Study to assess Time of Day tariffs for Rajasthan DISCOMs

Prayas (Energy Group)

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Prayas (Energy Group)

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About Prayas

Prayas (Initiatives in Health, Energy, Learning and Parenthood) is a non-Governmental, non-profit organization based in Pune, India. Members of Prayas are professionals working to protect and promote public interest in general, and interests of the disadvantaged sections of the society, in particular. Prayas (Energy Group) works on theoretical, conceptual, regulatory and policy issues in the energy and electricity sectors. Our activities cover research and engagement in policy and regulatory matters, as well as training, awareness, and support to civil society groups. Prayas (Energy Group) has contributed to policy development in the energy sector as part of several official committees constituted by Ministries, Regulatory Commissions and the Planning Commission/NITI Aayog. Prayas is registered as SIRO (Scientific and Industrial Research Organization) with Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India.

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1 Background and context

The Rajasthan Electricity Regulatory Commission (RERC) vide letter dated 3rd August 2022 and the Order in Case Nos. 2011/22, 2012/22, 2013/22 appointed Prayas (Energy Group) to conduct a study on Time of Day (ToD) tariff design for Rajasthan.

Prayas (Energy Group) or PEG was to analyse demand and supply variations on an hourly/ 15 min. basis in Rajasthan and study ToD tariff design in other states in India. PEG was to recommend:

- Time of day tariff design based on demand and supply variations and trends
- Possibility of seasonal variation in penalties and surcharges
- Time period for applicability of recommended ToD design and framework for future rate determination.
- Roadmap for applicability of ToD framework for consumers with minimum connected load threshold.
- Mechanism / formats to capture impact of changes made in ToD tariff structure on DISCOM's load curve.

The study and the recommendations, presented in this report are applicable for the three state-owned Distribution Companies in Rajasthan, namely:

- Ajmer Vidyut Vitran Nigam Limited
- Jaipur Vidyut Vitran Nigam Limited
- Jodhpur Vidyut Vitran Nigam Limited

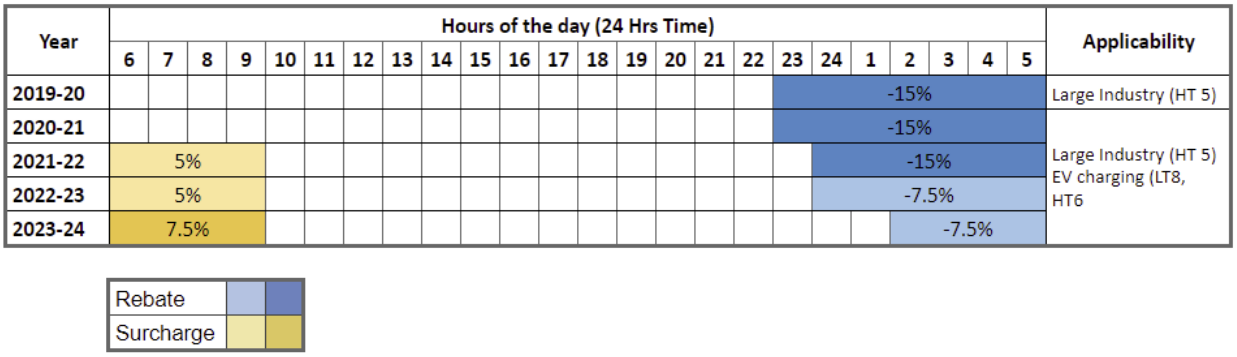
1.1 Time of Day (ToD) tariffs in Rajasthan

Presently, all three DISCOMs in Rajasthan have a single procurement agency, namely Rajasthan Urja Vikas Nigam Limited (RUVNL) and a centralised procurement and planning process under the Energy Assessment Committee (EAC). All Rajasthan DISCOMs have the same tariffs for particular categories.

Unlike many other states where ToD tariffs were levied in the 2000s, Rajasthan DISCOMs started charging Time of Day tariffs only by 2019-20 after RERC approved a 15% rebate from 23:00 to 06:00. The tariffs were applicable only on HT Industry category[1]. Since 2019-20, there have been changes in the ToD tariff design almost every year as shown in Figure 1.

[1] RERC Order in Case Nos.1541/19, 1542/19, 1543/19 dated 06/02/2020

Figure 1: ToD tariffs approved by RERC- A timeline



In 2020-21, the rebate was extended to the EV charging category (both LT and HT) which has continued till 2023-24[2]. In 2021-22, concerned that only round the clock industries were availing rebate without any load shifting, a 5% surcharge was introduced on consumption during 4 hour morning peak (6:00 to 10:00). The night time rebate continued as previous years but it was levied not for six hours as in previous years but five[3]. In the subsequent year, amidst concerns of rising power purchase costs of the DISCOM, the rebates were reduced to 7.5% of the energy charge. For similar reasons, the surcharge was increased to 7.5%[4] in the following year.

For HT Industrial consumers, 7.5% of energy charges translates ₹ 0.55/unit. Even though the cost of supply in Rajasthan is comparable to the national average, the ToD surcharges and penalties are about half the national average tariff levied. For reference, the average rebate across states India is about ₹ 1.15/unit and surcharge at about ₹ 1.39/unit. If such tariffs were levied in Rajasthan, it would amount to 20% surcharge and 15% rebate in Rajasthan[5].

The ToD tariff design in various states is discussed in greater detail in Chapter 2.

1.2 National policy framework

As per Section 62 (3) of the Electricity Act 2003[6] SERCs have the mandate to differentiate tariffs according to "total consumption of electricity during any specified period or the time at which the supply is required". Adoption of Time of Day Tariffs was also encouraged in the National Electricity Policy, 2005.[7] The National Tariff Policy, in 2016 emphasized the need for ABT metering infrastructure towards ToD tariff implementation[8].

The most detailed framework for Time of Tariffs was stipulated in the recently notified Electricity (Rights of Consumers) Amendment Rules, 2023[9]. The relevant section of these Rules, under the Electricity Act are quoted below:

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[2] RERC Order in Case Nos 1841/2020, 1842/2020, 1843/2020, 1627/2020, 1625/2020, 1626/2020, 1596/2019, 1799/19 dated 24/11/2021.

[3] RERC Orders in Case No. 2011/2022, 2012/2022 and 2013/2022 dated 01/09/2022.

[4] RERC Orders in Case No. 2066/2022, 2067/2022 and 2068/2022 dated 31/03/2023.

[5] It is interesting to note that in 2012, the DISCOMs proposed ToD tariffs which included a 22% surcharge and a 12% rebate for HT Industry. This proposal was rejected due to the absence of a detailed load analysis to support it (RERC Order in Case No. 238,239and 240/10 dated 08.09.2011).

[6] https://cercind.gov.in/Act-with-amendment.pdf

[7] https://powermin.nic.in/content/national-electricity-policy

[8] https://www.cercind.gov.in/2018/whatsnew/Tariff_Policy-Resolution_Dated_28012016.pdf

[9] https://powermin.gov.in/sites/default/files/webform/notices/30_d_Electricity_Rights_of_Consumers_Amendment_Rules_2023..pdf

*"**(8A) Time of Day Tariff***

*The Time of Day tariff for **Commercial and Industrial consumers** having **maximum demand more than ten Kilowatt** shall be made effective from a date not later than **1st April, 2024** and for **other consumers** except agricultural consumers, the Time of Day tariff shall be made effective not later than **1st April, 2025** and a Time of Day tariff shall be made effective immediately after installation of smart meters, for the consumers with smart meters:*

*Provided that, the Time of Day Tariff specified by the State Commission for **Commercial and Industrial consumers** during **peak period** of the day shall **not be less than 1.20 times** the normal tariff and for other consumers, it shall **not be less than 1.10 times** the normal tariff:*

*Provided further that, tariff for **solar hours of the day**, specified by the State Commission shall be **atleast twenty percent less** than the normal tariff for that category of consumers:*

*Provided also that the Time of Day Tariff shall be applicable on **energy charge component** of the normal tariff:*

*Provided also that the duration of **peak hours shall not be more than solar hours** as notified by the State Commission or State Load Despatch Centre." **(emphasis added)***

The Rules mandate that:

- ToD tariffs are applicable on all Commercial and Industrial (C&I) consumers with maximum demand (rather than connected/contract demand) higher than 10 kW from April 2024.
- For other consumers, ToD tariffs are to be notified from April 2025.
- Surcharge and rebates should be levied on the energy charge component of the normal tariff.
- A rebate of at least 20% of the tariff is provided during solar hours to these consumers.
- The surcharge should not be less than 20% of tariff for C&I consumers and not less than 10% for other consumers.
- Notably, the floor for rebates and surcharges is specified in terms of tariff (without any surcharge or rebate) rather than energy charges for the category.
- The rules also limit the number of hours in slots where surcharge is levied to less than the solar hours notified by the SLDC or State Commission.
- For non-C&I consumers, ToD tariffs to be applicable after the installation of smart meters.

This framework is reflective of recent changes in demand and supply profiles in states, where low-cost renewable energy (RE), especially solar is available during day-time. Provision of rebates to encourage consumption in these periods, aids load balancing and effective grid integration of RE. It also can be beneficial to consumers who are able to shift their load to avail rebates.

Time of Day tariffs, which reflect demand and supply patterns, help distribution companies (DISCOMs) implement cost-reflective pricing. In the long run, when tariffs accurately reflect costs during peak and off-peak periods, ToD pricing can help smooth out demand and reduce the need for additional infrastructure investments and capacity.

To achieve these benefits, the national framework must be adapted to each state's specific conditions, including:

- Daily and seasonal variations in demand and supply patterns
- Load-shifting potential based on the state's electricity sales mix
- Status of current metering infrastructure and planned investments in metering improvements.

Any ToD tariff design should remain in place for at least 5 years once adopted. This stability allows:

- Consumers to adjust their operations and invest in load-shifting technologies
- Better planning for supply options and investment decisions by consumers regarding open access and captive power. ToD tariff structure can impact the viability of open access and captive options for consumers as detailed in Box 1.
- Informed decision-making about renewable energy (RE) banking for consumers, since banking restrictions are based on ToD time slots.

Box 1: Impact of 20% day-time rebates on savings for consumers via open access and captive options

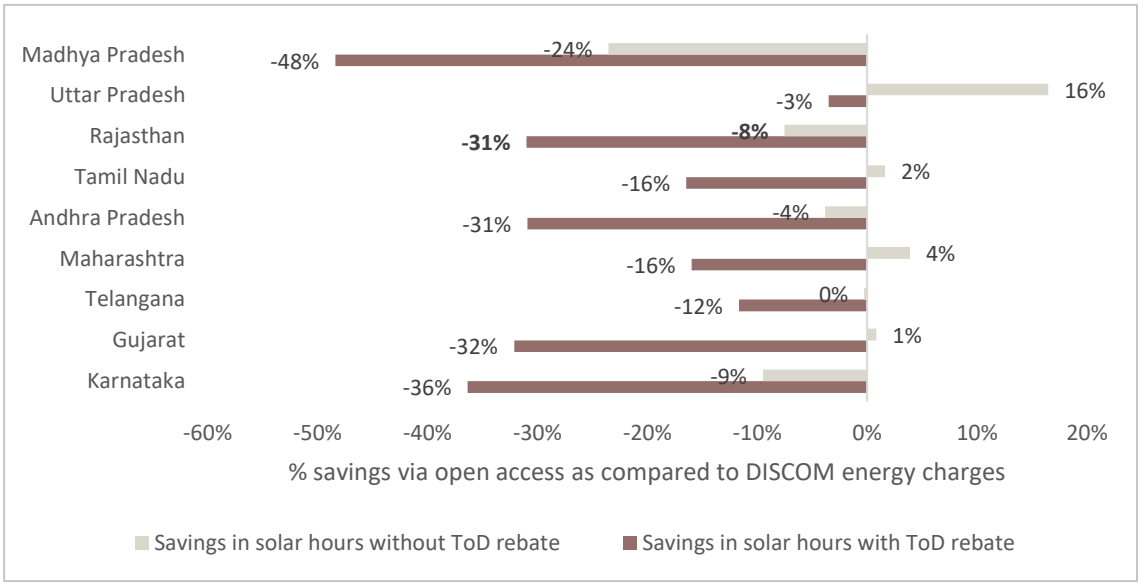
Consumer savings through green open access depend on the arbitrage between the applicable energy charge by DISCOMs and the cost of alternative power sources (third party contracts or captive). The availability of low-cost solar power and competitive daytime market rates creates significant potential for daytime savings.

In Rajasthan, assuming that the cost of power is about ₹ 4/unit, open access is not a viable option, given applicable open access charges. However, with captive, consumers can save 27% vis-à-vis DISCOM energy charges.

With the adoption of the framework in the Electricity (Rights of Consumers) Amendment Rules, 2023 and the introduction of 20% rebate on tariffs during solar hours, the savings reduces to 10% for captive.

