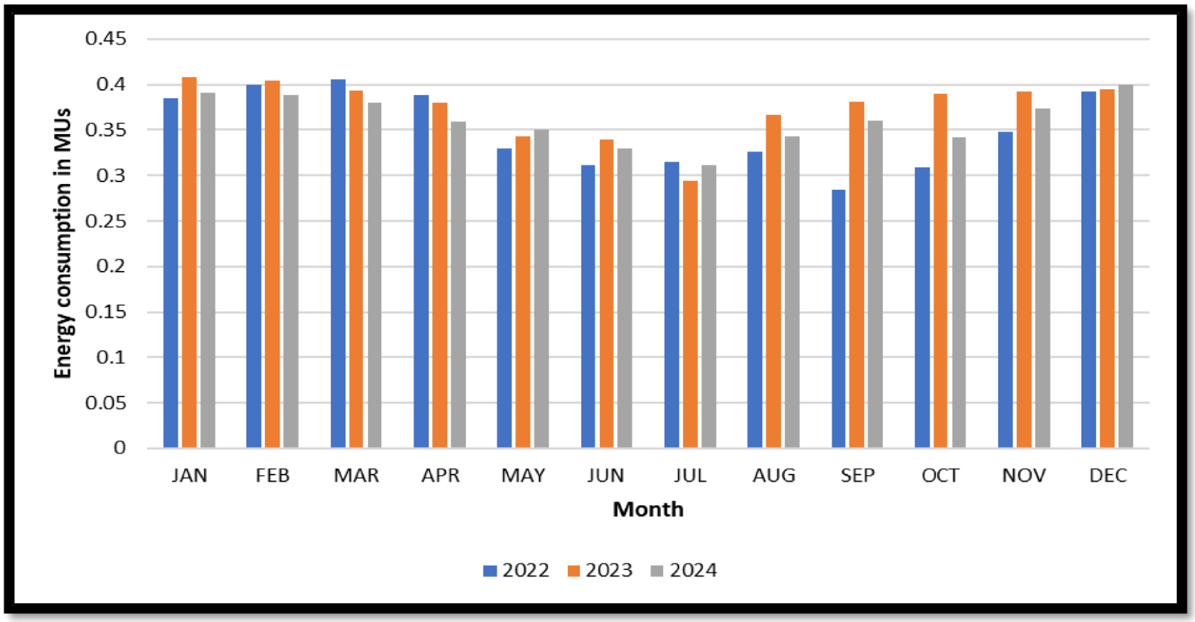

Figure 364: Peak variation over years in MUs – Nashik (2022-2024)

Summary

The plot shows a monthly comparison of peak energy consumption values across three years.

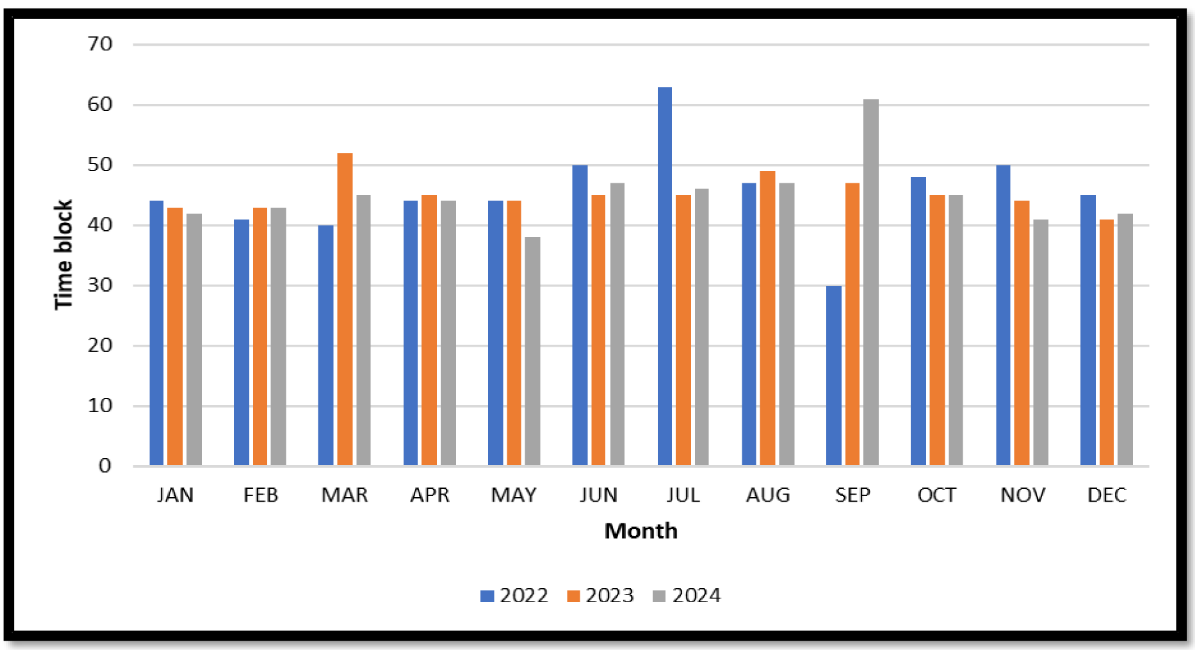

Figure 365: Time block of peak – Nashik (2022-2024)

Summary

The plot illustrates month-wise shifts in the time block of peak energy consumption across the years 2022–2024.

