

STUDY OF DEMAND PATTERNS AND TIME OF DAY (TOD) TARIFF STRUCTURE IN ELECTRICITY TARIFF IN GOA

December 2024



ELECTRICITY DEPARTMENT
Government of GOA

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1 Background

1.1 Context

The concept of Time of Day (TOD) tariff has been increasingly adopted across India to optimize electricity consumption patterns by aligning energy demand with supply capabilities. TOD tariff structures are primarily designed to incentivize consumers to shift their electricity usage away from peak demand periods and into off-peak hours. Such initiatives reduce the strain on generation and distribution systems while minimizing overall electricity procurement costs.

In Goa, electricity planning and tariff management are primarily overseen by the Electricity Department of Goa (ED-Goa) and the Joint Electricity Regulatory Commission (JERC) for the state of Goa and Union Territories. Goa's unique geographical and economic profile, characterized by tourism, industries, and a growing urban population, results in distinctive electricity consumption trends. Seasonal variations in demand (monsoon, summer, and winter) further influence the electricity load curve. Goa, being a major tourism hub in India, sees a sharp rise in electricity demand at the end of the year. This is mainly due to increased usage in domestic, hotels, and businesses driven by the influx of tourists.

The demand pattern for the state of Goa has notably changed over the years. It is to be noted that the ED-Goa is always in deficit of peak power and hence has to procure expensive power from Open Market. This report proposes changes in the ToD structure and tariff rates which can help shift the load from Peak to off-peak and normal hours, similar to the practices adopted by the other Indian states.

1.2 Scope of Work

- **Demand Curve Analysis:** Analysis of 15-minute demand data from the Goa SLDC to assess peak and off-peak load variations.
- **Comparative Study:** Comparison of TOD tariff structures from other Indian states to identify best practices.
- **Recommendations:** Developing a comprehensive TOD tariff proposal aimed at flattening the demand curve.

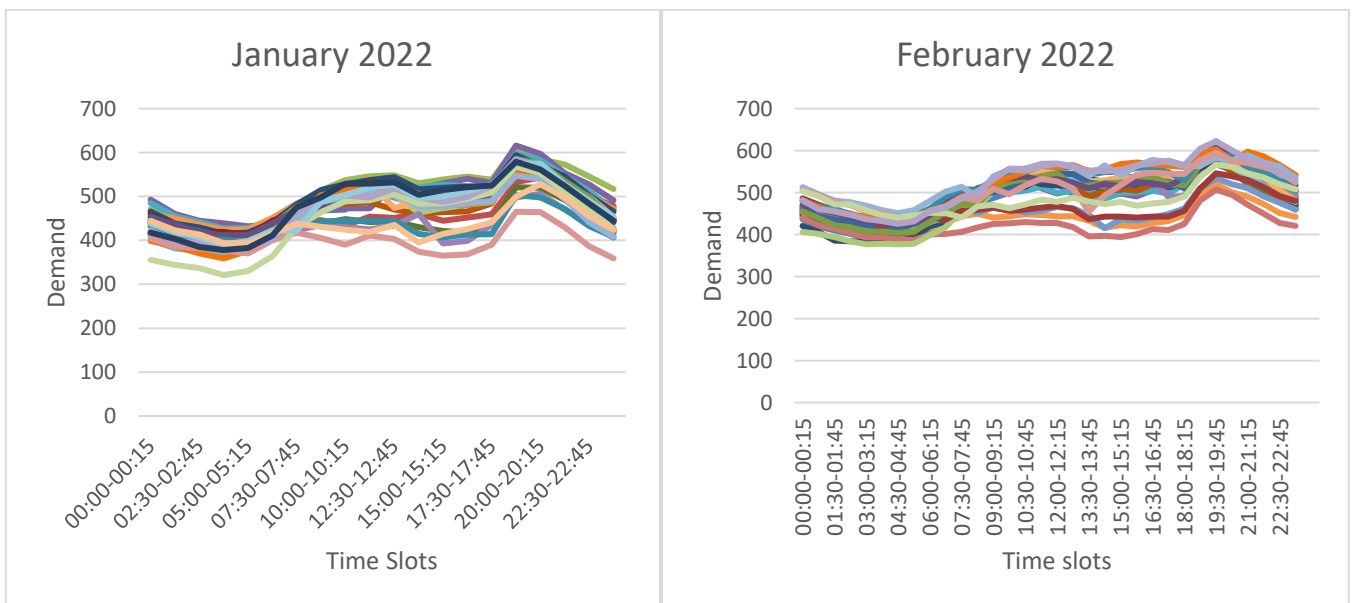
2 Introduction

The study aims to analyze the 15-minute interval demand data of two years (2022 & 2023) provided by the Goa State Load Dispatch Centre (SLDC) to understand the consumption patterns and load curves of the Distribution Licensees in Goa. This analysis aims to identify variations in electricity demand across different times of the day and months, with a particular focus on peak and off-peak periods. The objective is to determine the most effective time slots for demand response to flatten or shift the load curve. Utilizing the verified demand data, the study seeks to redesign the Time-of-Day (ToD) tariff structure for the Distribution Licensees in Goa.