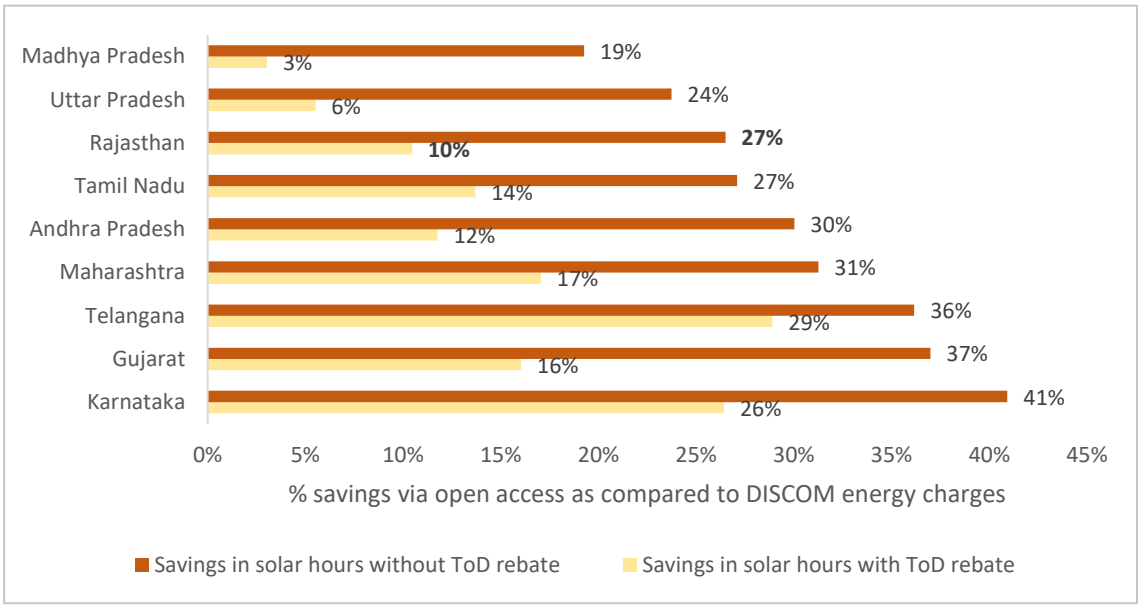
A similar impact is also seen in other states as shown in Figure 2 and 3.

Figure 2: Impact of solar hours rebate on open access savings (based on charges in 2023-24)



Source: Analysis based on data from Regulatory orders and filings from multiple states

Figure 3: Impact of solar hours rebate on captive savings (based on charges in 2023-24)



Source: Analysis based on data from Regulatory orders and filings from multiple states

While clarity and certainty is needed for ToD tariffs, it is also crucial that there is innovation in ToD tariff design as metering infrastructure improves. ToD tariffs can evolve into more sophisticated pricing mechanisms. Real-Time Pricing, much more reflective of demand-supply gaps faced by DISCOMs, could vary by hour, block, or even 5-minute intervals rather than pre-defined slots. Critical Peak Pricing could be introduced for limited-duration events, announced on short notice, to help manage system shocks and variations. Peak-Time Rebates could also become feasible as electricity markets deepen and broaden, and as consumer participation in demand response programs increases. Therefore, medium-term ToD frameworks should anticipate future improvements in metering and market development that will enable these advanced pricing mechanisms.

2 ToD tariffs in Indian states

This study analyzed Time of Day (ToD) tariffs across 35 Indian states and union territories (UTs) for 2023-24. Despite policy emphasis on ToD implementation six states do not levy ToD tariffs. These are Manipur, Nagaland, Sikkim, Andaman & Nicobar, Lakshadweep, Arunachal Pradesh. Additionally, six states have optional ToD tariffs for all consumer categories. These are Chandigarh, Haryana, Jharkhand, Odisha, Mizoram and Tripura.

This section details of the design and features of the ToD tariff levied in the remaining 23 states and UTs. Many states have not updated their ToD tariff design or rates for nearly a decade, despite new Rules being notified and significant changes in demand-supply patterns during this period. In this chapter, three critical aspects of the ToD tariff design will be detailed:

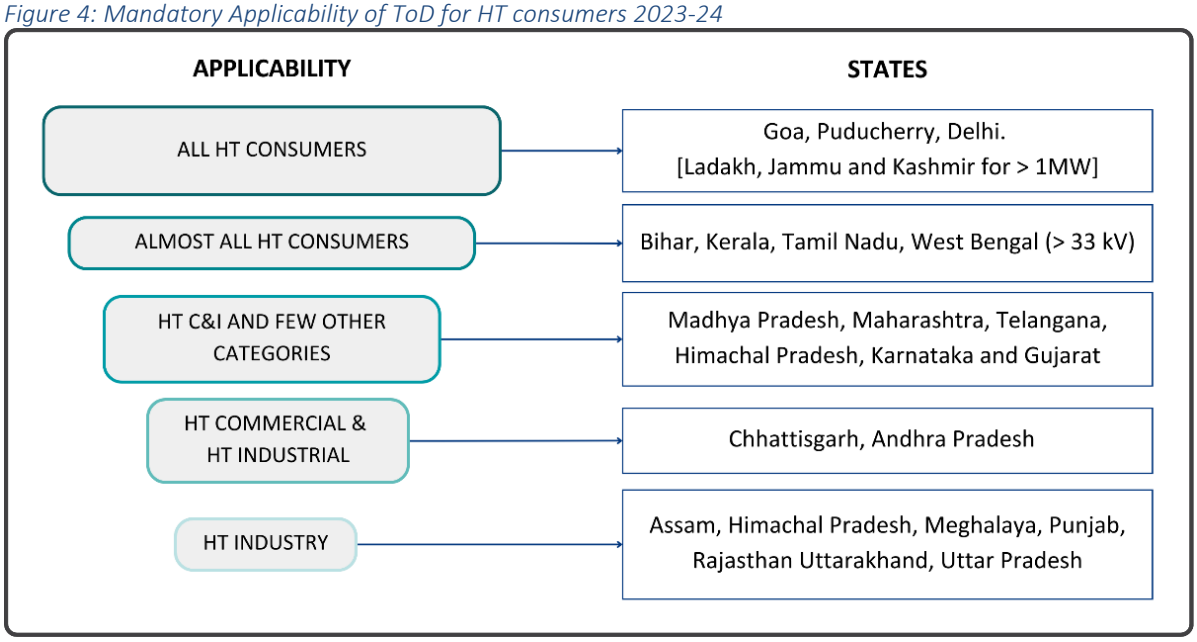
- **Applicability**: Consumers (based on load, categories/slabs) on whom tariffs are applicable.
- **Slots and Seasons identified**: Variation in tariffs across months/time-blocks.
- **Extent of surcharges and penalties**: Actual surcharges or rebates applicable.

2.1 Applicability

Most state ERCs stipulate ToD tariffs for only High Tension (HT) consumers. While HT consumers (especially C&I consumers) are relatively fewer in number in most states, they contribute disproportionately to overall electricity sales and revenue. This limited consumer base had two advantages: it simplifies administration of ToD tariffs and increases the economic feasibility of installing metering equipment for slot-wise energy accounting.

However, even though metering technology has advanced and costs have decreased in recent years, ToD tariffs are still not mandatory for all HT consumer categories – with only Goa, Puducherry, and Delhi as exceptions. In fact, for 7 of the 23 states, ToD tariffs are only applicable on Industrial consumers in the HT segment. This is shown in Figure 4.

Figure 4: Mandatory Applicability of ToD for HT consumers 2023-24



Note: ToD is not applicable on Commercial consumers in Himachal Pradesh
Source: Analysis of Tariff Orders by various SERCs with tariffs applicable for the year 2023-24.

Six of the 23 states levy ToD tariffs on certain LT categories for consumers above a certain connected load. In Gujarat it is as high as 50 HP and applicable only for one category whereas in Delhi, it is applicable for all consumers (except domestic) with load above 10 kW. The are listed in Table 1.

Table 1: Threshold of levy of ToD tariffs on LT consumers 2023-24

State	Minimum Load for eligibility	LT categories under mandatory ToD tariffs
Delhi	10 kW	All except domestic
Kerala	20 kW	Industry, Domestic (3 phase using more than 500 units per month)
Maharashtra	20 kW	Industry, Commercial, Public service, Public water works. EV charging (No limit)
Uttarakhand	25 kW	Industry
Gujarat	50 HP (36.8 kW)	Water works (only Rebate)

Source: Analysis of Tariff Orders by various SERCs with tariffs applicable for the year 2023-24.

In Maharashtra, consumers with connected load less than 20 kW in the categories where ToD is levied can opt for ToD tariffs. It is interesting to note that in 2023-24, ToD tariffs are levied on LT domestic consumers only in the state of Kerala. In Tamil Nadu, ToD slot-wise metering infrastructure is only available for consumers with loads above 25 HP (18.6 kW). As an interim measure during the infrastructure rollout, the TNERC has established a default practice: for consumers without appropriate meters, 20% of their monthly electricity consumption is billed at peak slot rates[10]. Subsequently, in order to mitigate impact on consumer tariffs of ToD levy, LT Industries were provided subsidies. With the state government subsidies, the effective peak penalty reduced from 25% of energy charges to 10% of energy charges[11].

Four states have mandatory ToD tariffs specified for certain categories but without a load limit, such that it applies to all consumers in that category. These states are:

- Himachal Pradesh: Small industry, Irrigation, Water works
- Rajasthan: EV charging stations
- Uttar Pradesh: Small industry, EV charging, Public Lamps (metered)
- West Bengal: Agriculture, Temporary supply, Commercial Plantation

As there are categories like agriculture and public lamps (streetlights) which are typically small and poorly metered, it is unclear if such tariffs are actually being levied based on slot-wise consumption.

2.2 ToD tariff design: Slots, Seasons and Charges

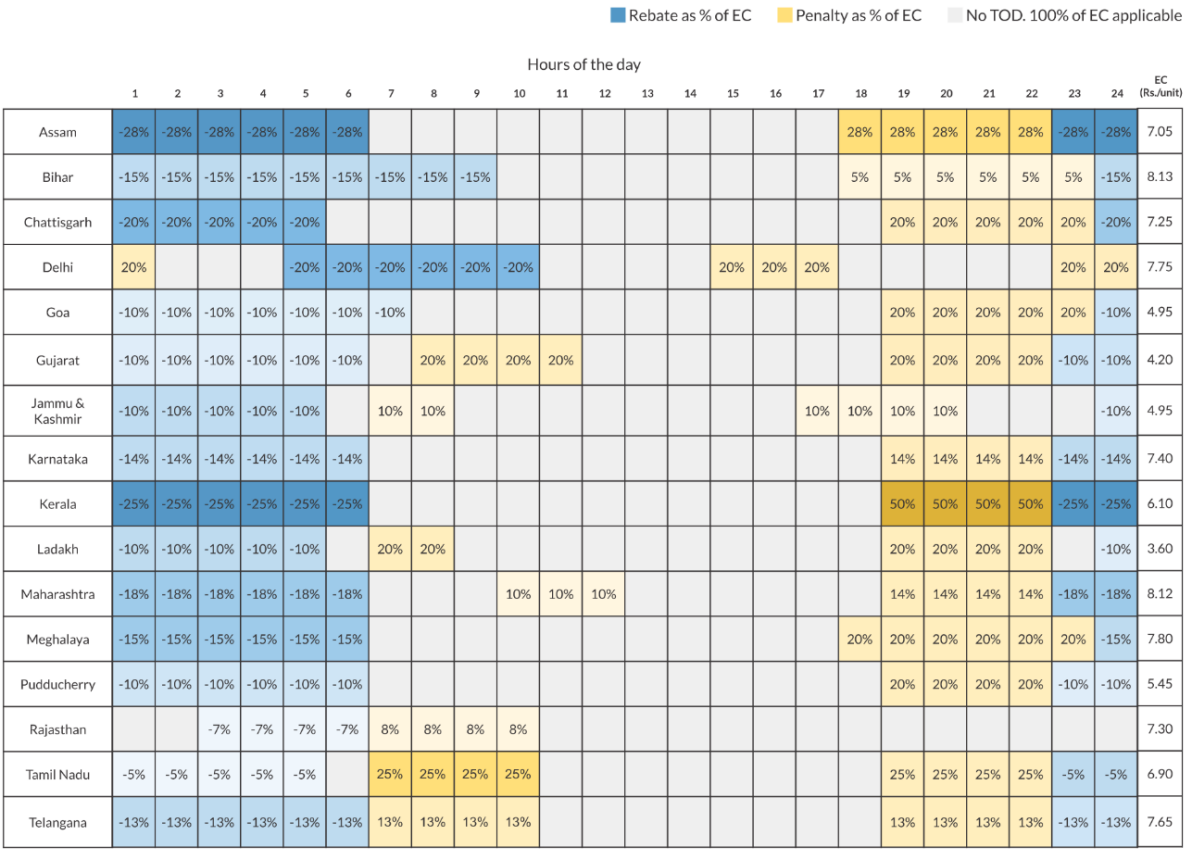
The tariff design for ToD across states and categories were also documented. Since most consumers with ToD levy are HT Industrial consumers, this section will discuss the variation in ToD tariff design for this category. Figures 5 and 6 show the state-wise ToD slots, seasonal variation in ToD tariffs as well as the applicable surcharges and rebates.

The hours shaded blue represent the slots with rebates and those in yellow, surcharges. The color intensity indicates the magnitude of the surcharge or rebate: darker shades represent larger amounts. All levies are shown as a percentage of the energy charge. The applicable energy charge is listed on the right side of each figure. Figure 5 shares information only on states without seasonal variation in tariffs and Figure 6 has data for seasonal variation in the seven states where it is levied.