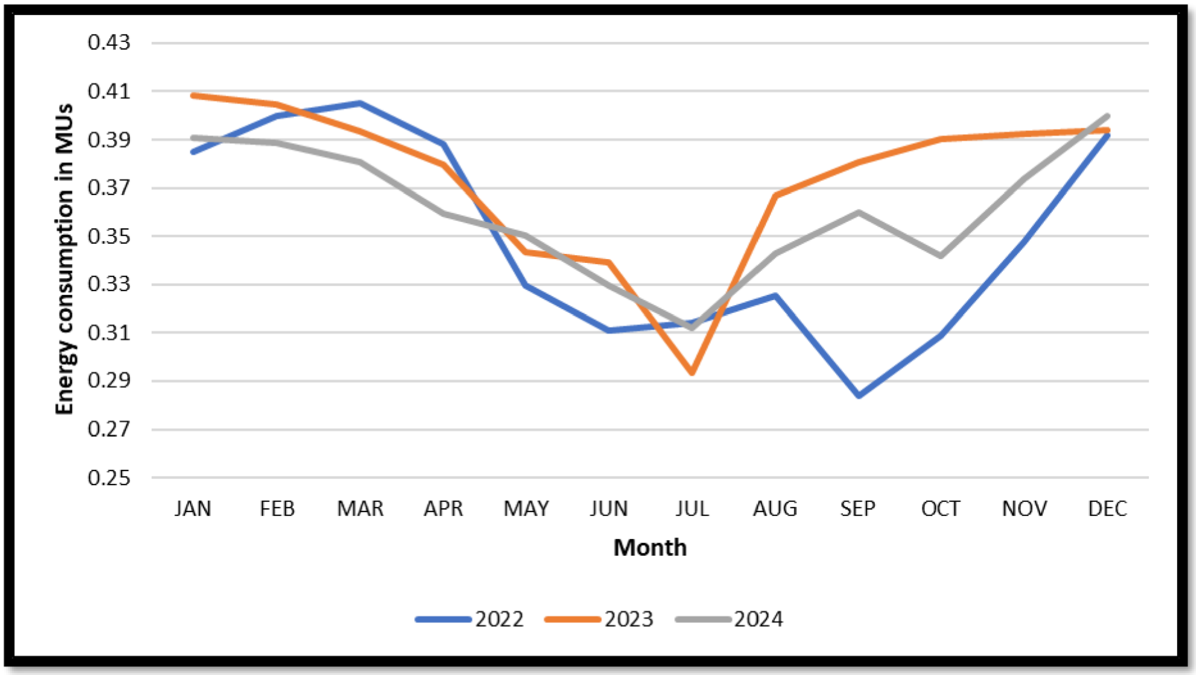

Figure 366: Peak comparison – Nashik (2022-2024)

Summary

The plot depicts peak values on monthly peak days for the period 2022–2024.

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28. Peak day analysis of 12 districts in terms of Rooftop capacity & total energy consumption (2022-2024)

28.1 Introduction

The districts in Maharashtra have been identified based on their energy consumption and rooftop solar capacity. Pune, Thane, Mumbai Suburban, Raigad, and Nashik are the districts with the highest energy consumption. Pune, Nagpur, Nashik, Chhatrapati Sambhajinagar, Jalgaon, Thane, Kolhapur, Amravati, Solapur, and Ahilyanagar are the districts with the highest rooftop solar capacity. Peak days for a total of 12 districts have been plotted here for the period 2022–2024.

28.2 Peak day behaviour for Pune (2022-2024)

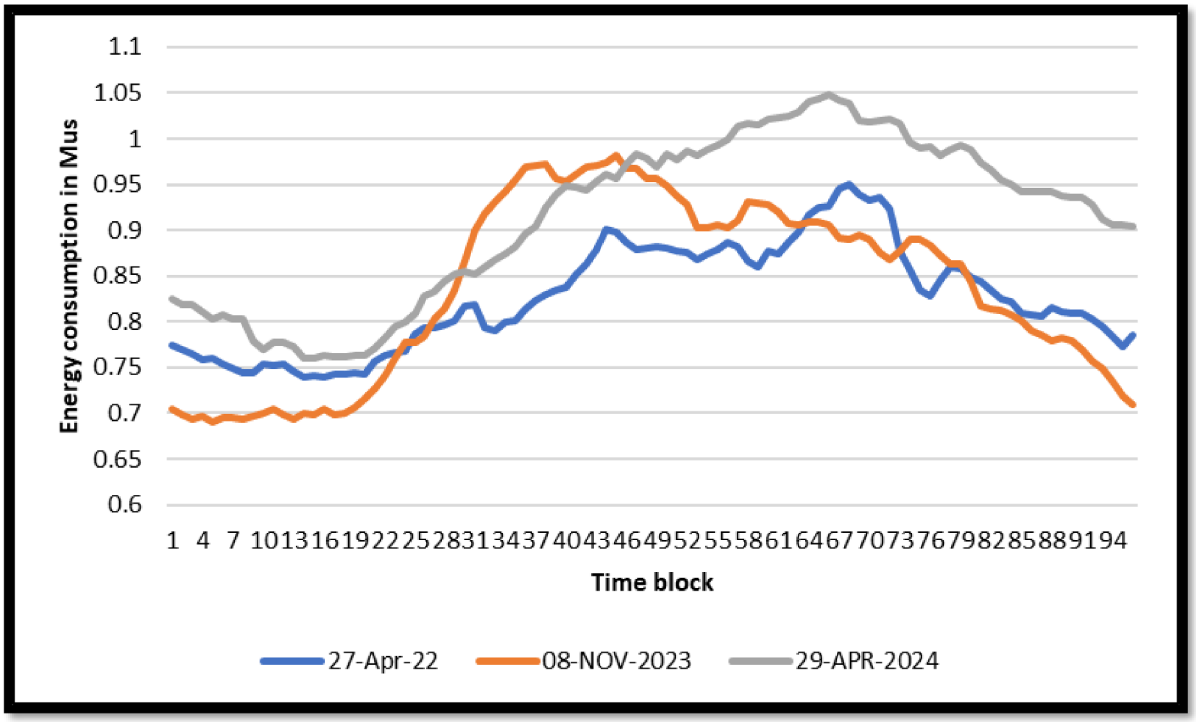

Figure 367: Pune peak days (2022-2024)