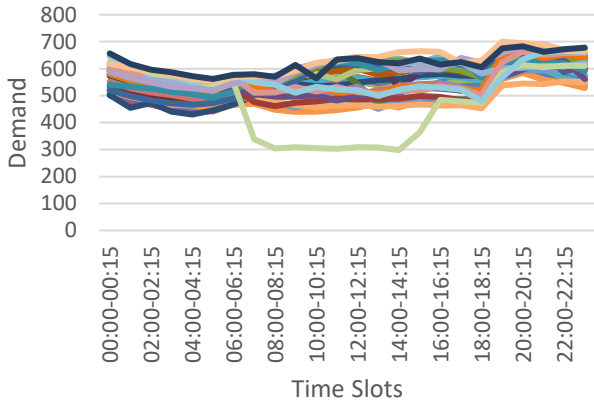
For this study, 15-minute interval demand data from the Goa SLDC was utilized and cross-verified with the hourly demand data from the Monthly Reports available on the WRLDC website.

The WRLDC reports present hourly figures of four 15-minute intervals by averaging them. Upon comparison with the data available on the SLDC website, consistency was observed with the RLDC data, confirming its accuracy through verification from two sources. The demand pattern is illustrated in the monthly graphs provided below –

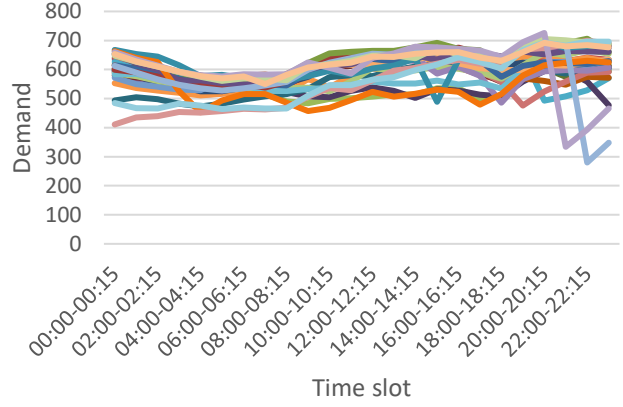