[10] http://www.tnerc.gov.in/Orders/files/TO-Suo-motu%20O030720231556.pdf

[11] http://www.tnerc.gov.in/Orders/files/TO-Order%20No%20240620240232.pdf

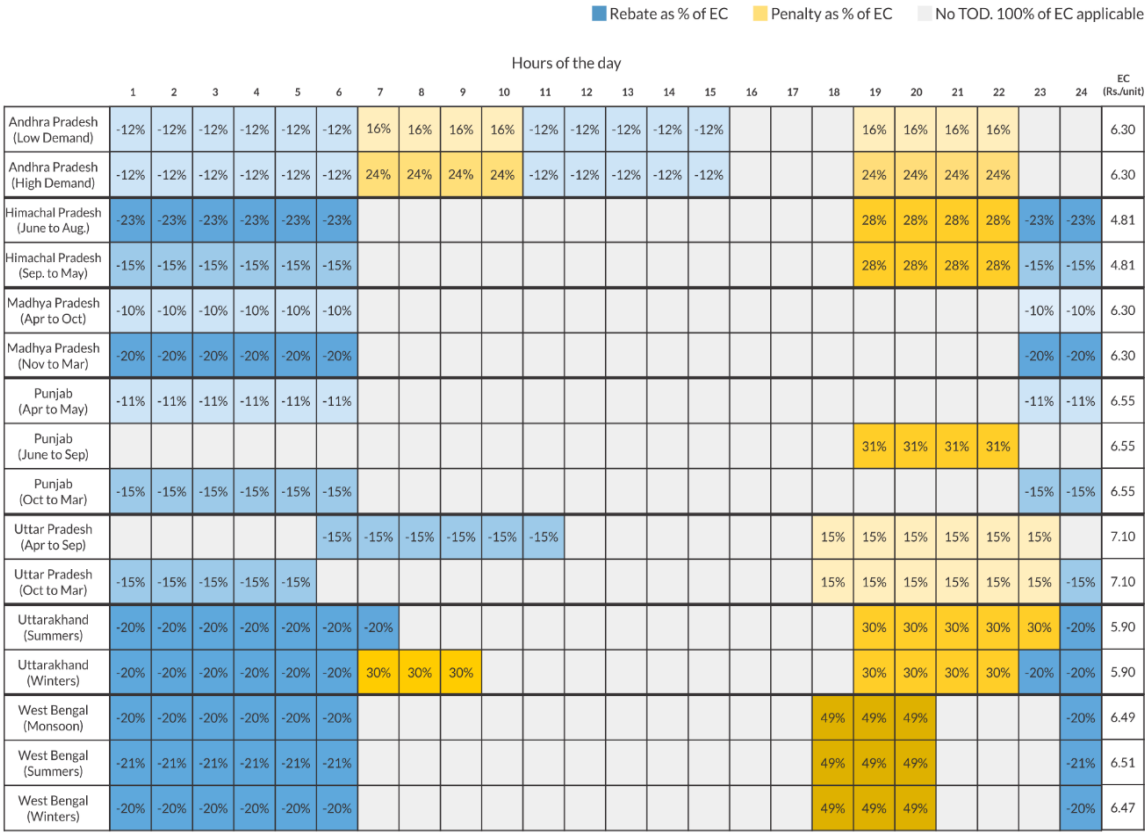
Figure 5: ToD tariff - Extent of Rebates and Surcharge for HT (11 kV) Industry consumers for 2023-24



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	EC (Rs./unit)
Assam	-28%	-28%	-28%	-28%	-28%	-28%												28%	28%	28%	28%	28%	-28%	-28%	7.05
Bihar	-15%	-15%	-15%	-15%	-15%	-15%	-15%	-15%	-15%									5%	5%	5%	5%	5%	5%	-15%	8.13
Chattisgarh	-20%	-20%	-20%	-20%	-20%														20%	20%	20%	20%	20%	-20%	7.25
Delhi	20%				-20%	-20%	-20%	-20%	-20%	-20%					20%	20%	20%						20%	20%	7.75
Goa	-10%	-10%	-10%	-10%	-10%	-10%	-10%												20%	20%	20%	20%	20%	-10%	4.95
Gujarat	-10%	-10%	-10%	-10%	-10%	-10%		20%	20%	20%	20%								20%	20%	20%	20%	-10%	-10%	4.20
Jammu & Kashmir	-10%	-10%	-10%	-10%	-10%		10%	10%									10%	10%	10%	10%				-10%	4.95
Karnataka	-14%	-14%	-14%	-14%	-14%	-14%													14%	14%	14%	14%	-14%	-14%	7.40
Kerala	-25%	-25%	-25%	-25%	-25%	-25%													50%	50%	50%	50%	-25%	-25%	6.10
Ladakh	-10%	-10%	-10%	-10%	-10%		20%	20%											20%	20%	20%	20%		-10%	3.60
Maharashtra	-18%	-18%	-18%	-18%	-18%	-18%				10%	10%	10%							14%	14%	14%	14%	-18%	-18%	8.12
Meghalaya	-15%	-15%	-15%	-15%	-15%	-15%												20%	20%	20%	20%	20%	20%	-15%	7.80
Puducherry	-10%	-10%	-10%	-10%	-10%	-10%													20%	20%	20%	20%	-10%	-10%	5.45
Rajasthan			-7%	-7%	-7%	-7%	8%	8%	8%	8%															7.30
Tamil Nadu	-5%	-5%	-5%	-5%	-5%		25%	25%	25%	25%									25%	25%	25%	25%	-5%	-5%	6.90
Telangana	-13%	-13%	-13%	-13%	-13%	-13%	13%	13%	13%	13%									13%	13%	13%	13%	-13%	-13%	7.65

Source: Analysis of Tariff Orders by various SERCs with tariffs applicable for the year 2023-24.

Figure 6: Seasonal variation in ToD tariffs for HT (11 kV) Industry consumers for 2023-24



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	EC (Rs./unit)
Andhra Pradesh (Low Demand)	-12%	-12%	-12%	-12%	-12%	-12%	16%	16%	16%	16%	-12%	-12%	-12%	-12%	-12%				16%	16%	16%	16%			6.30
Andhra Pradesh (High Demand)	-12%	-12%	-12%	-12%	-12%	-12%	24%	24%	24%	24%	-12%	-12%	-12%	-12%	-12%				24%	24%	24%	24%			6.30
Himachal Pradesh (June to Aug.)	-23%	-23%	-23%	-23%	-23%	-23%													28%	28%	28%	28%	-23%	-23%	4.81
Himachal Pradesh (Sep. to May)	-15%	-15%	-15%	-15%	-15%	-15%													28%	28%	28%	28%	-15%	-15%	4.81
Madhya Pradesh (Apr to Oct)	-10%	-10%	-10%	-10%	-10%	-10%																	-10%	-10%	6.30
Madhya Pradesh (Nov to Mar)	-20%	-20%	-20%	-20%	-20%	-20%																	-20%	-20%	6.30
Punjab (Apr to May)	-11%	-11%	-11%	-11%	-11%	-11%																	-11%	-11%	6.55
Punjab (June to Sep)																			31%	31%	31%	31%			6.55
Punjab (Oct to Mar)	-15%	-15%	-15%	-15%	-15%	-15%																	-15%	-15%	6.55
Uttar Pradesh (Apr to Sep)						-15%	-15%	-15%	-15%	-15%	-15%							15%	15%	15%	15%	15%	15%		7.10
Uttar Pradesh (Oct to Mar)	-15%	-15%	-15%	-15%	-15%													15%	15%	15%	15%	15%	15%	-15%	7.10
Uttarakhand (Summers)	-20%	-20%	-20%	-20%	-20%	-20%	-20%												30%	30%	30%	30%	30%	-20%	5.90
Uttarakhand (Winters)	-20%	-20%	-20%	-20%	-20%	-20%	30%	30%	30%										30%	30%	30%	30%	-20%	-20%	5.90
West Bengal (Monsoon)	-20%	-20%	-20%	-20%	-20%	-20%												49%	49%	49%				-20%	6.49
West Bengal (Summers)	-21%	-21%	-21%	-21%	-21%	-21%												49%	49%	49%				-21%	6.51
West Bengal (Winters)	-20%	-20%	-20%	-20%	-20%	-20%												49%	49%	49%				-20%	6.47

Source: Analysis of Tariff Orders by various SERCs with tariffs applicable for the year 2023-24

2.2.1 *Observations on ToD slots across states in 2023-24*

- In 2023-24, Andhra Pradesh was the only state that provided rebates during peak solar hours from 10:00 to 15:00.
- In majority of the states (19 of 23), surcharges are levied in the evening periods, typically between 18:00 and 22:00. Some SERCs (9 of 23) levy surcharges in what is designated as morning peak periods (typically between 06:00 to 10:00).
- Rebates are provided between 22:00 and 06:00 in 21 states, which have historically been off-peak periods. However, surcharges in Delhi are levied between 22:00 to 01:00 and between 14:00 to 17:00. This is perhaps indicative of Delhi's unique load shape in past.
- While most SERCs levy surcharges and rebates, there are three states- namely, Haryana, Odisha and Madhya Pradesh that only offer rebates. In Punjab, surcharge is levied for the months of June to September and there are no rebates.

2.2.2 *Observations on ToD tariffs (as % of energy charges) across states in 2023-24*

- Four states have surcharges at 10% of energy charge or less, namely Jammu and Kashmir, Bihar, Rajasthan and Maharashtra (morning peak). **The surcharge is lowest in Bihar at 5%.** It is between 11% to 15% in Uttar Pradesh, Karnataka, Telangana and Maharashtra (evening peak).
- Rebates are between 0-10% in Goa, Gujarat, Jammu and Kashmir, Ladakh, Rajasthan, Puducherry, Madhya Pradesh (from April to October) and Tamil Nadu. **In Tamil Nadu, the rebates are the**

lowest at 5%. Rebates are between 11 to 15% in seven states namely Uttar Pradesh, Karnataka, Telangana, Bihar, Meghalaya, Andhra Pradesh and Punjab.

- In most cases, the surcharges vary between 16% to 20% (Delhi, Chhattisgarh, Goa, Gujarat, Ladakh, Meghalaya, Puducherry as well as low demand season in Andhra Pradesh). In case of rebates, Maharashtra, Madhya Pradesh (Nov to Mar), Uttarakhand, West Bengal, Delhi and Chhattisgarh provide rebates in the range of 16 to 20%.
- In some cases, surcharges range from 21% to 28%- namely, Assam, Himachal Pradesh and Tamil Nadu as well as the High Demand season for Andhra Pradesh. Rebates are similarly high in Himachal Pradesh, Kerala and West Bengal (Summer). The rebates are highest in Assam at 28%.
- There are some states which provide even higher rebates than Assam but the ToD tariff is optional rather than mandatory for consumers. This is the case in Haryana and Tripura where up to 40% rebates are offered.
- Odisha only provided rebates (no surcharges) in their ToD tariffs on an optional basis. Jharkhand and Mizoram offer ToD rebates and surcharges ranging from 15% to 20% as an option for HT Industrial consumers.
- In case of Uttarakhand, the surcharge is about 30%. This is also the case in Punjab from June to September. Tripura levies surcharge of 40% on an optional basis. However, the highest surcharge is in West Bengal and Kerala where it is close to 50%.

2.2.3 Observations on seasonal variation in ToD tariffs levied in 2023-24

- In Uttarakhand, morning peak surcharge between 06:00 and 09:00 is levied only in winter months. There are also marginal changes in slots across the two seasons.
- In 2023-24, only rebates were provided in Madhya Pradesh. However, between November to March, rebates are at 20% rather than the 10% in the rest of the months.
- In Andhra Pradesh, in the high demand periods, surcharge increases from 16% to 24% of energy charges. The rebates and the slots remain the same through the year.
- In Uttar Pradesh, while the rates stay the same, the slots for rebates change seasonally. From April to September, it is from 05:00 to 11:00 rather than the late night/early morning period (23:00 to 05:00).
- Punjab has three seasons- summer, winter and monsoon. Only rebates are applied in summer and winter months from 22:00 to 06:00. In the monsoon, consumers pay surcharge from 18:00 to 22:00 and avail no rebates.
- In West Bengal, even though tariffs vary for summer, monsoon and winter months, the ToD tariffs change only marginally (1 percentage point (p.p.) or less), not incentivizing any major change in load nor compensation to the DISCOM.
- In Himachal Pradesh, while peak surcharge is applicable throughout the year, night time rebate is only applicable in the months of June, July and August.
- ToD tariffs are applicable for only one season in Delhi, Karnataka, and Haryana. These are not counted among the states where there is seasonal variation in ToD tariffs.

There is significant diversity in time of day tariffs levied across states, indicative of unique features in state load profiles when ToD tariffs were introduced or modified. A closer examination of changing load shapes and supply profiles is required in many states while determining future ToD design. Some efforts have been underway in Tamil Nadu and Maharashtra as discussed in Chapter 3.

3 Recent ToD studies in states

In order to revise the ToD tariff design, the DISCOM in Tamil Nadu and the Regulatory Commission in Maharashtra commissioned studies in 2019 and 2022 respectively. Both studies involved analysis of load curves, supply profiles and market price variations along with few other parameters The methodology, recommendations and Commission's decisions based on the study are summarised in Table 2.

Table 2: An over-view of ToD tariff studies in Tamil Nadu and Maharashtra

Relevant aspects	Study commissioned by	
	TANGEDCO (2019)	MERC (2022)
Methodology	• Load curve analysis for 2 years • Study of Peak power purchase for 2 years • ToD slot-wise consumption analysis for 8000-9000 consumers	• Analysis of hourly load, source-wise supply and market prices for 3 years • Demand, supply projections for 2022-23 • Analysis of ToD slot-wise consumer data
Recommendations	• ToD tariff for consumers with load > 25 HP (or 18.6 kW) • Penalties increased to 25% of energy charges • Different ToD tariffs in 2 seasons	• ToD for >20 kW including domestic • Day-time rebate @ ₹ 1/unit, Penalties in evening and night • Different ToD tariffs in 2 seasons
Commission Decision	• Penalties increased as recommended • All > 25 HP consumers to have ToD • If appropriate meters are not present, 20% of total sales are considered in peak slot.	• ToD tariffs unchanged even after study • However, framework for revised ToD specified in MYT regulations

The studies focused more on prevailing load patterns, supply options and peak power procurement costs for DISCOMs. The focus of the study was not just on the potential for load shifting but also on the system costs incurred by DISCOMs to supply power across various times in the day. In spite of having details of consumer category-wise demand available, the focus on system cost was a conscious methodological choice given the importance of changing supply profiles of the DISCOM. In both studies, seasonal variations in demand and supply were noted and seasonal change in ToD tariffs were recommended but the Regulatory Commissions decided to implement such changes at a later date.

In recent years, there have been no studies conducted by SERCs to assess the impact of load shifting across various types and categories of consumers after the implementation of ToD tariffs. Perhaps DISCOMs can undertake such exercises in a periodic manner to better understand the efficacy of ToD tariff levy with respect to load shifting and peak shaving.

4 Data and Methodology for the study

The study's methodology is based on the current status and medium-term outlook for Rajasthan state, considering the requirements for an effective ToD tariff design and the availability of data on various aspects.