28.3 Peak day behaviour for Nagpur (2022-2024)

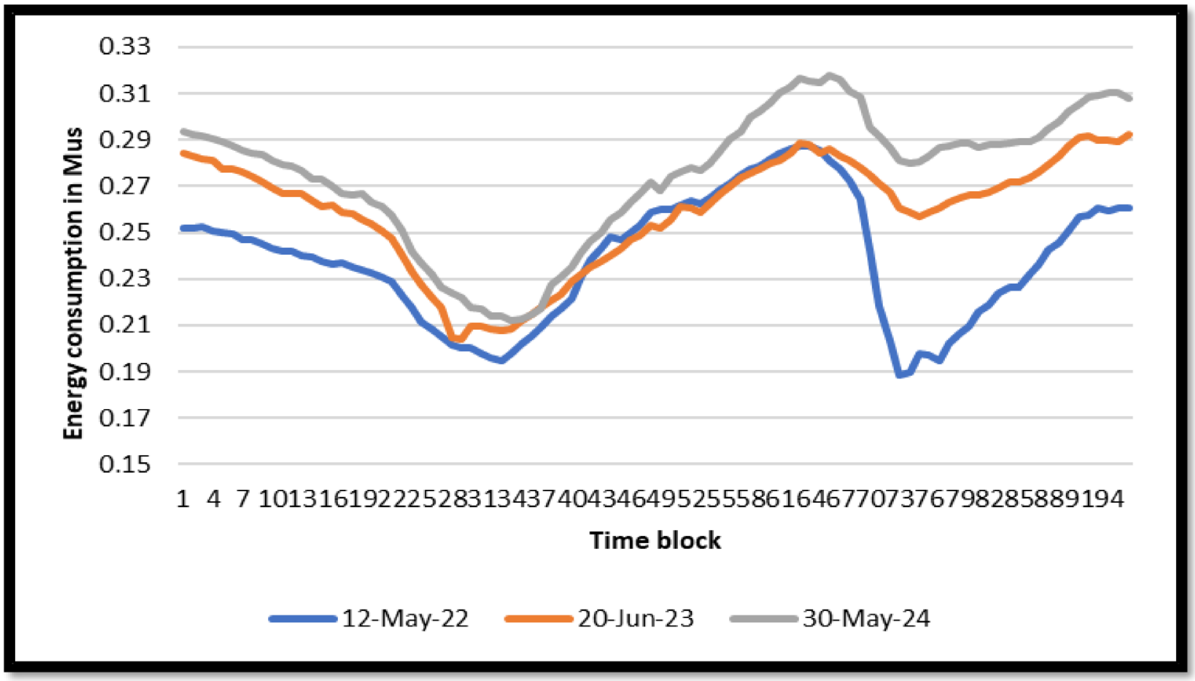

Figure 368: Nagpur peak days (2022-2024)

28.4 Peak day behaviour for Nashik (2022-2024)

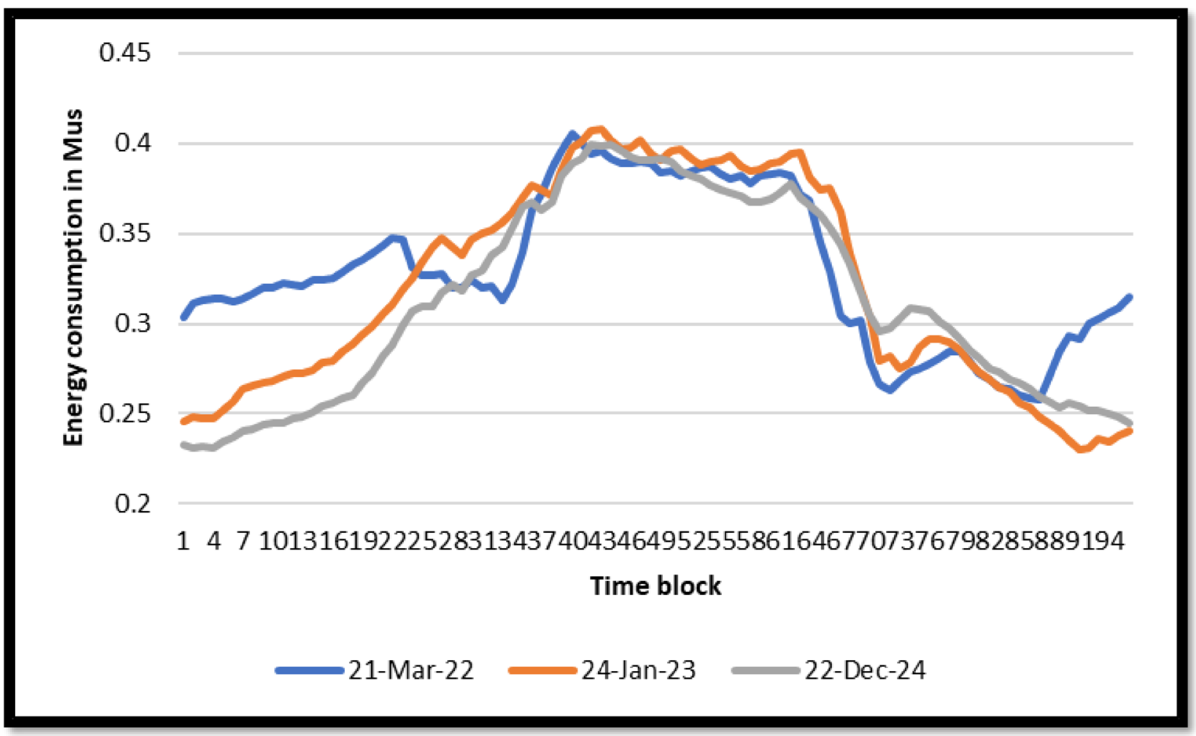

Figure 369: Nashik Peak days (2022-2024)