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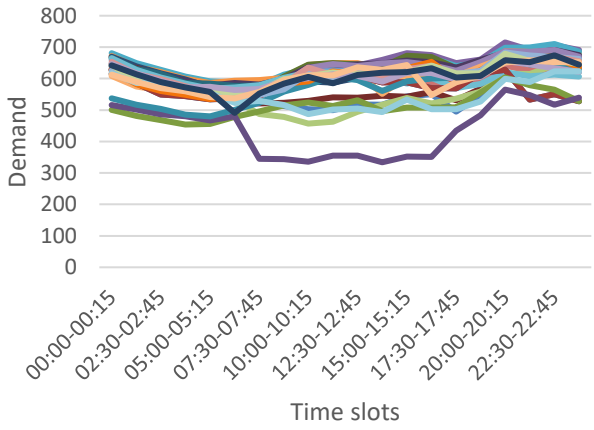
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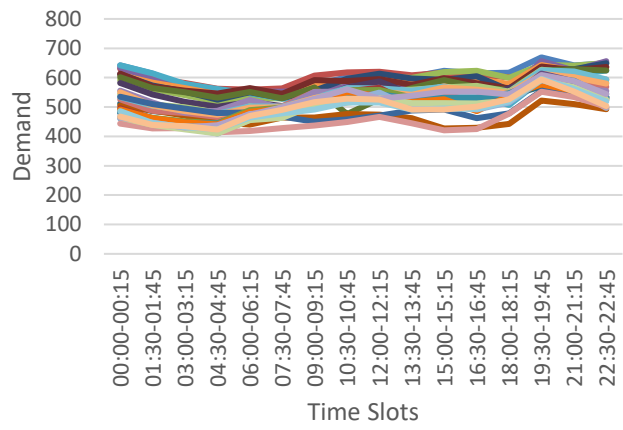
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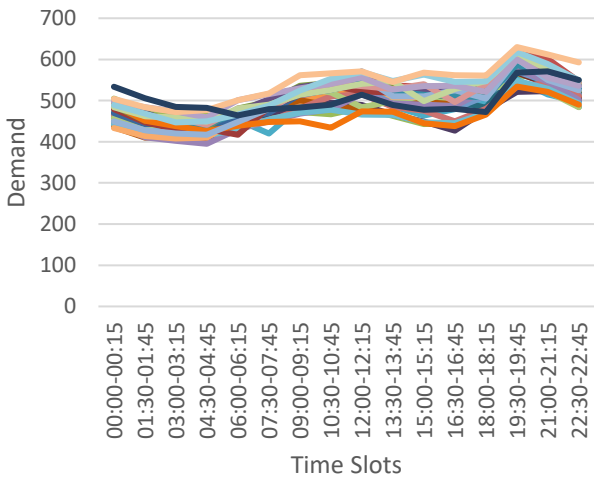
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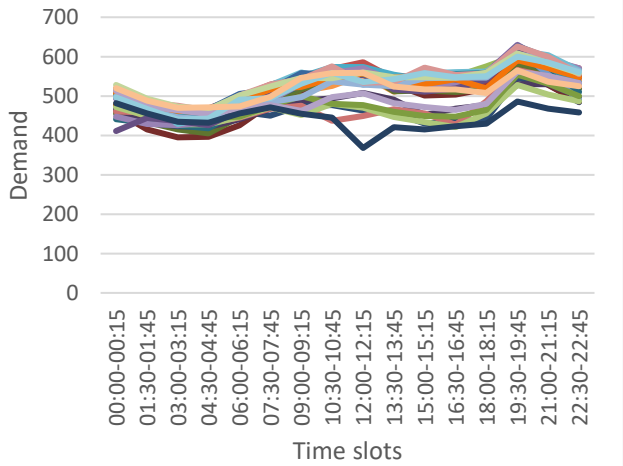
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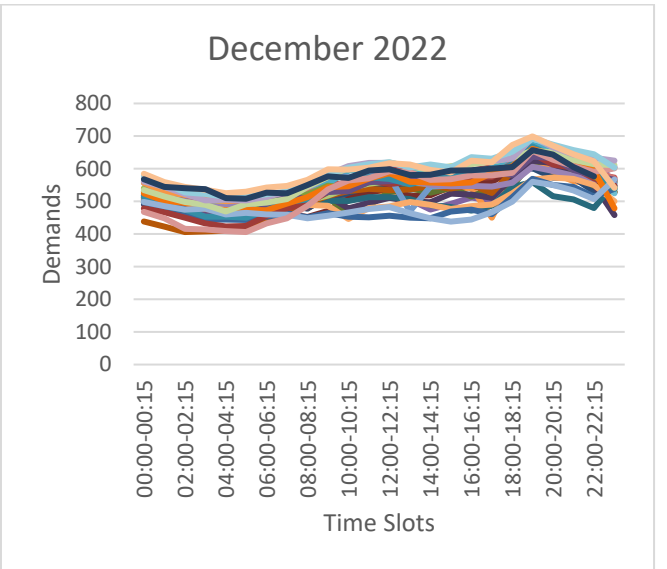
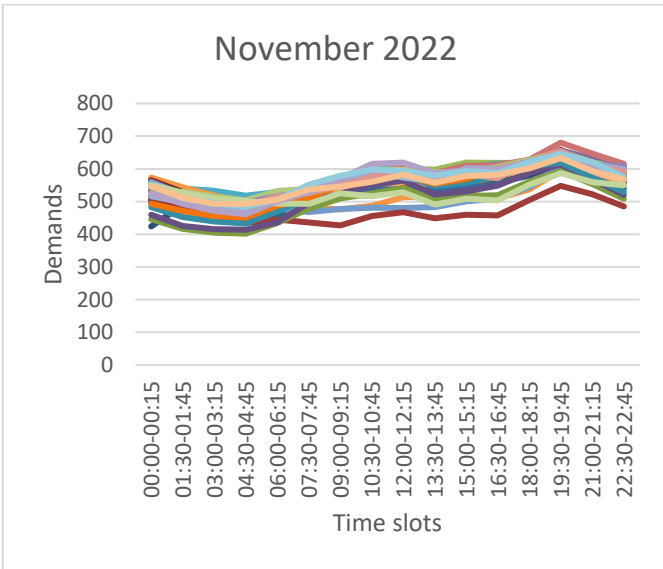
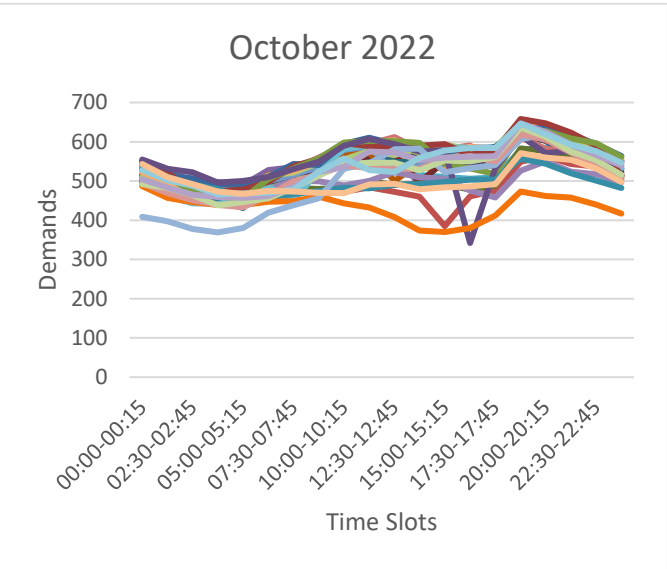
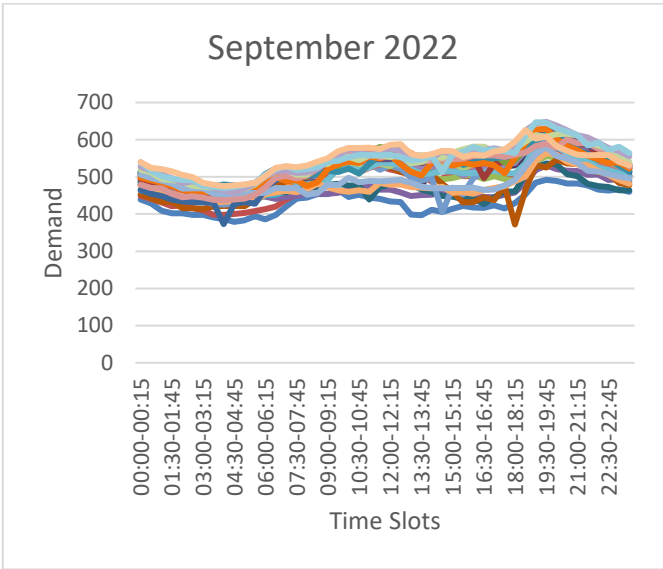