4.1 Outlook in the Context of Rajasthan State

The objective of levying Time of Day tariffs in Rajasthan would be to ensure timely recovery of system costs incurred through cost-reflective tariffs. It is to also encourage shifting of load by providing adequate price signals- incentivizing consumption when cost is low and penalizing when cost is high. Ideally, such tariffs should be universally and mandatorily levied on all consumers.

However, ToD tariffs levied also have to be cognizant of existing metering infrastructure and potential improvements in metering in the medium term to enable requisite energy accounting for levy of more dynamic tariffs.

To address implementation challenges and provide consumers with adequate time to make changes and adapt to the ToD tariffs, it is crucial that:

- A trajectory be specified for the levy of ToD tariffs for the medium term (say, 5 years)
- The trajectory be fixed/certain for the five year period.

Given the need for future certainty, the determination of ToD tariff design should not only consider changes in supply mix and demand today but also for future years Therefore, demand and supply projections based on historical trends and considering impact of policies (such as compliance with renewable purchase obligations, implementation of green energy open access, net metering and provision of day-time supply to agricultural consumers and EV charging) should be factored in. This is critical in the case of Rajasthan where significant changes are anticipated in the next 5 years:

- **Demand** is expected to increase by 4.2% from 100 BU in 2022-23 to 133 BU by 2030 as per Central Electricity Authority' (CEA) Electric Power Survey (EPS) projections[12]. Historically demand has been increasing at 4.6% on average since 2019[13]. As per the recent Energy Assessment Committee (EAC) projections as well as CEA projections, demand growth will be about 6% per annum[14].

- **Renewable energy capacity addition**, especially of low-cost solar and wind is expected to be significant. About 44-50 BU of solar and 9-10 BU of wind would be required by 2030 to meet the statutory renewable purchase obligation by that year[15]. This itself accounts for about 40% of power procurement by the DISCOMs. Such significant procurement requires changes in load shapes to match supply profiles for effective RE integration.

- **Agricultural consumption** accounts for about 40% of the sales in Rajasthan. If majority of this load is shifted during the day, there is potential to meet 24-27 GW of demand through solar in the

[12] https://cea.nic.in/wp-content/uploads/psl f/2022/11/20th EPS Report Final 16.11.2022.pdf
[13] https://cea.nic.in/wp-content/uploads/psl f/2022/11/20th EPS Report Final 16.11.2022.pdf
[14] As per the 28th EAC meeting minutes dated 07.01.2022
[15] Based on the Rajasthan Electricity Regulatory Commission (Renewable Purchase Obligation) Regulations, 2023 on 13th June 2023 as well as energy requirement and sales and projected in the 20th EPS and as per EAC.

coming years. The DISCOMs are already tying up about 4 GW of solar capacity for day time supply to agriculture under KUSUM C and efforts are underway to shift 17 GW of demand to day time[16].

- **Sales migration:** For 2021-22, DISCOM reported that 2,685 MUs were consumed by open access consumers[17]. As per CEA, captive consumers consumed about 9,696 MUs from captive sources[18]. As of May 2024, about 1200 MW of rooftop solar systems have been installed in Rajasthan[19]. As of June 2024, about 18,601 rooftop systems were installed for residential consumers with the cumulative capacity of 120 MW[20].This trend is expected to grow with the implementation of green energy open access provisions, revised net metering regulations, and the *Surya Ghar Muft Bijli Yojana*. As open access and captive consumers increase, and more consumers invest in rooftop solar, they are likely to reduce consumption from DISCOMs during high solar/wind periods or when market prices are low. Conversely, they may draw power from DISCOMs during net peak/stress periods when power purchase costs are higher. Therefore, ToD frameworks should be robust enough to provide compensation when consumers switch suppliers opportunistically.
- **Consumer metering improvements**: In recent years, there has been significant reduction in the cost of metering technology, especially for slot-wise recording of data. Further, smart metering technologies especially with large scale central sector scheme support (such as RDSS), many more consumers can be brought under the ToD ambit in the future for lesser cost.

It must be noted that implementation of ToD tariffs alone, would not be sufficient in RE grid integration and improving cost-recovery for DISCOMs. Complimentary efforts to reduce costs, improve operational efficiencies and change load (such as implementation of KUSUM C, loss reduction under RDSS and utility led Demand Side Management schemes) are also crucial.

4.2 Data availability

For the purpose of the study, the following data was provided by state agencies:

- Block-wise (15 min) demand for 5 years (2018-19 to 2022-23) from the State Load Dispatch Centre (SLDC)
- Block-wise, source-wise supply from in-state sources (2018-19 to 2022-23) from the SLDC
- Details of all Power Purchase Agreements (PPAs) and Power Sale Agreements (PSAs) including contract duration, capacity and price from RUVNL
- List of upcoming/planned capacity, demand projections and RE targets recorded in various Minutes of Meetings of the EAC.
- Source-wise weekly variable costs as per Merit Order Dispatch (MoD) from DISCOMs for 5 years from 2018-19 to 2022-23.

In addition, the following data was also captured from publicly available sources:

[16] As per the 28th EAC meeting minutes dated 07.01.2022
[17] RERC Order in Case No.2066/2022 dated 31.03.2023
[18] https://cea.nic.in/wp-content/uploads/general/2023/GR_Final.pdf
[19] https://web.archive.org/web/20240624000520/https://mnre.gov.in/physical-progress/
[20] https://sansad.in/getFile/loksabhaquestions/annex/182/AU1440_JN4ajk.pdf?source=pqals

- Block-wise (15 min), source-wise supply from out of state sources (2020-21 to 2022-23) from the NRLDC WBES system[21].
- Block-wise, Power sale and purchase data and area clearing prices for 5 years from NRLDC WBES system and India Energy Exchange (IEX) (2018-19 to 2022-23)
- Monthly consumption for various consumer categories from tariff filings of DISCOMs (2018-19 to 2022-23)
- Power purchase quantum and rate as per true-up filings of DISCOMs

Detailed information on the following was also sought from agencies for the study but could not be provided due to issues with data availability:

- Block-wise, consumer category-wise load profiles for industrial consumers where available
- Hourly, feeder level input energy for industrial, agricultural, urban feeders
- Block-wise details on open access and captive consumption

4.3 Methodology

Based on the available data and information, and the principles for ToD tariff design outlined in this section, the methodology for this study focused on:

- Trend analysis of historical block-wise demand, net demand and market purchases
- Estimation of block-wise/ slot-wise cost (average and marginal) for 2022-23
- Indicative assessment of block-wise/slot-wise cost (average and marginal) for 2029-30

4.3.1 Historical Trend Analysis (2018-19 to 2022-23)

Historical trends in demand and net demand as well as market purchase and price were documented to understand daily and seasonal variations in demand before the DISCOMs. **These trends were used to determine the Seasons and Slots for tariff variations.**

To understand variation in cost and demand for DISCOMs it is crucial to assess variation in demand as well as net demand. Net demand refers to the total electricity demand minus the electricity generated by RE sources (solar and wind). Variation in net demand is as important as demand as it highlights the quantum of electricity supplied by dispatchable sources such as coal. Net demand variation throughout the day and across seasons showcases the mismatch between demand and low-cost renewable energy generation, particularly solar at a given time. With higher solar penetration, peak demand often occurs during the day but peak net demand occurs in the evening, when solar is unavailable. Therefore, net demand trends also helps understand stress periods for DISCOMs. Procurement of power from the market and the average price of procurement is also indicative of which periods are peak and stressed for the DISCOMs. Thus, historical trends in market purchase (on a block-wise basis) were also analysed in this study.

4.3.2 Estimation of slot-wise average and marginal cost for 2022-23

Based on the source wise dispatch reported for each generator and source of power in 2022-23, the average and the marginal cost of power was estimated for each block. The year 2022-23 was considered for this analysis as it was the latest year for which data was available. In previous years of 2020-21 and 2021-22, the demand was quite suppressed due to Covid-19 related lockdowns.

[21]The Northern Regional Dispatch Centre (NRLDC) has Web Based Energy Scheduling (WBES) reports for this time-period available here: https://wbes.nrldc.in/Report

In order to estimate the average and marginal cost,

- Station/Contract-wise dispatchable and non-dispatchable capacity costs were analysed for each block. For sources with two-part tariffs (coal and gas), variable costs were considered, while average costs were applied for must-run capacity. Cost estimations drew from both annual averages reported in regulatory filings and weekly rates from Merit Order Dispatch (MOD) reports.
- The average block-wise cost for energy purchased was determined.
- Marginal costs were estimated by analyzing the costs of generation in progressive tiers - starting with the top 10% of capacity by cost, then expanding to 20%, 30%, and finally capacity with top 40% of cost for each block. This tiered analysis revealed the variations and deviations between marginal and average costs.
- Average and marginal costs (top 10% to top 40%) were calculated on a monthly block-wise and slot-wise basis.
- Average and marginal power procurement costs (top 10% to top 40%) *for the entire month* were compared with monthly average and marginal power procurement costs (top 10% to top 40%) for each block and slot. The slot-wise comparison is shown in the example below:

Illustrative Example	Unit	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
Monthly cost for top 40%	*Rs/kWh*	3.5				
Slot-wise top 40% marginal cost	*Rs/kWh*	3.68	3.33	3.15	3.85	3.68
Slot-wise variation in cost	*%*	5%	-5%	-10%	10%	5%

4.3.3 Indicative assessment of slot-wise average and marginal cost for 2029-30

To estimate monthly and average costs for 2029-30, block-wise demand and supply projections for 2030 were considered along with technology-wise costs.

- Block-wise demand was projected based on historical demand growth and 20th EPS projections.
- Solar and wind supply was estimated on a block-wise basis assuming similar profiles as 2022-23 but increased in block-wise capacity in order to meet RPO obligations for 2030.
- Capacity addition in the pipeline as reported in EAC minutes for 2030 were factored in the supply profiles.
- Costs were escalated based on historical price trends on a nominal basis.

Based on the demand-supply profiles, a block-wise merit order dispatch was constructed for the available capacity and the block-wise demand[22]. Where demand exceeded available capacity, procurement from market sources was assumed. The average and marginal cost of the capacity utilized was then estimated in a manner similar to the methodology for block/slot-wise cost analysis for 2022-23. The 2022-23 and 2029-30 estimates are the basis for slot-wise surcharges and penalties in potential ToD tariff framework.

[22] With increased variable renewable energy procurement, storage systems would play a significant role. To estimate use of storage and the block-wise associated cost, a detailed production cost modelling exercise is required. This was not conducted as part of this study. Instead to capture the impact of storage, we have assumed that demand is met through market purchase or storage depending on price and other considerations. The price for market or storage purchase is assumed to be Rs. 8/unit in nominal terms for 2029-30.

5 Trend analysis to determine slots and seasons

The monthly average demand for each 15-minute block was estimated for each year from 2018-19 to 2022-23. Similarly, the monthly average block-wise net demand (demand net of wind and solar generation) was estimated for the same period. This is to help understand persistent trends and changes over the years. With COVID-19 related lock-downs skewing demand patterns and recent efforts towards shifting agricultural demand to day-time, it is likely that demand trends in more recent years would be more relevant to understand for future profiles. Further, the blocks with high-priced market purchases in significant volumes indicate periods of stress for DISCOMs, typically when contracted power supply is either costly or insufficient to meet demand. The recent trends in weighted average market price (weighed with the quantum of purchase from market) are also analysed in this section.

5.1 Block-wise Average Demand and Net Demand trends

5.1.1 Seasonal variation in demand and net demand

From the demand trends, there are 4 clear seasons in Rajasthan namely:

- **Summer:** Between March and June (4 months), characterised by increased temperatures and rising demand especially from residential and commercial segment.
- **Monsoon:** July and August (2 months), with increased wind availability, dip in demand.
- **Post Monsoon:** September and October (2 months), where we typically see post-monsoon increase in net demand and agricultural demand increasing with the start of the rabi sowing season in October.
- **Winter:** November to February (4 months), characterised by the highest demand in Rajasthan with rabi sowing in two phases till February.

This seasonal variation in demand is clear in Figure 7 which shows the seasonal variation in 15-minute block-wise average demand and Figure 8 which shows the seasonal variation in net demand. The average monthly demand and net demand in Figures 7 and 8 are expressed as a proportion of the maximum block-wise demand recorded in the year. This is to enable comparison across months and focus on the change in load shapes.

Figure 7: Season-wise average 15-minute block-wise demand for 2022-23.

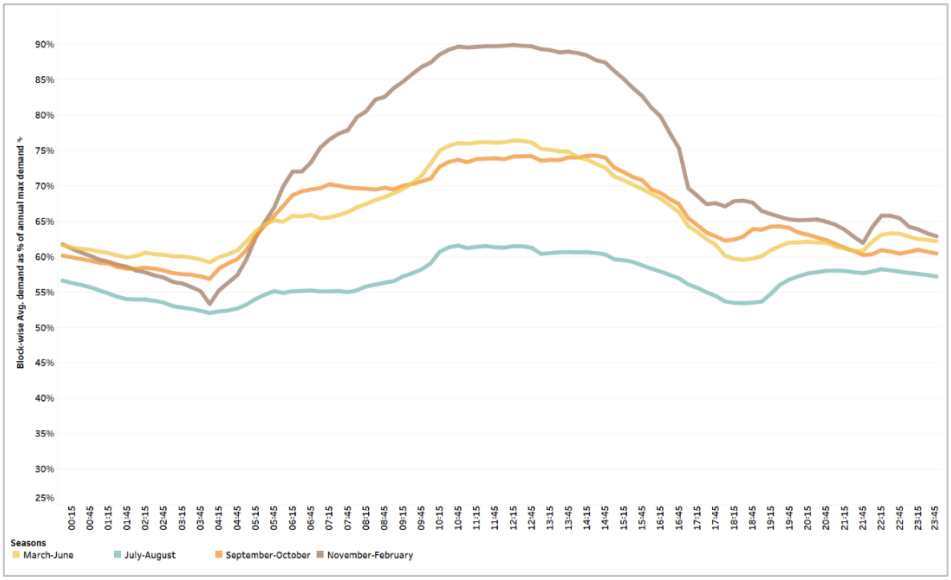


Figure 8: Season-wise average 15-minute block-level net demand for 2022-23.