28.5 Peak day behaviour for Ch. Sambhajinagar (2022-2024)

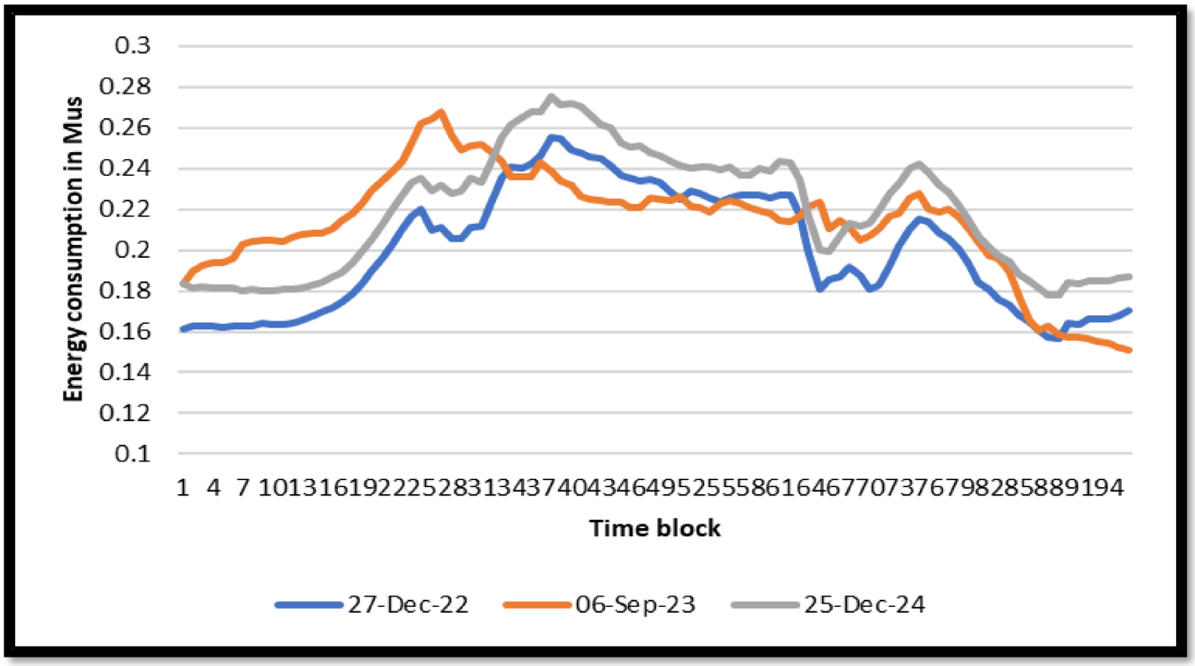

Figure 370: Ch. Sambhajinagar peak days (2022-2024)

28.6 Peak day behaviour for Jalgaon (2022-2024)

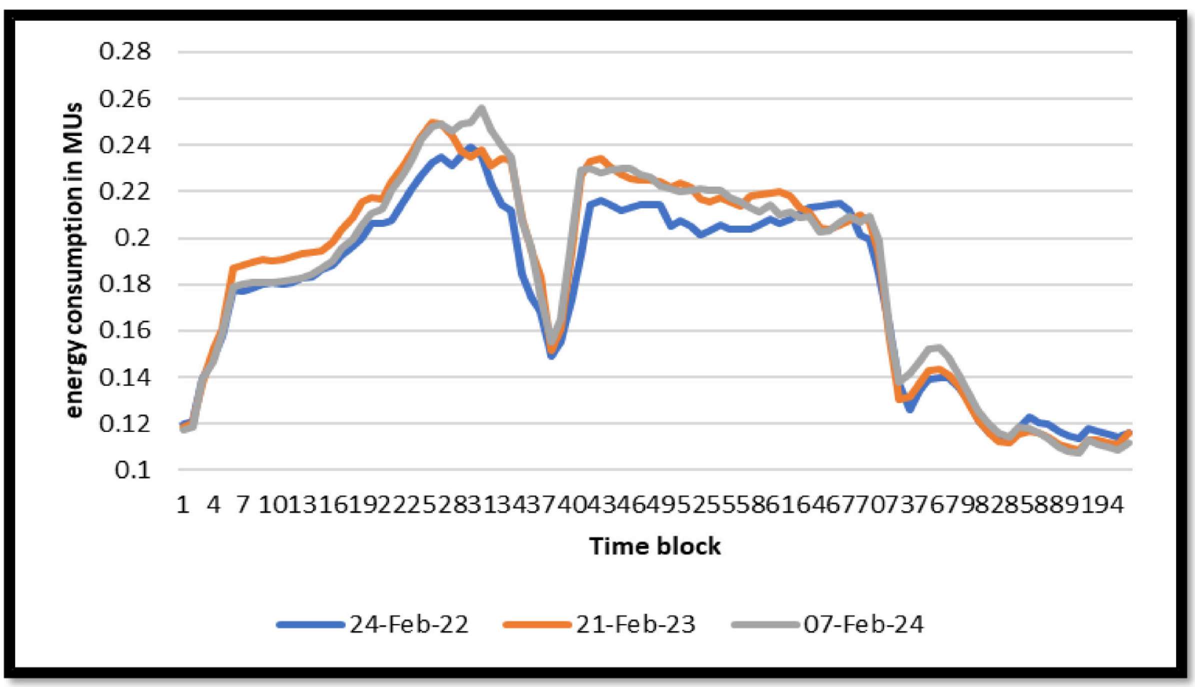

Figure 371: Jalgaon peak days (2022-2024)

28.7 Peak day behaviour for Thane (2022-2024)

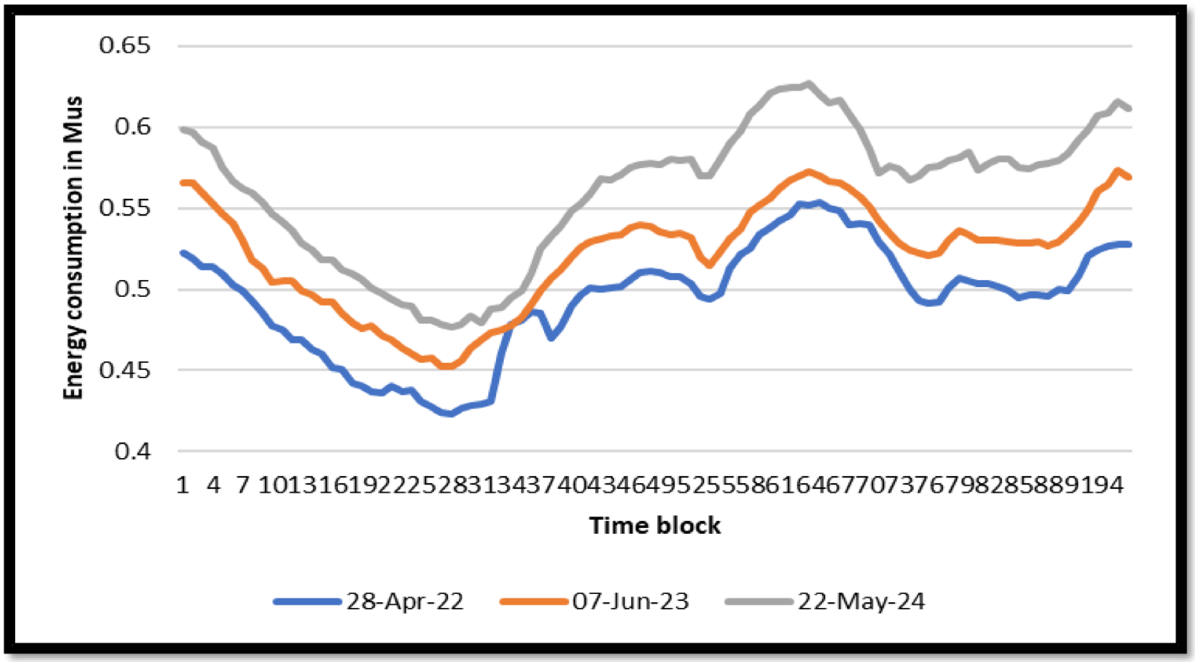

Figure 372: Thane peak days (2022-2024)