July 2022



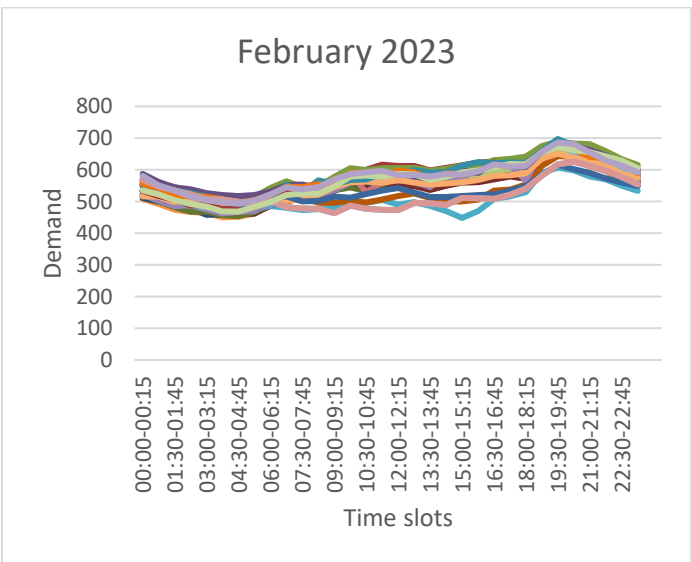
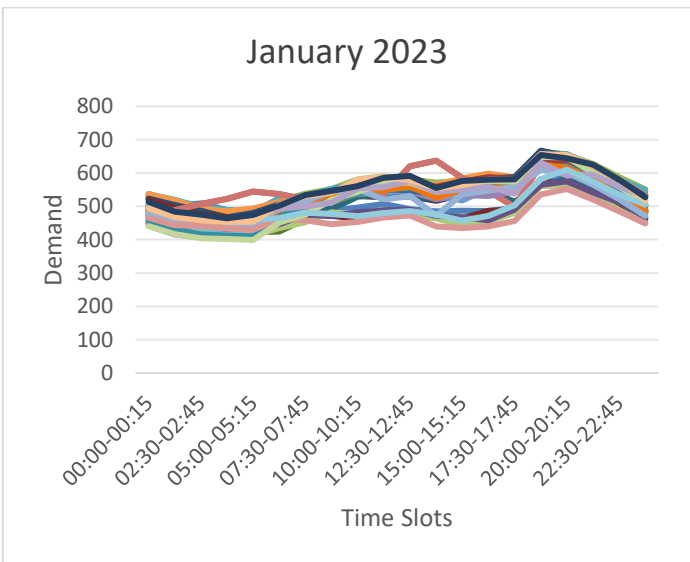
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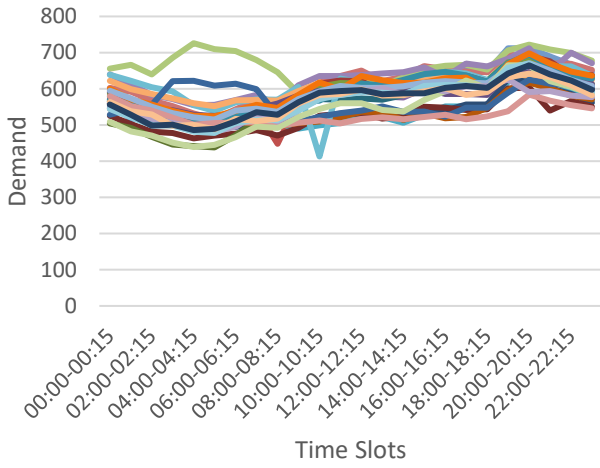


**There have been some outliers days observed in few months, due to absence of data is some time-slots*

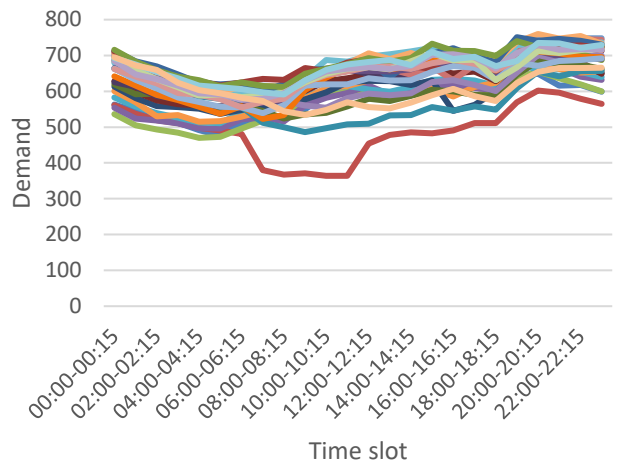
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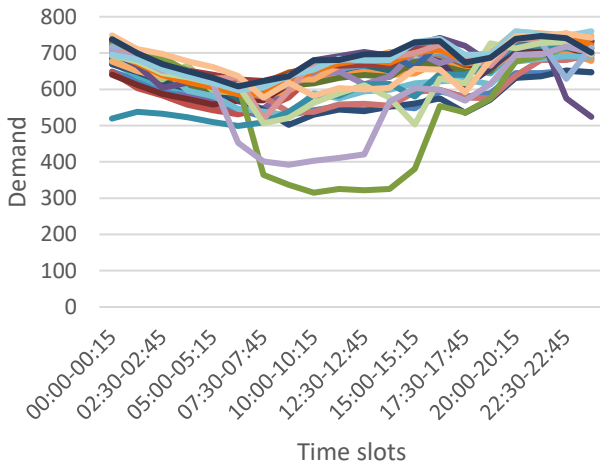
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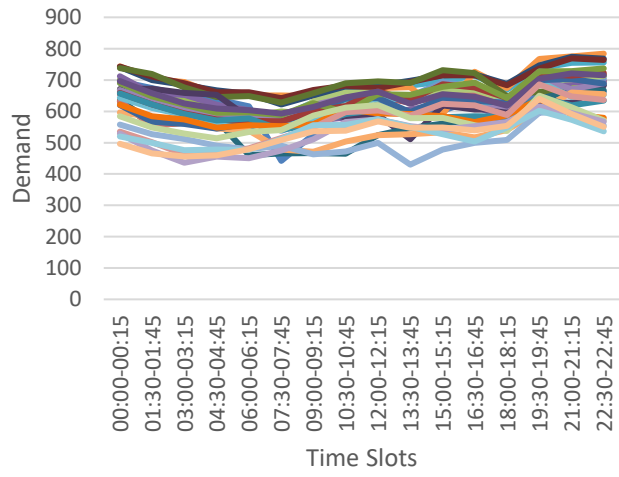
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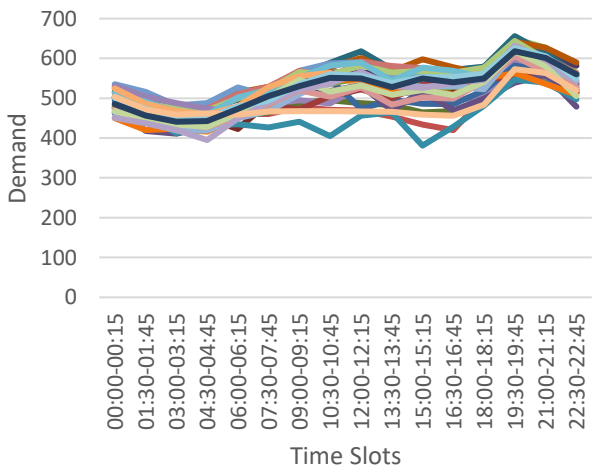
May 2023