5.1.2 *Trends in block-wise monthly average demand and net demand for 2022-23*

In addition to seasonal variation, there is also monthly variation in hourly demand and net demand. Figure 9 captures the block-wise monthly average demand (grey shaded area) as well as net demand (orange lines) trends for 2022-23.

Figure 9: Block-wise, monthly average demand and net demand for 2022-23

Based on 2022-23 demand and net demand trends, key observations include:

- Demand and net demand typically increase from 04:00 in most months, with exceptions in May (earlier start at 02:00-03:00) and July (later start at 05:00).
- The 04:00 to 06:00 period shows highest net demand increases (32% to 37%) in October and winter months (December and January), while monsoon months (June and August) show minimal increases (4% to 6%).
- Post 06:00, demand continues rising, reaching peak between 11:00 and 13:00 across all months except September. Winter months (November to February) show highest demand growth (25% to 30%) from 07:00, while June and post-monsoon months (September and October) show lowest (8% to 13%). Summer (March and April) and monsoon months (July and August) show moderate increases (approximately 20%).
- After 06:00, net demand follows an inverse pattern to demand due to solar generation, reaching lowest points around 13:00 to 13:30 in most months. Exceptions include September and October (lowest at 10:00), May and June (lowest at 09:00), and January (mostly flat throughout day).
- Between 13:30 and 17:00, while demand decreases across most months, net demand increases during monsoon, post-monsoon, April, and December. Other months show flat or marginally decreasing net demand.
- Evening periods show converging demand and net demand patterns as solar generation decreases. Both metrics increase during evening, night, and early morning, with net demand peaking between 18:00 and 20:00 and maintaining high levels until 22:00, followed by gradual decrease until 04:00.
- Notable exceptions include May (flat net demand from 10:00 to 22:00), September and October (earlier decline from 20:00), and November (20% rapid decline 18:15 to 21:45, followed by 13% increase until 22:30).

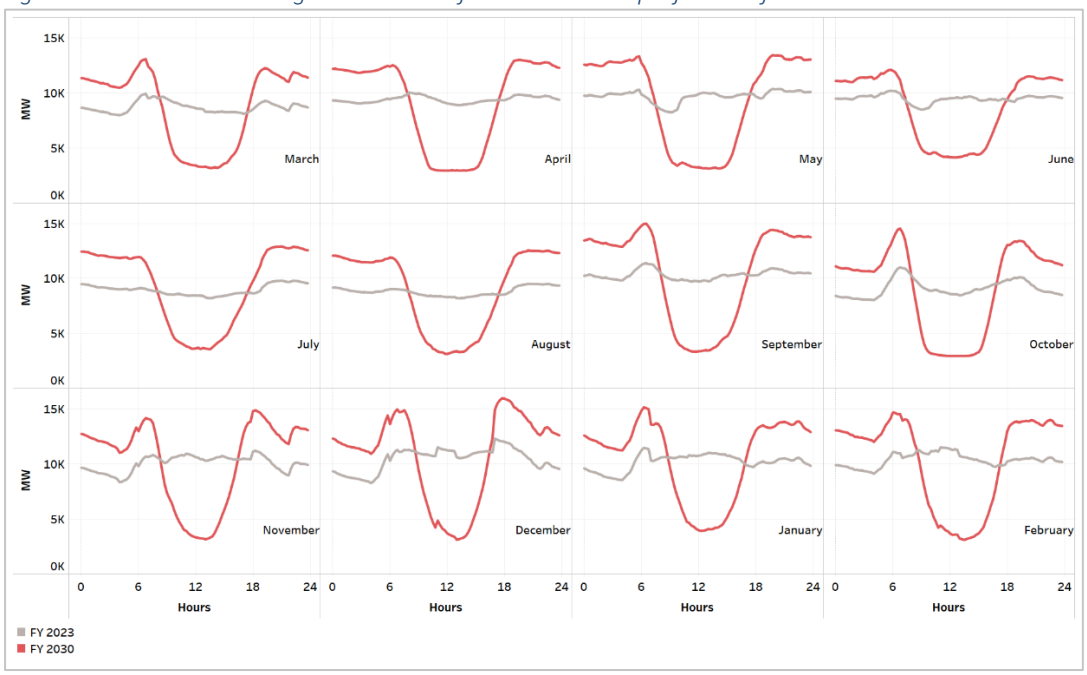
Similar exercise was carried out for 2018-19 and many of the broad observations hold. However, day-time demand peaks are more prominent in 2022-23 perhaps due to the shifting of agricultural demand to day time. The month-wise demand and net demand curves for the years 2019-20 to 2022-23 organized along the lines of the 4 seasons are available in Annexure 1.

5.1.3 Block-wise monthly average demand and net demand projected for 2029-30

As mentioned in Section 4.3.3, demand was projected for 2029-30 based on existing load profiles. Further, based on RPO targets specified by RERC and existing wind and solar profiles, net demand was projected for 2029-30.

Figure 10 shows the block-wise monthly average net demand curves for 2022-23 (grey line) and the estimated block-wise monthly average net demand for 2029-30 (red line).

Figure 10: Block-wise average net demand for 2022-23 and projections for 2029-30



Some major observations on the changes in net demand for 2029-30 are noted below:

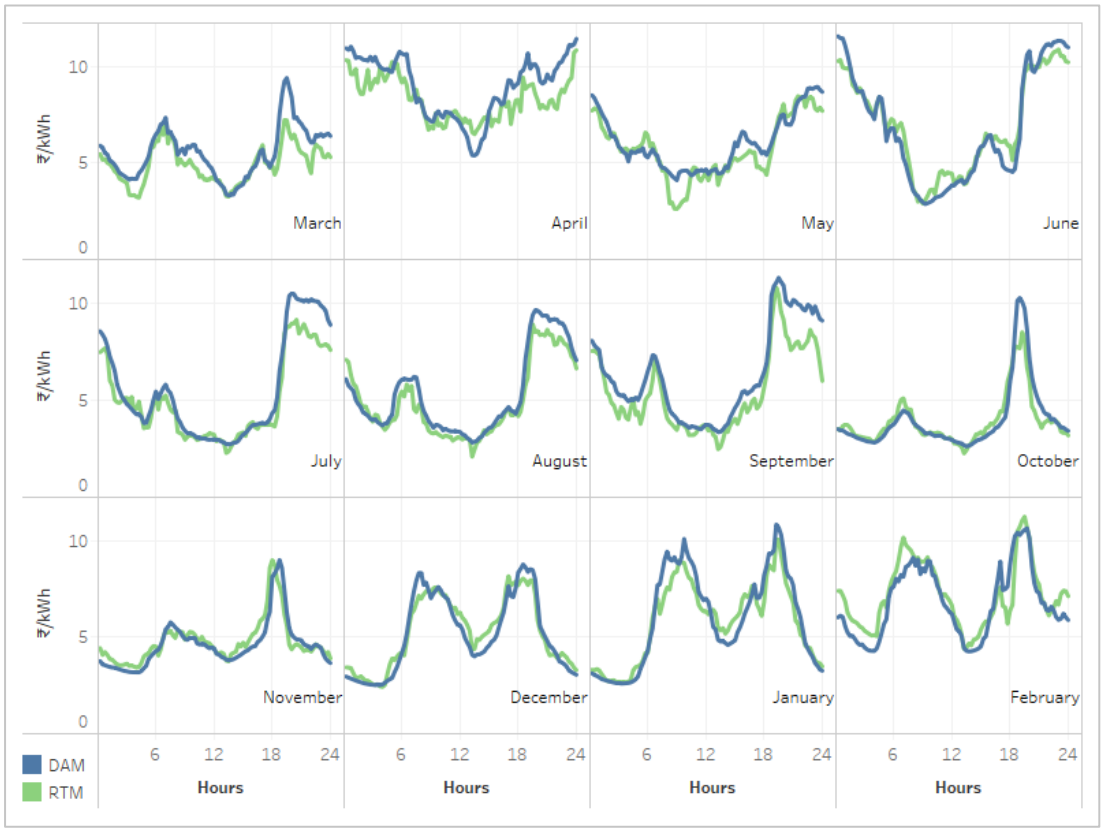
- Net demand in 2022-23 begins rising around 04:00 and continues increasing until 06:00-07:00 across most months. Post 07:00, substantial solar generation leads to significant net demand reduction until 10:00-11:00.
- After 11:00, net demand decreases more gradually until 12:00, then stabilizes until 15:00, ranging between 2900 MW and 4700 MW. For 2030, dispatchable capacity with a weighted average energy charge of ₹3.5/unit (nominal rates) is projected to be available to meet this demand.
- A sharp increase in net demand occurs between 16:00 and 19:00, rising from 15:00 levels to approximately 13,000-14,800 MW. This necessitates a 150% to 350% capacity increase within 4 hours, significantly impacting procurement costs.
- Net demand maintains consistently high and mostly flat levels from 19:00 to 06:00 across all months.

Net demand patterns highlight critical aspects for future planning: the steep evening peak increases, consistent morning peaks, and sustained high demand during evening and night periods all significantly shape future supply requirements and tariff measures to shift/shave demand.

5.2 Trends in weighted average market prices for purchase by Rajasthan DISCOMs in 2022-23

Figure 11 shows the monthly weighted average price for each 15-minute block for 2022-23.

Figure 11: Monthly block-wise weighted average prices in DAM and RTM for Rajasthan for 2022-23



Note: These are IEX Area Clearing Prices weighted with quantum purchased in Rajasthan state for each block of 2022-23

The weighted average prices shown are for two contracts in the India Energy Exchange, based on the quantum procured by Rajasthan DISCOMs for each block[23]. The two contracts- Day Ahead Market (DAM) and Real Time Market (RTM) are contracts where price discovery takes place through transparent double-sided auctions. These two contracts also account for bulk of the short-term procurement by Rajasthan DISCOMs.

The trends reveal lower prices during solar hours and consistent price increases in evening hours (18:00 to 22:00) across most months. System stress is evident through high prices extending from 22:00 to 04:00, and sometimes until 06:00. Winter months uniquely show high market prices during morning hours, demonstrating distinct seasonal patterns. Monthly analysis reveals:

— In April, market prices maintain ₹10/unit from 18:00 to 06:00, before declining from ₹8/unit at 09:00 to ₹6/unit by 15:00 during solar hours.

[23] Daily reports of NRDLC WBES captures procurement from power exchanges from the DAM and RTM segment. This was used along with the Area Clearing Price relevant for Rajasthan DISCOMs reported by IEX. Since more than 96% of trades are in the DAM and RTM segment of IEX, the IEX price provide a reasonable estimate.

- June follows a similar pattern, with prices rising to ₹8/unit between 18:00 and 22:00, peaking at ₹10/unit or more between 22:00 and 04:00. Prices stay elevated at ₹7/unit until 06:00, then drop sharply to ₹4/unit during daytime.
- Winter months (November to February) show distinct patterns, with prices declining from evening peaks of ₹6.5/unit (Nov-Dec) or ₹8/unit (Jan-Feb) to ₹3/unit between 22:00 and 06:00. Morning hours (06:00 to 09:00) see prices rise to ₹7-8/unit, continuing until 11:00, before settling at ₹5-6/unit until 18:00.
- October experiences a sharp price spike to ₹9/unit between 18:30 and 20:00, while maintaining ₹3/unit during other hours.
- May, July, August, and September show high prices (₹7-9/unit) from 18:00 to 04:00, followed by a reduction to ₹4-5/unit between 04:00 and 06:00, and further decreases during solar hours.

5.3 Determination of slots

Based on the above trends in demand and net demand, changes can be traced to five slots.

Morning slots

- 4:00 to 6:00- clear increase in demand and net demand is observed in most months
- 6:00 to 9:00- characterised with a continued increase in demand but a reduction in net

Day-time slot

- 9:00 to 18:00- day time slot with significant solar generation with the highest divergence in demand and net demand

Evening / Night slots

- 18:00 to 22:00- significant increase in demand and peak net demand and high procurement prices from the market on average
- 22:00 to 4:00- reduction in both demand and net demand

There are some variations in slots besides the five identified in some months but they are not consistent across months. With improvements in metering infrastructure, such variations can also be captured in pricing frameworks.