28.8 Peak day behaviour for Kolhapur (2022-2024)

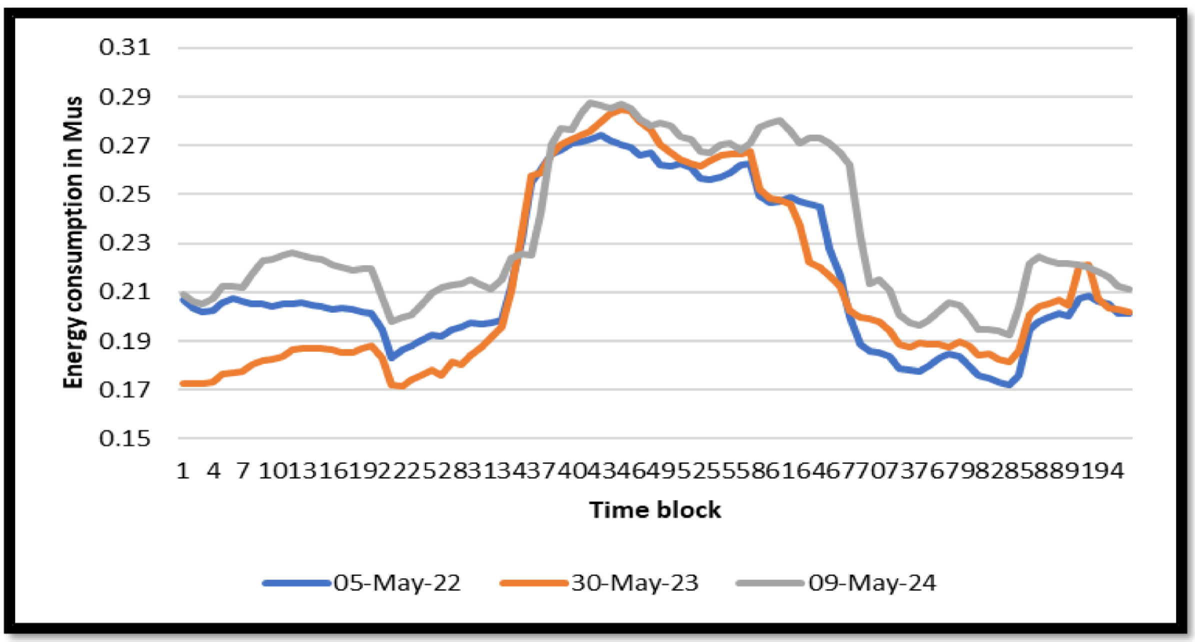

Figure 373: Kolhapur peak days (2022-2024)

28.9 Peak day behaviour for Amravati (2022-2024)

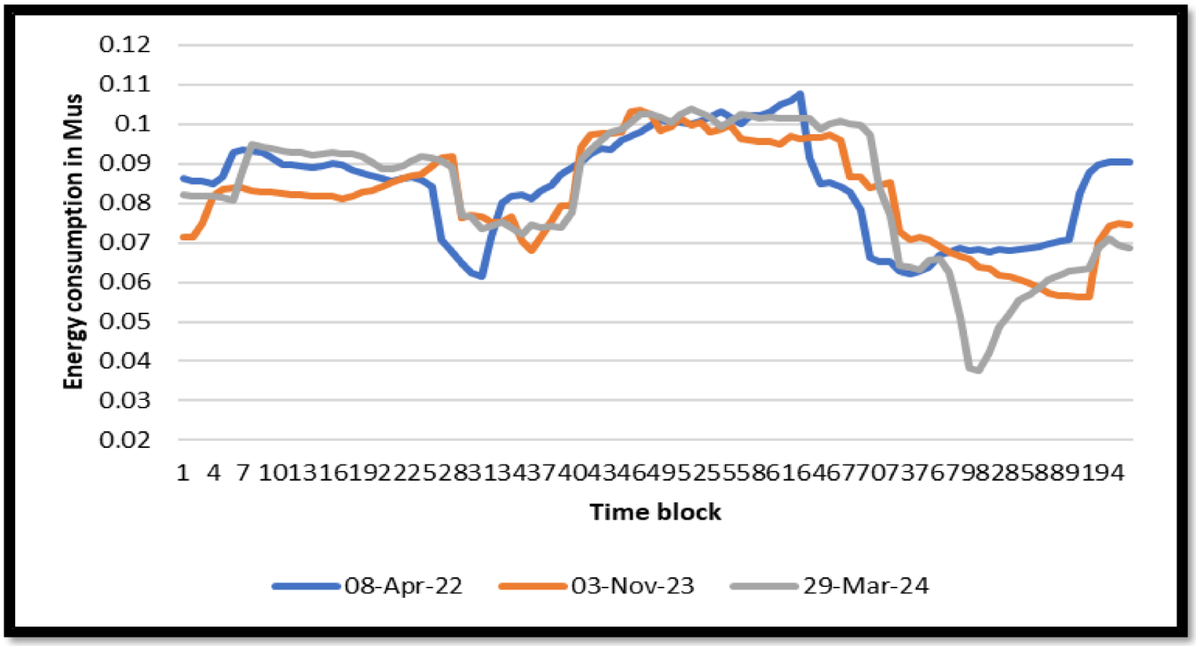

Figure 374: Amravati peak days (2022-2024)