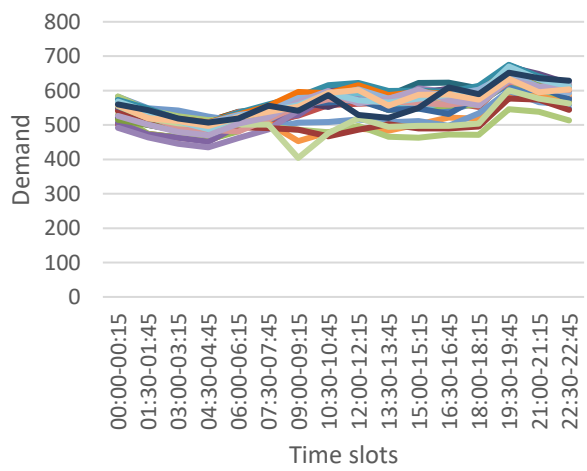
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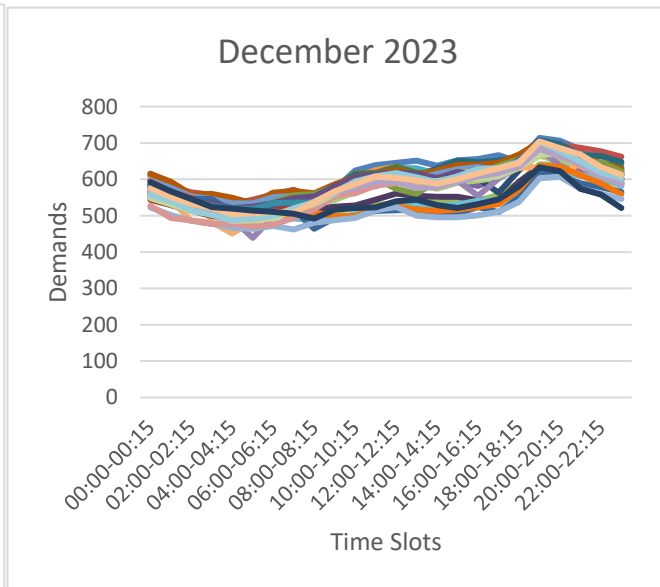
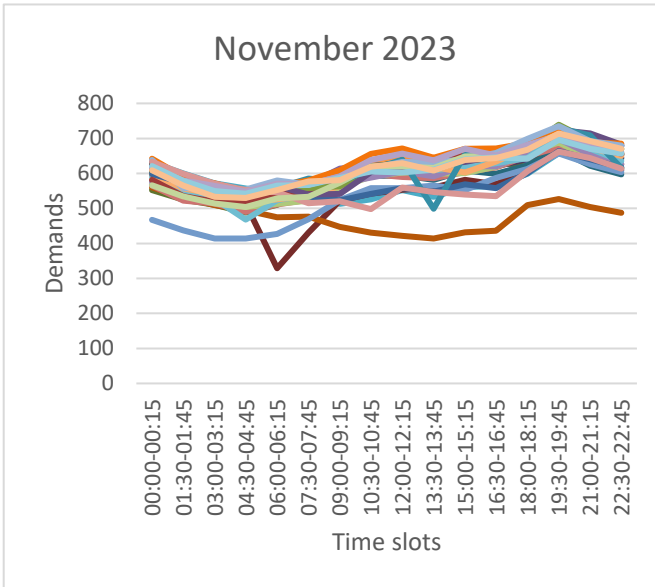
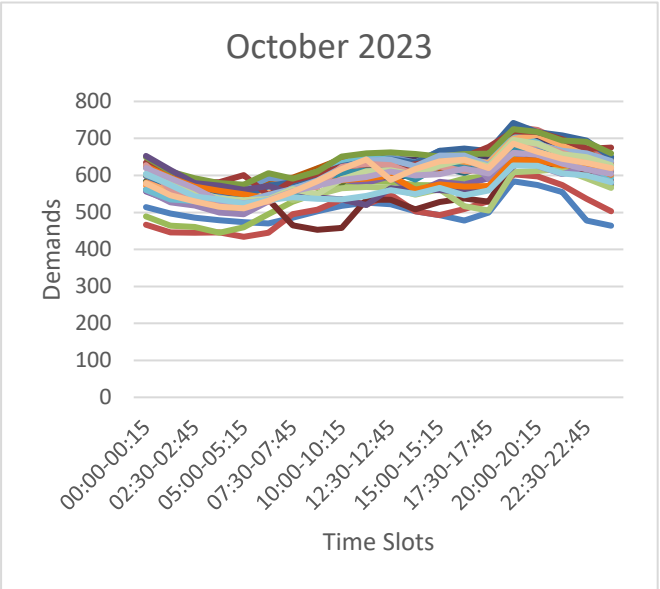
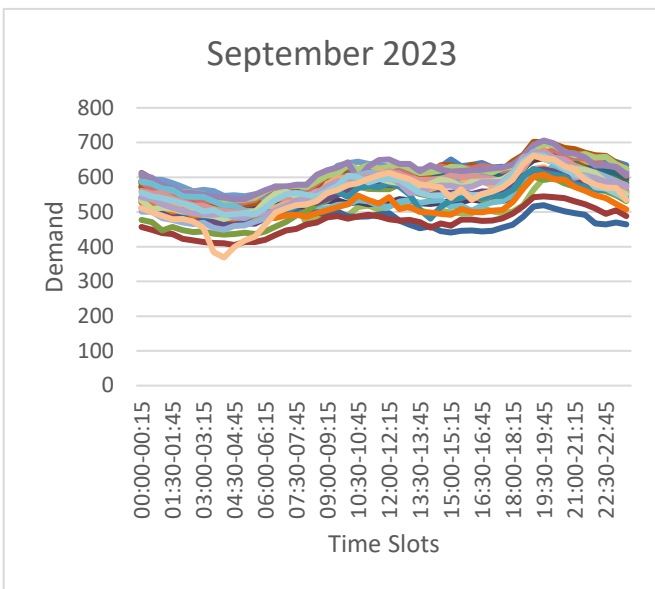