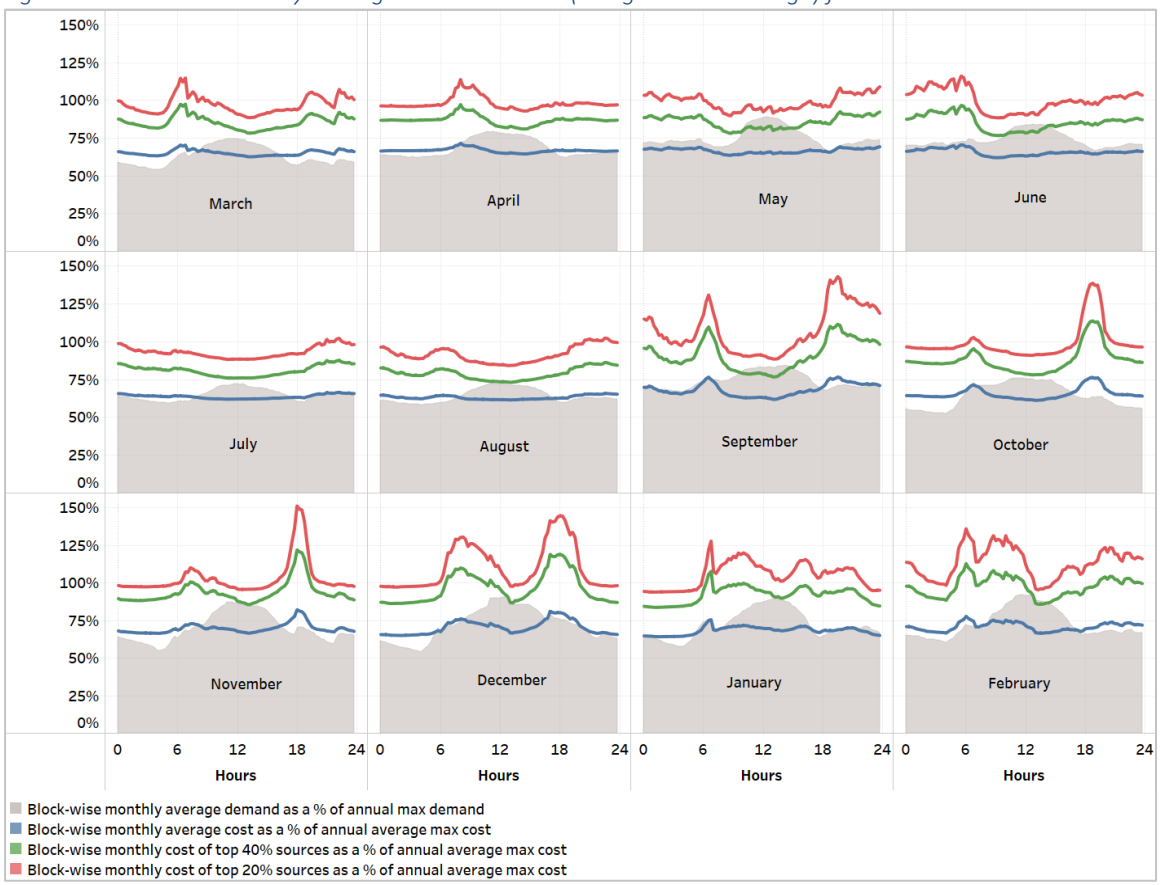
6 Average and Marginal Cost Analysis

Variations in average and marginal costs for each block was estimated and studied. Along with the average cost for each block, the cost of top 20% (price-wise) and the top 40% of the capacity dispatched in the block was captured. The average cost as well as the marginal cost (top 20%, top 40%) estimated for each block was averaged on a block-wise basis for each month. The observations based on this analysis are detailed in this section.

6.1 Variation in average and marginal cost for 2022-23

Figure 12 highlights the monthly average and marginal block-wise cost for 2022-23.

Figure 12: Trends in monthly average block-wise cost (marginal and average) for 2022-23



The monthly average block-wise trends for average cost (blue line) and marginal cost (top 20% (red line) to 40% (green line) capacity cost-wise) is clear from Figure 12. All three cost trends are expressed as a percentage of the maximum cost incurred in the year. For reference, the monthly average block-wise demand curve (shaded grey area) is also provided.

The percentage variation between 2 specific aspects is captured in Table 3:

— Slot-Specific Marginal Cost (SSMC) which is the marginal cost specific to a time-slot for the month
— Monthly Marginal Cost (MMC) which is the marginal cost (top 40% of capacity by cost) averaged across 5 slots for each month.

Some key observations are regarding SSMC as compared to MMC are:

— Between 04:00 to 06:00, increases occur only in May and June, contrasting with overall demand and net demand trends which show increases across most months during this slot. December and January even show a reduction.
— Between 06:00 and 09:00, increases appear in 7 of 12 months, again contrasting with net demand trends which show reduction in this period.
— The SSMC between 09:00 and 18:00 is 5% to 10% lower in summer months (March and May) and throughout monsoon and post-monsoon periods. However, winter months show minimal variation with SSMC at 3% or less.
— The SSMC between 18:00 to 22:00 is marginally higher (by 5% to 9%) in May, post-monsoon, and early winter months. During monsoon, this slot's SSMC shows a more substantial increase of 16%.
— The slot between 22:00 and 04:00, typically considered off-peak, has a 5% higher SSMC in May-June and monsoon. However, winter months show a 5% to 10% lower SSMC during this period.

Table 3: % Variation in SSMC from MMC for each month in 2022-23

Month	04:00-06:00		06:00-09:00		09:00-18:00		18:00-22:00		22:00-04:00	
March	–	1%	↑	8%	↓	-4%	–	3%	–	1%
April	–	0%	↑	6%	–	-2%	–	1%	–	0%
May	↑	4%	↓	-4%	↓	-4%	↑	4%	↑	5%
June	↑	11%	–	-1%	↓	-5%	–	0%	↑	5%
July	–	1%	–	0%	↓	-5%	↑	4%	↑	5%
August	–	1%	–	1%	↓	-5%	↑	5%	↑	4%
September	–	1%	↑	5%	↓	-10%	↑	16%	–	3%
October	–	-1%	–	2%	↓	-6%	↑	16%	–	-1%
November	–	-3%	↑	4%	–	-2%	↑	9%	↓	-4%
December	↓	-9%	↑	8%	–	2%	↑	6%	↓	-10%
January	↓	-6%	↑	6%	–	3%	–	2%	↓	-8%
February	–	1%	↑	7%	–	-2%	–	3%	–	-2%

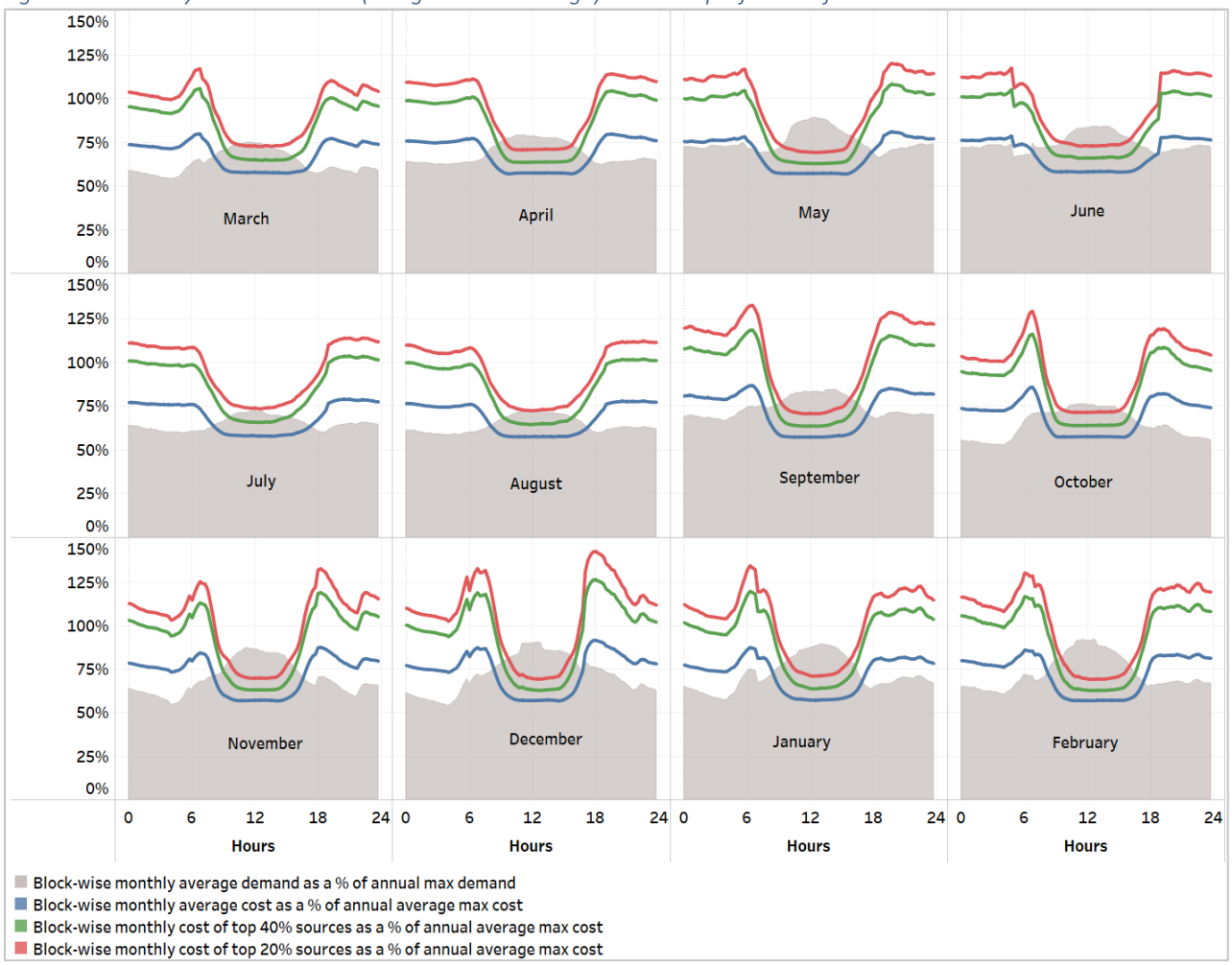
Analysis of cost and marginal cost trends shows that the 06:00 to 09:00 slot is more significant than the 04:00 to 06:00 period, which mirrors patterns of the night slot (22:00 to 04:00) where SSMCs largely match MMC across months.

During solar hours (09:00 to 18:00), SSMCs are lower in all months except winter, reflecting seasonal demand variations, particularly in agriculture electricity demand. While SSMCs are generally higher in the 18:00 to 22:00 slot, they show limited impact in summer months but become crucial during post-monsoon period in 2022-23. These patterns, also reflected in the top 20% cost comparison between SSMCs and MMCs. demonstrate the pronounced seasonal nature of cost trends in 2022-23.

6.2 Variation in Average and Marginal cost for 2029-30

The average and marginal cost curves for 2029-30 were projected for each block based on the supply profiles. In a manner similar to Figure 12, the block-wise monthly average and marginal cost curves for 2029-30 are available in Figure 13.

Figure 13: Monthly block-wise cost (marginal and average) based on projections for 2029-30



Cost patterns in 2029-30 closely follow net demand variations. The cost curves for top 20% and top 40% capacity in each block show similar patterns and converge during certain periods. While morning and evening peak demand periods consistently show highest costs across months, the night period (22:00 to 04:00) demonstrates stable costs in most months, with brief cost volatility appearing only in winter. Notably, costs during this night period remain consistently higher than daytime costs across all months.

The slot specific marginal costs (SSMC) (for top 40% of capacity by cost) are also compared to the monthly marginal costs (MMC) for 2029-30 in Table 4. The slot-wise variation corroborates the block-wise observations:

- In 2029-30, cost trends display greater consistency across months with reduced seasonal variations.
- During solar hours (09:00 to 18:00), SSMCs remain 20% to 25% lower than MMC across all months.
- The 18:00 to 22:00 slot consistently shows the highest SSMCs across all periods, indicating significant system stress. These SSMCs peak in winter months at 19% to 25% above MMC, while reaching their lowest in monsoon months at 15-16% above MMC.
- The night period (22:00 to 04:00) and early morning (04:00 to 06:00) show comparable SSMCs, both substantially higher than MMC. With increasing solar-dominated RE capacity and demand growth through 2030, meeting net load during this 8-hour period becomes costly. Despite being

traditionally off-peak, SSMCs exceed MMCs by at least 14% for nine months yearly in this period, suggesting sustained system stress. This strain will likely intensify as open access, captive, and net metering consumers rely on DISCOMs for banking and reliability services during non-solar hours.

— While the 06:00 to 09:00 slot marked the morning peak in Rajasthan during 2022-23, by 2030 its SSMCs align closest with MMC compared to other slots, particularly from May to August.

— Winter months show relatively lower SSMCs during the 22:00-04:00 period.

Table 4: % Variation in SSMC from MMC for each month in 2029-30

Month	04:00-06:00		06:00-09:00		09:00-18:00		18:00-22:00		22:00-04:00	
March	↑	14%	↑	13%	↓	-20%	↑	15%	↑	13%
April	↑	17%	↑	6%	↓	-22%	↑	20%	↑	16%
May	↑	20%	–	-2%	↓	-22%	↑	21%	↑	19%
June	↑	18%	–	-3%	↓	-21%	↑	16%	↑	19%
July	↑	14%	–	1%	↓	-20%	↑	15%	↑	17%
August	↑	15%	–	3%	↓	-20%	↑	16%	↑	17%
September	↑	20%	↑	10%	↓	-25%	↑	22%	↑	17%
October	↑	14%	↑	14%	↓	-20%	↑	22%	↑	10%
November	↑	10%	↑	13%	↓	-20%	↑	21%	↑	14%
December	↑	11%	↑	18%	↓	-20%	↑	25%	↑	7%
January	↑	15%	↑	20%	↓	-22%	↑	19%	↑	12%
February	↑	17%	↑	18%	↓	-25%	↑	22%	↑	17%

Between 2022-23 and 2029-30, significant changes in net demand and cost patterns emerge across slots and seasons, driven by substantial demand growth and increased RE procurement, particularly solar. Key shifts include sharp cost reductions during solar hours (09:00 to 18:00) and notable increases in average and marginal costs during night hours (22:00 to 06:00). While 2022-23 shows more pronounced seasonal variations, by 2030 the distinction in SSMCs between summer and monsoon months diminishes. Winter months maintain their distinct characteristics in 2030, though with SSMC patterns differing from those observed in 2022-23.

Based on the slot-wise demand and cost trends (marginal and average), the tariff trends are discussed for all four seasons and five slots till 2030. This is detailed in Annexure 2. Like the trends in costs, the changes tariffs also show reduction in seasonal variation by 2030. The recommendations in the next chapter for tariff design and based on the observations of demand, cost and tariff trends.

7 Recommendations

Based on the study findings, the recommendations focus on:

— Broad Principles for ToD tariff design

— A roadmap for applicability of the ToD tariff framework for consumers with minimum connected load threshold.

— Slot-wise and seasonal variation in Time of Day Tariffs from 2024-25 to 2029-30.

— Reporting processes to capture, monitor and document the implementation of ToD tariff in Rajasthan.

These recommendations are detailed in this section.