28.10 Peak day behaviour for Solapur (2022-2024)

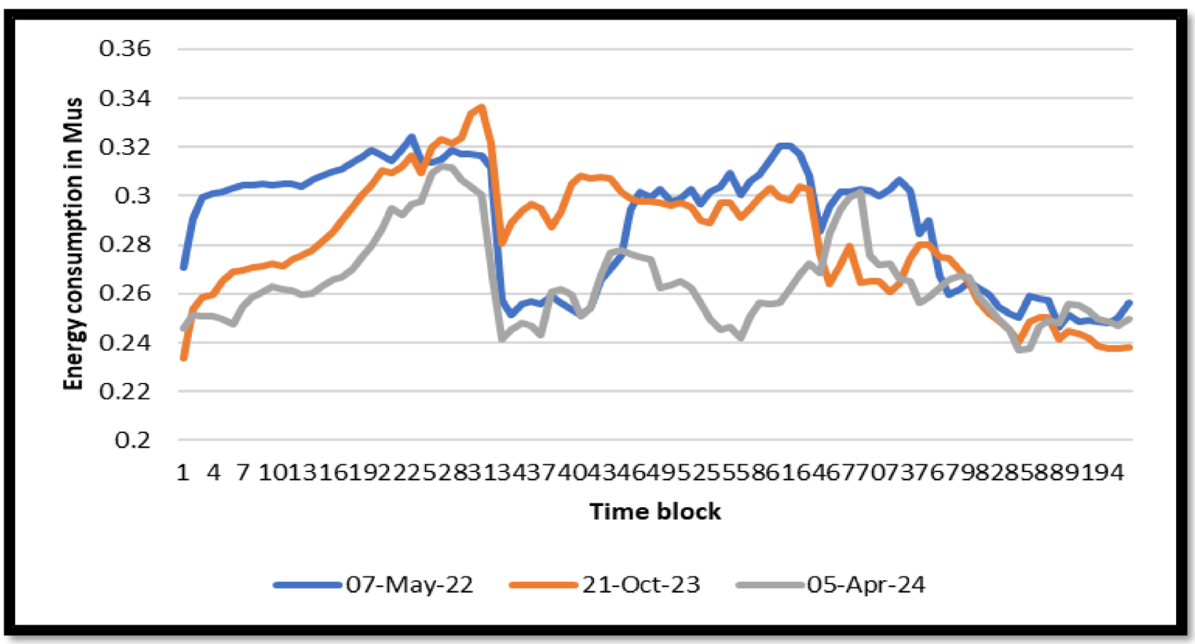

Figure 375: Solapur peak days (2022-2024)

28.11 Peak day behaviour for Ahilyanagar (2022-2024)

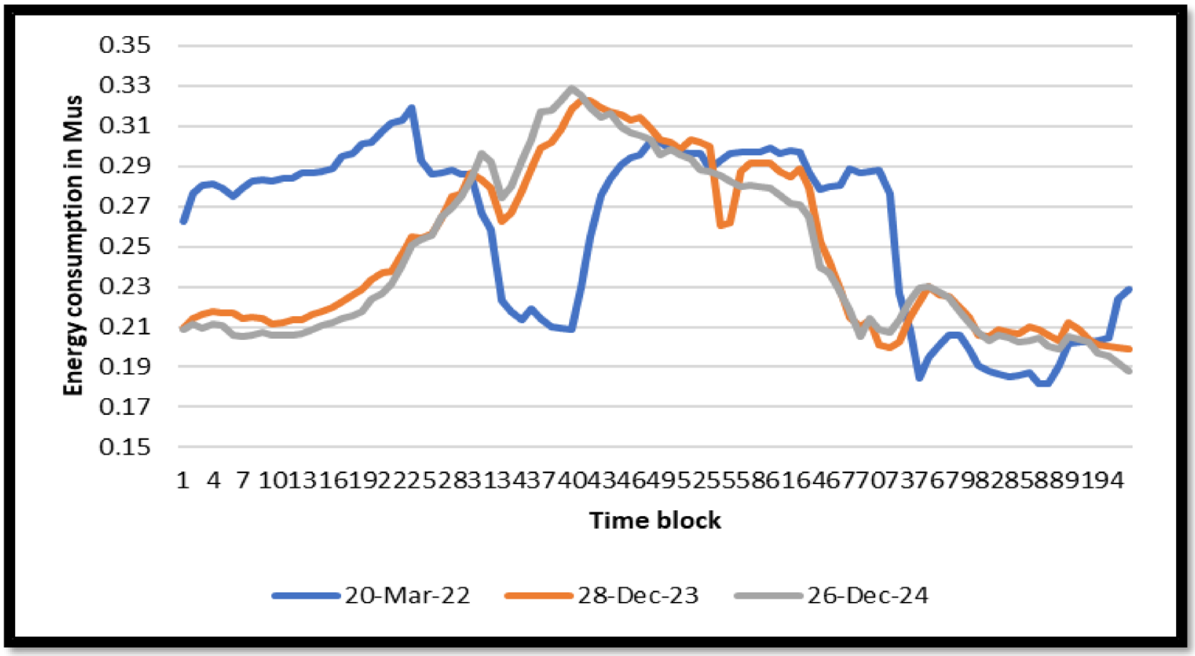

Figure 376: Ahilyanagar peak days (2022-2024)