July 2023



August 2023





**There have been some outliers days observed in few months, due to absence of data in some time-slots*

The graphs typically illustrate, the 15-minutes time block wise demand for 24-hour period and the variation in electricity demand across all the 12 months in a year. It helps analyze energy consumption/load patterns at different times of the days and months, allowing the utility and planners to understand the peak and off-peak periods and optimize its power procurement and grid operations. The above Graphs shows:

1. Peak demand times (Evening when activities like hotels, restaurants, resorts, Clubs, etc. are High) Tourism-driven demand may add significant load in the evenings (hospitality and entertainment sectors).
2. Low demand during morning (when most residential and commercial activities are minimal).

3 Methodology

The patterns in demand have been studied to identify different time slots where changes are required to be introduced.

As a part of this analysis, we have analysed the data provided by the Goa SLDC which was submitted to the Electricity Department of Goa (ED-Goa) through their Daily Load Report (DLR) sheet from January 2022 to December 2024.

1. Data Collection:

- **15-Minute Slot Demand Data:** The study utilizes demand data provided by the State Load Dispatch Centre (SLDC) for Goa, which records electricity demand in 15-minute intervals. This data allows for a detailed analysis of load patterns throughout the day.
- **Historical Load Data:** Data from previous years (2022, 2023) is analysed to identify trends and variations in electricity demand.

2. Demand Curve Analysis:

- **Hourly and Seasonal Demand Curves:** The analysis involves creating hourly demand curves for the DISCOM, comparing them across different seasons. This helps identify peak demand periods and off-peak periods.

3. Forecasting and Projections:

- **Future demand projections** can be made based on historical data trends and expected changes in consumer behaviour due to the introduction of ToD tariffs. This forecasting helps in planning for future energy supply requirements.

By employing the above methodology, the study aims to provide actionable insights into observing the changes in demand patterns over the years and how the changes in the ToD structure can be effectively implemented in Goa, corresponding to its actual patterns and helping in power procurement optimization, deploying strategies to try and shift the demand/load curve to flatten it, ensuring sustainability while meeting consumer needs.

4 Study and Findings on TOD structure in Goa

The existing TOD structure of Goa is given below:

Time of Use	Demand Charge	Energy Charge
Normal Period (7 AM to 6 PM)	Normal Rate	Normal Rate
Evening Peak Load (6 PM to 11 PM)	Normal Rate	130% of Normal rate
Off-Peak Load (11 PM to 7 AM)	Normal Rate	80% of Normal rate

However, from the demand patterns, it can be observed that the peak hours have increased from 5 hours to minimum 8 to 10 hours. Further, ED-Goa now observes two peaks – Morning and Evening. In addition, the peak hours and demand pattern changes corresponding to the seasons.