7.1 Broad Principles for ToD tariff design

— Clear and certain trajectory for the medium term: This will afford consumers with medium-term clarity and time to make operational and investment decisions to align demand as well as non-DISCOM supply profiles to optimize their bills. This is especially relevant for:
  - Impact on Captive and Open Access viability with solar hour ToD rebates
  - Captive RE banking restrictions being defined based on ToD tariff slots
  - For consumers with significant consumption from DISCOMs

— Cost-reflective for the DISCOM and benefits consumers: The tariff design should ensure that DISCOMs benefit from the timely recovery of costs incurred and reduce costs over time by avoiding additional high-cost power procurement to meet persistent shortages during net peak demand periods. Additionally, the ToD tariff design should incentivize consumers to shift demand and provide substantive benefits to those who move their load to periods with low cost and net demand.

— Accounts for changes in demand and supply for the DISCOMs in the medium term: The ToD tariff design trajectory should ideally be based not only on present cost and net demand trends but also on future demand trajectories. The extent of RE procurement can significantly impact the incentives offered and surcharges levied. Therefore, based on the progress with RE and storage procurement by DISCOMs, there should be a periodic review of the ToD tariff trajectory for the state.

— Simple to understand and implement: Given the existing metering infrastructure, changing ToD tariff design for a wide range of consumers would require implementation steps such as reprogramming meters and altering existing billing practices. Furthermore, to ensure consumer acceptability, the impact of ToD tariff changes should be clear and easy to understand. Expressing surcharges and rebates as a percentage of energy charges not only ensures consumer category-wise differentiation in ToD tariff levies but also reduces complexity in the design.

— Can be applicable to a wide ambit of consumers: Ideally, ToD tariffs should be applicable to as many consumers as possible to maximize their impact. The trajectory should envision improvements in metering infrastructure to support this.

7.2 Applicability of ToD tariff framework

Discussions with the DISCOMs in Rajasthan indicate that the existing metering infrastructure can record consumption data for at least five time slots for LT consumers with a connected load greater than 25 HP or 18.6 kW. With the installation of smart meters, more LT consumers should become eligible for the mandatory implementation of ToD tariffs.

For HT consumers, particularly those equipped with AMI or SEM, energy accounting is conducted on an hourly or block-wise basis. Therefore, a more granular ToD tariff structure could also be considered for HT consumers in the future.

It is recommended that ToD tariffs be applied to all consumers in a phased manner:

— **Immediate applicability** for all HT consumers (HT-1: Domestic, HT-2: Non-Domestic, HT-3: Medium Industries, HT-4: Bulk Supply Load, HT-5: Large Industries, and HT-6: EV Charging).

— **Within 6 months** for all non-agricultural LT consumers across categories with a load above 25 HP/18.6 kW.

— **Within 2 years** for non-agricultural consumers with a connected load above 10 kW. For non-agricultural consumers with a load below 10 kW, the rollout of ToD applicability can occur in phases based on the progress of smart meter installation.

Agricultural consumption is increasingly shifting to solar hours in Rajasthan. If necessary, seasonal variations in agricultural tariffs can be considered to account for higher demand during the winter months.

7.3 Recommended ToD Tariff Design from 2024-25 to 2029-30

From Section 7 and Annexure 2, it is clear that while there are 4 distinct seasons currently, the seasonal variation in net demand reduces with increase in renewable energy, especially solar procurement. Over time, summer and monsoon exhibit similar trends and so do monsoon and post-monsoon months. Therefore, a two-season (March to August and September to February) ToD tariff design with five slots is recommended, as shown in Table 5. The recommended tariff trajectory is in two phases. The recommended trajectory for Phase 2 from 2027-28 to 2029-30, is contingent on progress with renewable energy procurement as per RERC RPO targets and the impact of ToD levy in Phase 1.

Table 5: Slot-wise variation in ToD tariffs for two seasons

Phase 1: 2024-25 to 2026-27						
Time-Slot	**2024-25**		**2025-26**		**2026-27**	
	Mar-Aug	Sep-Feb	Mar-Aug	Sep-Feb	Mar-Aug	Sep-Feb
06:00 to 09:00	0%	5%	0%	5%	0%	5%
09:00 to 18:00	-10%	-15%	-15%	-20%	-15%	-20%
18:00 to 22:00	10%	10%	10%	10%	10%	15%
22:00 to 04:00	10%	-5%	10%	-5%	10%	0%
04:00 to 06:00	5%	0%	5%	0%	10%	5%
Phase 2: 2027-28 to 2029-30						
Time-Slot	**2027-28**		**2028-29**		**2029-30**	
	Mar-Aug	Sep-Feb	Mar-Aug	Sep-Feb	Mar-Aug	Sep-Feb
06:00 to 09:00	0%	5%	0%	5%	0%	5%
09:00 to 18:00	-20%	-25%	-20%	-30%	-25%	-30%
18:00 to 22:00	10%	10%	15%	10%	15%	10%
22:00 to 04:00	10%	0%	15%	0%	15%	0%
04:00 to 06:00	10%	5%	15%	5%	15%	5%

As shown:

— Rebates are recommended for nine hours (09:00 to 18:00), ranging from 10% to 20% of energy charges between 2024-25 and 2026-27.

— For 2027-28 to 2029-30, higher rebates ranging from 20% to 30% of energy charges are recommended, contingent upon DISCOMs meeting their RPO obligations.
— Surcharges for the morning peak period (06:00 to 09:00) are recommended only from September to February.
— In the remaining months (March to August) surcharges are recommended for 12 hours from 18:00 to 06:00 each year, ranging from 5% to 10% in Phase 1 and 10% to 15% in Phase 2.
— For September to February, surcharges are recommended only from 18:00 to 22:00 during the first two years of Phase 1. From 2026-27 to 2029-30, a 5% surcharge is applicable from 04:00 to 06:00. Normal tariffs (no surcharge or rebate) and recommended from 22:00 to 04:00 during these months for these years. In the first two years, a 5% rebate can be provided from 22:00 to 04:00 during this season. However, it is recommended at these rebates be phased out as soon as possible given the evolving demand and supply profiles in Rajasthan.

7.4 Reporting Progress of ToD implementation

A challenge before the commission while considering ToD tariff proposals by DISCOMs was to assess the impact of the ToD tariff design implemented in shifting load and ensuring cost recovery for DISCOMs. To address this for future years, it is recommended that:

— DISCOMs submit a detailed report to the Commission within 2 years with a clear assessment of variation in costs of the DISCOM across blocks and seasons. Such report should be submitted along with the tariff petition.
— The detailed report should be based on block-wise DISCOM demand and ToD Slot-wise consumption for all consumers with ToD tariffs. It should also account for hourly, ToD slot-wise data for open access, captive and net metering consumption.

In addition, it is crucial that the Commission is able to track the status of ToD tariff implementation in the state. Therefore, an annual ToD tariff implementation report should also be submitted by the DISCOMs with each year's tariff petition to the Commission. The report should include:

— DISCOM-wise details on category-wise number of consumers with ToD tariff applicability.
— Category-wise, number of consumers where meter upgradation is required to enable ToD based billing and timeline for replacement of the meters.

These details should be provided in formats specified by the Commission along with the tariff petition. Suggested formats are available in Annexure 3.

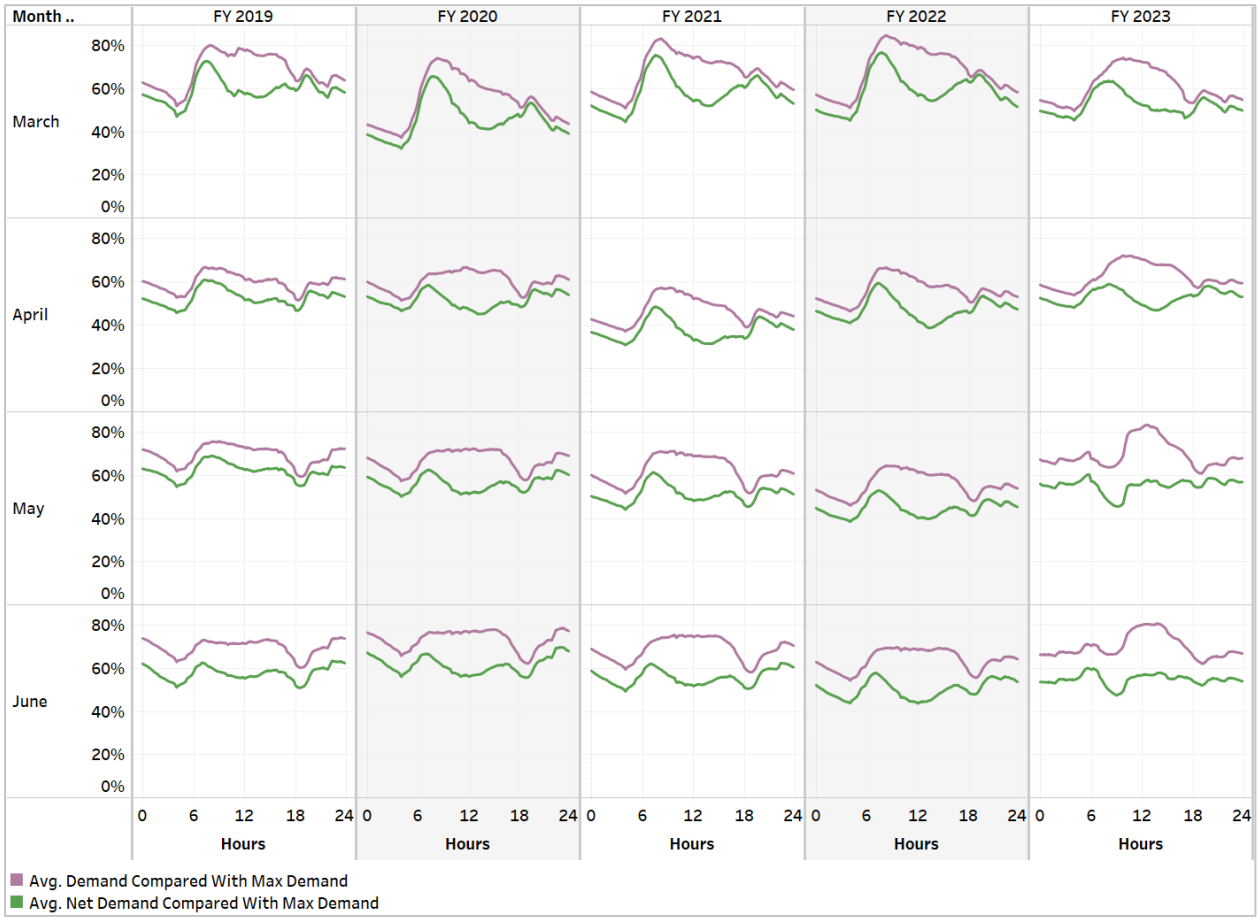
Based on the detailed report and data submitted by the DISCOMs, Commission can make necessary changes to the time of day tariff design, if required.

8 Annexures

8.1 Annexure 1: Load and net load from 2018-19 to 2022-23

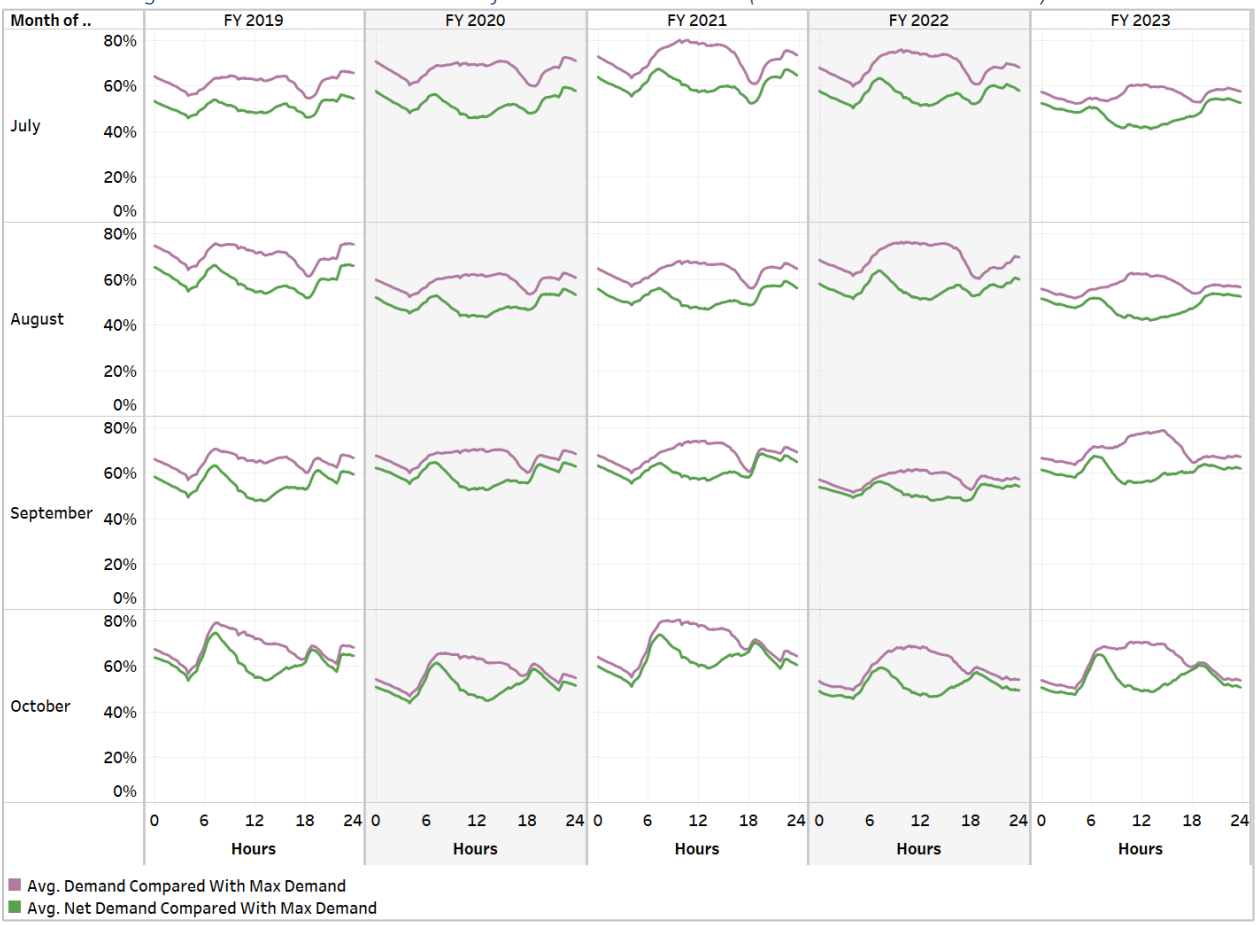
Figures 14 to 16 display demand and net demand patterns on a seasonal basis, expressed as a proportion of the maximum block-wise demand recorded for the year. The average demand and net demand trends for each month are presented on a 15-minute block-wise basis. Figure 14 specifically outlines these trends for the summer months from 2018-19 to 2022-23

Annexure 1 Figure 14: Block-wise demand & net demand trends for 2018-19 to 2022-23 (Summer)



As observed in the graph, demand and net demand begin to rise around 04:00, peaking at approximately 09:00. From 09:00 to 18:00, demand shows a declining trend. The gap between demand and net demand during these hours increases over time, during the solar hours. Figure 15 details demand and net demand patterns for monsoon and post-monsoon months.