28.12 Peak day behaviour for Mumbai Suburban (2022-2024)

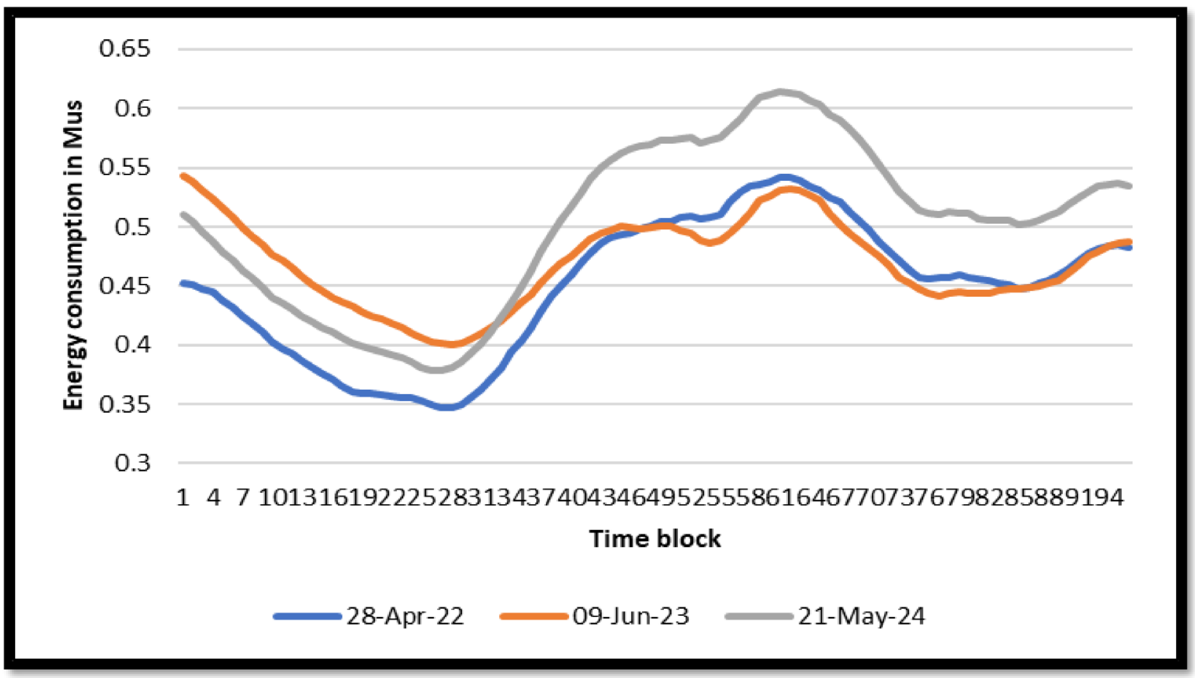

Figure 377: Mumbai suburban peak days (2022-2024)

28.13 Peak day behaviour for Raigad (2022-2024)

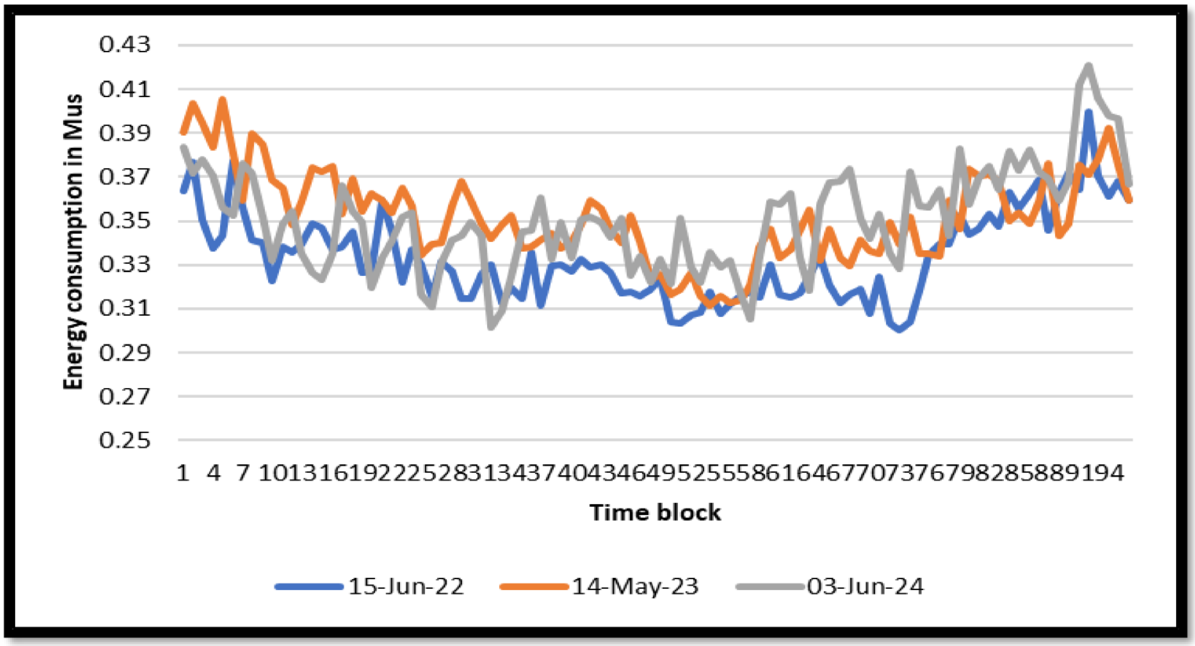

Figure 378: Raigad peak days (2022-2024)

28.14 Time Block Shift on Yearly Peaks (2022–2024) for Districts with the Highest Energy Consumption and Highest Rooftop Solar Capacity