To further understand the practices done by other Indian states, their current TOD structure and tariff has to be observed –

- **Maharashtra**

Time of Use	TOD Tariffs (in addition to the base Tariffs) (Rs/kWh)
22:00 hours to 06:00 hours	(1.50)
06:00 hours to 09:00 hours & 12:00 hours to 18:00 hours	0.00
09:00 hours to 12:00 hours	0.80
18:00 hours to 22:00 hours	1.10

- **Gujarat**

Charges for Seasonal Consumers:

Tariff Category	Minimum bill per installation for seasonal consumers	Charges for units consumed during the off-season period
NON-RGP	Rs. 1800 per annum per kW of the contracted load/ sanctioned load.	480 Paise per unit
LTMD	Rs. 2970 per annum per kW of the billing demand.	470 Paise per unit
HTP-I	Rs. 4550 per annum per kVA of the billing demand.	430 Paise per unit

Time of Use:

Tariff Category	Time of Use	Rate
LTMD	Additional charge for energy consumption during two peak periods, viz, 07:00 Hrs. to 11:00 Hrs. and 18:00 Hrs. to 22:00 Hrs.	45 Paise per Unit
WWSP	For energy consumption during the off-peak period, viz, 11:00 Hrs. to 18:00 Hrs.	40 Paise per Unit
HTP-I	For energy consumption during the two peak periods, viz, 07:00 Hrs. to 11:00 Hrs. and 18:00 Hrs. to 22:00 Hrs.	For billing demand up to 500 kVA - 45 Paise per Unit
HTP-II		For billing demand above 500 kVA - 85 Paise per Unit
HTP-III	Additional charge for energy consumption during two peak periods, viz, 07:00 Hrs. to 11:00 Hrs. and 18:00 Hrs. to 22:00 Hrs.	85 Paise per Unit

- Uttar Pradesh

Summer Months (April to September)

Time of Use	% of Energy Charges
05:00 hrs – 10:00 hrs	(-) 15%
10:00 hrs – 19:00 hrs	0%
19:00 hrs – 03:00 hrs	(+) 15%
03:00 hrs – 05:00 hrs	0%

Winter Months (October to March)

Time of Use	% of Energy Charges
05:00 hrs – 11:00 hrs	0%
11:00 hrs – 17:00 hrs	0%
17:00 hrs – 23:00 hrs	(+) 15%
23:00 hrs – 05:00 hrs	(-) 15%

- Karnataka

Time of Day	From July to November (monsoon period) (paise / unit)	From December to June (paise / unit)
06.00 Hrs to 09.00 Hrs	0	(+)100
09.00 Hrs to 18.00	0	0

Time of Day	From July to November (monsoon period) (paise / unit)	From December to June (paise / unit)
Hrs		
18.00 Hrs to 22.00 hrs	0	(+)100
22.00 Hrs to 06.00 Hrs	0	(-)100

- Uttarakhand**

TOD load

Season/Time of day	Morning Peak hours	Normal hours	Evening Peak Hours	Off-peak Hours
Winters 01.10 to 31.03	06:00-09:00 hrs	09:00-18:00 hrs	18:00-22:00 hrs	22:00-06:00 hrs
Summers 01.04 to 30.09	-	07:00-18:00 hrs	18:00-23:00 hrs	23:00-07:00 hrs

For LT Industry

Energy Charge during		
Normal Hours	Peak Hours	Off-peak Hours
Rs. 5.40/kVAh	Rs. 7.02/kVAh	Rs. 4.05/kVAh

For HT Industry

Load Factor	Energy Charge during		
	Normal Hours	Peak Hours	Off-peak Hours
Upto 40%	Rs. 6.00/kVAh	Rs. 8.32/kVAh	Rs. 4.50/kVAh
Above 40%	Rs. 6.40/kVAh	Rs. 8.32/kVAh	Rs. 4.80/kVAh

After observing the TOD structure of other states, the deviation in the time of use hours due to seasonality can be witnessed. Further, it is also evident that the overall number of peak hours are more than 5 hours with two peak load periods in most cases.

The analysis of the monthly load curves for CY 2022 and CY 2023, clearly establishes a pattern of demand with respect to peak and off-peak period, which is different from its current TOD structure approved by JERC. Further a monthly analysis based on the demand load pattern of Goa is provided below-

EDG's monthly analysis for the year 2022 is given below:

MONTHLY ANALYSIS (MORNING 2022)				
Month	Morning Peak	Highest Morning Peak (MW)	Average Morning Peak (MW)	No. of hours
Winter				
January	7.00AM-12.00PM	555	483	4
February	8.00AM-12.30PM	580	514	4.5
Summer				
March	8.00AM-1.30PM	655	543	5.5
April	8.15AM-1.30PM	673	673	5.15
May	8.00AM-2.00PM	659	586	6
June	7.45AM-2.00PM	630	541	6.15
Monsoon				
July	8.00AM-1.00PM	578	518	5
August	7.00AM-1.00PM	586	526	6
September	7.30AM-1.00PM	580	522	5.5
Tourist				
October	8.00AM-1.45PM	614	542	5.45
November	8.30AM-1.30PM	622	552	5
December	7.45AM-2.15PM	627	543	6.3

MONTHLY ANALYSIS (EVENING 2022)				
Month	Evening Peak	Highest Morning Peak (MW)	Average Morning Peak (MW)	No. of hours
Winter				
January	6.00 PM-10.00PM	616	540	4
February	6.00PM-11.15PM	622	540	5.15
Summer				
March	6.15PM-3.45AM	704	592	9.3
April	6.00PM-4.00AM	726	600	10
May	6.00PM-2.45AM	715	627	8.45
June	6.30PM-5.00AM	669	540	10.3
Monsoon				
July	5.45PM-12.30AM	631	536	6.45
August	5.30PM-11.30PM	631	554	6
September	5.00PM-12.00AM	652	551	7
Tourist				
October	5.30PM-3.00AM	658	548	9.3

MONTHLY ANALYSIS (EVENING 2022)				
Month	Evening Peak	Highest Morning Peak (MW)	Average Morning Peak (MW)	No. of hours
November	5.30PM-4.15AM	685	554	10.45
December	6.45PM-3.45AM	701	546	9

EDG's monthly analysis for the year 2023 is given below:

MONTHLY ANALYSIS (MORNING 2023)				
Month	Morning Peak	Highest Morning Peak (MW)	Average Morning Peak (MW)	No. of hours
Winter				
January	7:30AM-12:30PM	594	529	4
February	8:00AM-12:15PM	621	554	4.15
Summer				
March	8:00AM-1:15PM	650	574	5.25
April	8:00AM-1:00PM	711	615	5
May	8:00AM-2:00PM	703	614	6
June	8:00AM-1:45PM	708	602	5.75
Monsoon				
July	7:45AM-12:45PM	618	529	5
August	8:15AM-1:00PM	617	531	4.15
September	8:00AM-1:00PM	651	573	5
Tourist				
October	8:15AM-2:00PM	668	592	5.15
November	8:00AM-1:00PM	671	583	5
December	8:00AM-1:15PM	657	570	5.15

MONTHLY ANALYSIS (EVENING 2023)				
Month	Evening Peak	Evening Highest Peak (MW)	Evening Average Peak (MW)	No. of hours
Winter				
January	6:00 PM-10:00PM	680	608	4
February	6.00PM-11:15PM	699	600	9
Summer				
March	6.15PM-2:15AM	726	631	8
April	6.00PM-4:00AM	771	685	10
May	6:45PM-2:45AM	763	706	8
June	6:45PM-3:45AM	784	665	9
Monsoon				
July	6.00PM-12:00AM	657	598	6
August	6.00PM-12.00AM	677	603	6
September	6:00PM-1:00AM	709	610	7
Tourist				

MONTHLY ANALYSIS (EVENING 2023)				
Month	Evening Peak	Evening Highest Peak (MW)	Evening Average Peak (MW)	No. of hours
October	6:00PM-2:15AM	742	652	8.15
November	6.00PM-2:30AM	741	660	8.3
December	6.00PM-2:30AM	741	662	8.3

From the above analysis, the following can be concluded for the demand of Electricity Department of Goa:

Seasonal Variations in Demand:

Summer:

- The highest morning peaks and evening peaks are observed during the summer months (March to June).
- The demand during evenings is especially significant, with peak hours extending late into the night and early morning.
- April recorded the highest evening peak in 2022 (726 MW) and 2023 (771 MW), indicating the need for robust supply during these months.

Monsoon:

- Demand reduces slightly during the monsoon season (July to September).
- However, consistent demand during evening peaks suggests continued reliance on electricity even with cooler temperatures.

Tourism:

- Moderate demand is observed, with some months like November and December showing a notable increase in evening peaks, due to several festivals in Goa during these months and an in rush of tourist in Goa, during this period because of the tourism season and Christmas and new year celebrations.

Winter:

- Though winter is observed in few months in Goa, the demand in January and February, dips a bit owing to end of tourist seasons and festivities.

5 Recommendations on TOD structure in Goa

Based on the above discussion, it is clear that the current ToD structure in Goa is not in sync with the demand patterns of the state. The following are the recommendations regarding the TOD structure in the state of Goa:

- ED-Goa now observes two peaks – Morning and Evening. In addition, the peak hours and demand pattern changes corresponding to the seasons.
- Hence, it is suggested to increase the TOD slots (from 3 slots to 4 slots) and the number of hours after analysing the demand data for previous two years.
- The changes in the TOD structure and tariff rates are proposed to shift the load from Peak to off-peak and normal hours, which also are similar to the practices adopted by other states.
- The table below provides the existing and proposed TOD structure and tariff rates:

Existing TOD Structure and Tariff Rates			Proposed TOD Structure and Tariff Rates		
Same for all Seasons <i>(All the months)</i>			Summer & Tourist Season <i>(March, April, May, June, October, November, December)</i>		
Time of Use	Demand Charge	Energy Charge	Time of Use	Demand Charge	Energy Charge
Normal Period (7 AM to 6 PM)	Normal Rate	Normal Rate	Morning Peak (8 AM to 1 PM)	Normal Rate	120% of Normal rate
Evening Peak Load (6 PM to 11 PM)	Normal Rate	130% of Normal rate	Normal Period (1 PM to 5 PM)	Normal Rate	Normal Rate
Off-Peak Load (11 PM to 7 AM)	Normal Rate	80% of Normal rate	Evening Peak Load (5 PM to 2 AM)	Normal Rate	140% of Normal rate
			Off-Peak Load (2 AM to 8 AM)	Normal Rate	90% of Normal rate
			Other Season (Monsoon & Winter) <i>(January, February, July, August, September)</i>		
			Time of Use	Demand Charge	Energy Charge
			Morning Peak (8 AM to 12 PM)	Normal Rate	120% of Normal rate
			Normal Period (12 PM to 5:30 PM)	Normal Rate	Normal Rate
			Evening Peak Load (5:30 PM to 12:30 AM)	Normal Rate	140% of Normal rate
			Off-Peak Load (12:30 AM to 8 AM)	Normal Rate	90% of Normal rate

WRLDC monthly reports- https://www.wrlc.in/content/186_1_MonthlyMISReports.aspx

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