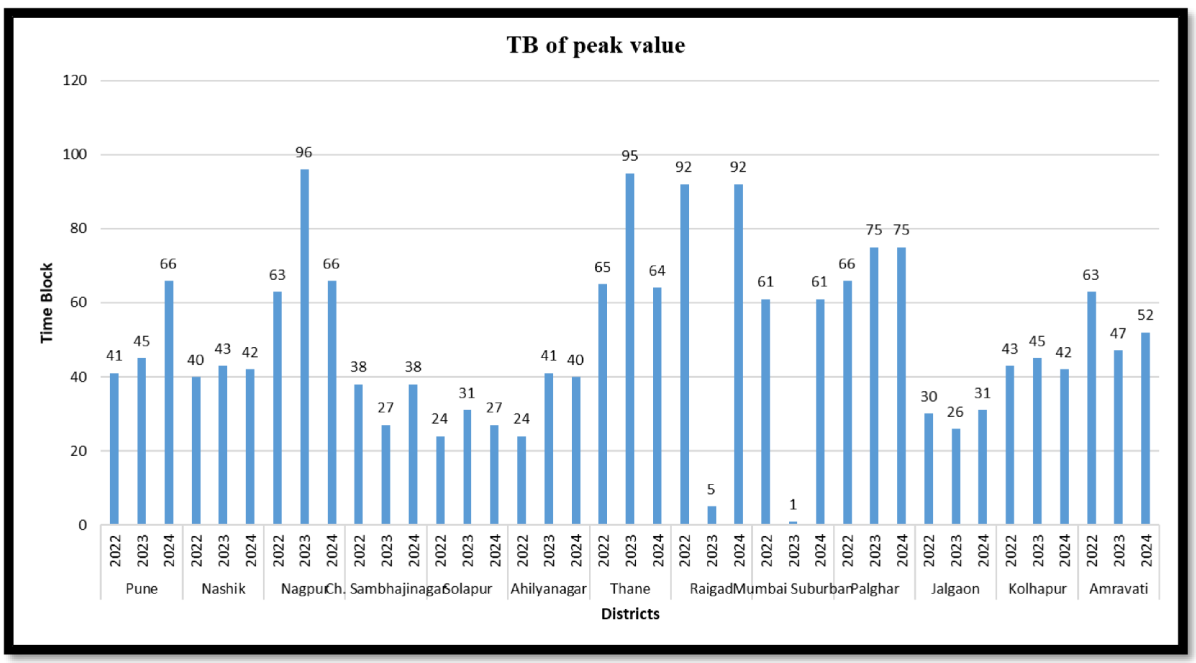

Figure 379: Time Block shift on yearly peaks for 13 districts (2022-2024)

Summary

The plot shows the time-block-wise shifting of peak values on yearly peak days for the districts with the highest energy consumption and highest rooftop solar capacity over the years 2022–2024. The table below provides statistical insights.

Table 68: Year-wise Time-Block of Peak Demand for 13 Districts (2022–2024)

District	Year	TB of peak value
Pune	2022	41
	2023	45
	2024	66
Nashik	2022	40
	2023	43
	2024	42
Nagpur	2022	63
	2023	96
	2024	66
Ch. Sambhajinagar	2022	38
	2023	27
	2024	38
Solapur	2022	24
	2023	31
	2024	27
Ahilyanagar	2022	24
	2023	41
	2024	40
Thane	2022	65
	2023	95
	2024	64
Raigad	2022	92
	2023	5
	2024	92
Mumbai Suburban	2022	61
	2023	1
	2024	61
Palghar	2022	66
	2023	75
	2024	75

District	Year	TB of peak value
Jalgaon	2022	30
	2023	26
	2024	31
Kolhapur	2022	43
	2023	45
	2024	42
Amravati	2022	63
	2023	47
	2024	52

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Appendix: Data Sources

State Demand represents the total electrical requirement of the State for a given time period. It reflects the total energy required to serve consumers, including both the energy supplied from various sources and the unmet demand due to load curtailment.

The State Demand is calculated using the following formula:

State Demand = State Generation + Central Sector Receipt + Load Shedding

1. Components of State Demand

1.1 State Generation

State Generation consists of the total electricity produced within the State boundary from all generating stations. It is computed as:

State Generation = Thermal Generation (MSPGCL + IPP/CPP) + Hydro Generation + Wind

Generation + Solar Generation

1.1.1 Thermal Generation (MSPGCL + IPP/CPP):

Output from State-owned thermal units operated by MSPGCL and private generating stations including Independent Power Producers (IPP) and Captive Power Plants (CPP).

1.1.2 Hydro Generation:

Generation from all hydroelectric stations located within the State.

1.1.3 Wind Generation:

Actual available wind generation, which is variable in nature and dependent on

weather conditions.

1.1.4 Solar Generation:

Total generation from all grid-connected solar plants within the State.

State Generation collectively represents the internal supply capability available for meeting

State demand.

1.2 Central Sector Receipt

Central Sector Receipt represents the net power imported by the State from Central Generating Stations (CGS) and other inter-state exchanges. It is calculated as:

Central Sector Receipt = Sum of Inter - State Line Flows

This includes:

Scheduled allocation from NTPC, NPCIL, and other central generating stations. Unscheduled or market-based interstate power flows (e.g., power exchange purchases). Net import from inter-state transmission corridors. A positive value indicates net power received from the grid, while a negative value indicates net export.

1.3 Load Shedding

Load Shedding represents the demand curtailed due to System constraints, Generation shortage.

Load Shedding is added in the formula to estimate the actual demand that would have occurred in the absence of curtailment. This ensures that the State Demand reflects both met and unmet demand.

2. Consolidated Methodology used in the Daily System Report to derive State Demand:

2.1 Collect State Generation Data

Hourly generation values are obtained from all thermal, hydro, wind, and solar units. In the Daily System Report, all generating stations enter their unit-wise gross generation readings on an hourly basis into the web-based data warehousing system. Nodal Substations collect wind and solar generation data from pooling substations under their jurisdiction.

2.2 Compile Central Sector Receipts

The Net power received from all Interstate tie lines is calculated. All inter-state tie-lines are considered as Ex-Bus values in the Daily System Report. Nodal Substations enter the hourly readings of all inter-state tie-lines into the web-based system.

2.3 Add Load Shedding

Actual load shedding values reported by system operators or distribution companies are added to reflect unmet demand.

2.4 Calculate State Demand

The final State Demand is calculated using:

State Demand = (Thermal + Hydro + Wind + Solar) + (Inter-State Receipts) + (Load Shedding)

3. Limitations in the Existing Method of Calculating Demand:

3.1 Rooftop Solar Generation Not Captured

Rooftop solar reduces consumer drawal from the grid. Since rooftop generation is not measured, the calculated demand appears lower than actual consumer consumption.

3.2 Embedded CPP / Solar / Wind Not Fully Accounted

Some CPP, solar, and wind generators are directly connected to DISCOM networks. Part of the demand is served by such embedded generation, which is not captured in the SLDC data. As a result, the actual demand cannot be derived accurately.

3.3 Demand Represents System Input, Not End-Consumer Demand

The Daily System Report reflects the input requirement at the transmission/generation level. It does not represent actual *consumer-level* demand after considering distribution losses, embedded generation, and rooftop solar. Therefore, the reported demand differs from actual consumption by consumers.

4.District-wise Energy Consumption and Rooftop Solar impact in Maharashtra

Block-wise DSM meter data for 36 districts is taken for analysis. Rooftop solar data is taken from MSEDCL and Mumbai utilities (AEML, BEST and TPC-D). For the analysis of rooftop solar impact on state and district peak days, only MSEDCL data is used.

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MAHATRANSCO
Maharashtra State Electricity Transmission Co. Ltd.

SLDC SUMMIT 2026
Powering Energy Transition

Maharashtra State Load Despatch Centre