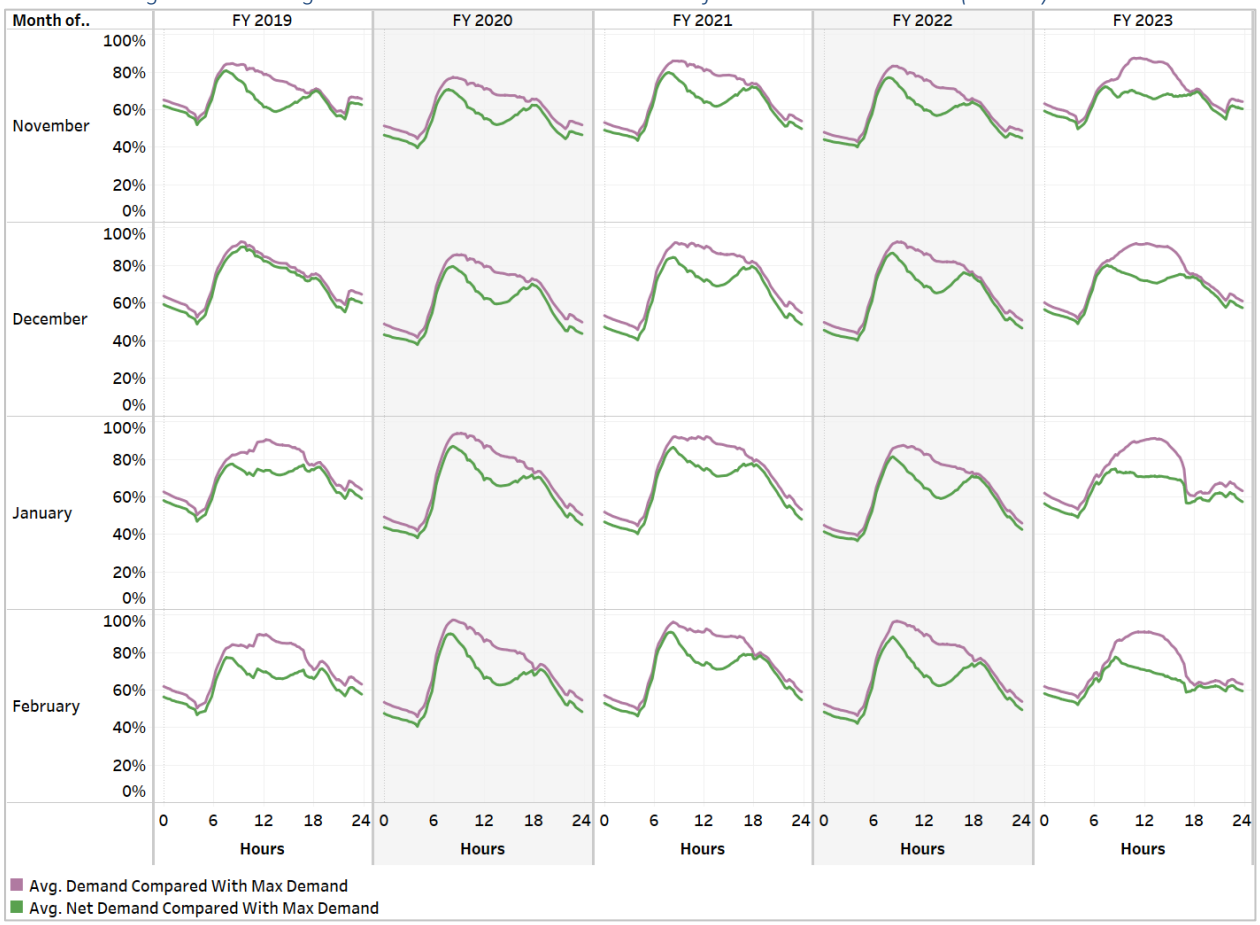
Annexure 1 Figure 15: Demand & net demand for 2018-19 to 2022-23 (Monsoon & Post-monsoon)



Compared to the summer months, the difference between morning demand and the afternoon dip in net demand is less pronounced. Additionally, in October, demand and net demand converge during non-daytime hours, perhaps due to reduced availability of wind energy.

Figure 16 details net demand and demand trends for winter months. Net demand and demand are much closer and sometimes identical during winter nights (18:00 to 09:00). Additionally, daytime demand is at its highest during this period of the year. Compared to other seasons, solar generation is insufficient to meet daytime demand, resulting in a smaller gap between the demand and net demand curves.

Annexure 1 Figure 16: Average block-level demand & net demand for 2018-19 to 2022-23 (Winter)



8.2 Annexure 2: Tariff projections based on cost and demand variations

Based on the analysis of demand, net demand, and cost trends (both average and marginal) for 2022-23 and 2029-30, this section presents yearly projections across four distinct seasons and five time slots. These trends can be studied across two periods: 2024-25 to 2026-27 and 2027-28 to 2029-30. The appliable tariffs projected are all indicated as percentage of energy charges, assuming that the base tariff increase shows a steady predictable trend over this period and there are no tariff shocks.

8.2.1 Phase 1: 2024-25 to 2026-27

Annexure 2 Table 6: 4 Season, 5 slot ToD tariff surcharge and rebate (-) for 2024-25

Year: 2024-25				
Time-slot	**Mar to June**	**Jul, Aug**	**Sep, Oct**	**Nov to Feb**
06:00 to 09:00	0%	0%	0%	5%
09:00 to 18:00	-10%	-10%	-15%	-10%
18:00 to 22:00	5%	10%	15%	5%
22:00 to 04:00	5%	10%	0%	-5%
04:00 to 06:00	5%	5%	0%	0%

Annexure 2 Table 7: 4 Season, 5 slot ToD tariff surcharge and rebate (-) for 2025-26

Year: 2025-26				
Time-slot	**Mar to June**	**Jul, Aug**	**Sep, Oct**	**Nov to Feb**
06:00 to 09:00	0%	0%	0%	5%
09:00 to 18:00	-15%	-15%	-20%	-15%
18:00 to 22:00	5%	10%	15%	5%
22:00 to 04:00	5%	10%	0%	-5%
04:00 to 06:00	5%	5%	0%	0%

Annexure 2 Table 8: 4 Season, 5 slot ToD tariff surcharge and rebate (-) for 2026-27

Year: 2026-27				
Time-slot	**Mar to June**	**Jul, Aug**	**Sep, Oct**	**Nov to Feb**
06:00 to 09:00	0%	0%	0%	5%
09:00 to 18:00	-15%	-15%	-20%	-15%
18:00 to 22:00	10%	10%	15%	5%
22:00 to 04:00	10%	10%	0%	0%
04:00 to 06:00	10%	10%	5%	0%

- Trends indicate the 06:00 to 09:00 slot have normal/neutral tariffs across most months except from November to February. Here, neutral tariffs are in 04:00 to 06:00 period.
- Solar hours between 09:00 to 18:00 see rebates across all seasons. The magnitude of these rebates for these 9 hours ranges from 10% to 15% in the first year and increases to 15% to 20% in subsequent years.

— Surcharges will be required between 18:00 and 06:00 from March to August. For this 12 hour period, the surcharges range from 5% to 10% of energy charges.
— From September to February, surcharges are required in the 18:00 to 22:00 slot. The surcharge is about 15% for September and October, decreasing to 5% during the winter months. Normal tariffs to apply from 22:00 to 06:00 in the post-monsoon period. In the winter months, a 5% rebate maybe required from 22:00 to 04:00 for the first two years, though this is not expected to continue in future years.

8.2.2 Phase 2: 2027-28 to 2029-30

Annexure 2 Table 9: 4 Season, 5 slot ToD tariff surcharge and rebate (-) for 2027-28

Year: 2027-28				
Time-slot	**Mar to June**	**Jul, Aug**	**Sep, Oct**	**Nov to Feb**
06:00 to 09:00	0%	0%	0%	5%
09:00 to 18:00	-20%	-15%	-25%	-20%
18:00 to 22:00	10%	10%	10%	10%
22:00 to 04:00	10%	10%	0%	0%
04:00 to 06:00	10%	10%	5%	0%

Annexure 2 Table 10: 4 Season, 5 slot ToD tariff surcharge and rebate (-) for 2028-29

Year: 2028-29				
Time-slot	**Mar to June**	**Jul, Aug**	**Sep, Oct**	**Nov to Feb**
06:00 to 09:00	0%	0%	0%	5%
09:00 to 18:00	-20%	-20%	-30%	-25%
18:00 to 22:00	15%	10%	10%	10%
22:00 to 04:00	15%	15%	0%	0%
04:00 to 06:00	15%	10%	5%	0%

Annexure 2 Table 11: 4 Season, 5 slot ToD tariff surcharge and rebate (-) for 2029-30

Year: 2029-30				
Time-slot	**Mar to June**	**Jul, Aug**	**Sep, Oct**	**Nov to Feb**
06:00 to 09:00	0%	0%	0%	5%
09:00 to 18:00	-25%	-20%	-30%	-30%
18:00 to 22:00	15%	15%	10%	10%
22:00 to 04:00	15%	15%	5%	0%
04:00 to 06:00	15%	10%	5%	0%

For the years 2027-28 to 2029-30, based on renewable energy procurement in accordance with the RERC RPO trajectory:

— The slot from 06:00 to 09:00 will continue to have normal/neutral tariffs for all months, except from November to February. During the winter months, normal tariffs will apply for an 8-hour period from 22:00 to 06:00.

- Rebates will still apply from 09:00 to 18:00 in all seasons during solar hours. However, the extent of these rebates will be higher than in the first year, ranging from 15% to 25% of energy charges in the first phase, increasing to 25% to 30% in subsequent years.
- For summer and monsoon months, surcharges will remain necessary for 12 hours from 18:00 to 06:00, ranging from 10% to 15% of energy charges.
- In the winter months, unlike Phase 1, there will be no surcharges from 22:00 to 06:00. The surcharge from 18:00 to 22:00 will be set at 10% of energy charges. By 2030, during the post-monsoon months, in addition to the 18:00 to 22:00 slot (10% surcharge), a 5% surcharge will also be applicable from 22:00 to 06:00.

8.3 Annexure 3: Suggested Formats for DISCOMs

To evaluate the effectiveness of Time-of-Day (ToD) tariff implementation in altering consumer demand patterns and compensating DISCOMs for power procurement costs, it is essential for DISCOMs to collect data in the formats outlined below and report it to the RERC.

Data in formats suggested in Tables 12 to 15 will facilitate an assessment of the current ToD tariffs and allow the Commission to conduct a review. These filled tables must accompany the tariff petition each year. Data in similar detailed formats have been submitted in the past for assessing the additional surcharge on open access consumers. Thus, DISCOMs can submit and report such data to the Commission. The Commission can initiate data collection for this reporting immediately.

DISCOMs are required to complete and submit the data formats specified in Tables 16, 17 and 18 annually to the Commission. This will enable tracking of consumers subject to the ToD tariff and monitor changes in metering infrastructure necessary for implementing the ToD tariff for a wider ambit of consumers.

Annexure 3 Table 12: Block-wise (15-minute) DISCOM level demand

DISCOM:					
Financial Year:					
Date	Time frame	Discom level Demand (MW)	Open Access Demand (MW)	Captive (MW)	Total (MW)
Going from 1 Apr to 31 March	Going from 00:00 to 12:45				

Note: Open access demand should only consist of open access via third party contracts. All captive demand (onsite and offsite) should be captured in the captive column. This information should be captured and reported by DISCOMs given the extent of embedded generation.

Annexure 3 Table 13:Block-wise, unit-wise, generation from in-state, out-of-state and RE sources

Month:								
Financial Year:								
Date	Time frame	Station/ Unit_1 (MW)	Station/ Unit_2 (MW)	Station/ Unit_n (MW)	Storage_1 Discharge (+) /Charging (-)	Storage_2 Discharge (+) / Charging (-)	Solar (MW)	Wind (MW)
Going from 1 Apr to 31 March	Going from 00:00 to 12:45							

Note: Dispatch for all contracted capacity as well short-term market purchase should be reported here. It is requested that the form is filled for all 'n' units comprising the entire contracted capacity (in-state and out of state). Of this, renewable capacity can be reported in aggregated manner as 'Total Solar' and 'Total Wind'.

Annexure 3 Table 14: Category-wise consumption from HT consumers under ToD

DISCOM:	
Financial Year:	
Voltage level	HT and above

Consumer Category	Voltage	Date	ToD Slot	Total Energy received from DISCOM (MUs) [A]	Total Energy received from OA (MUs) [B]	Total Energy received from captive (MUs) [C]	Total Energy received from RTPV system (MUs) [D]	Total consumption / Drawal by consumers (MUs) [E]	Surplus injection (MUs)
		Going from 1 April to 31 March	Each of the 5 slots						=(A+B+C+D)-(E)

Note: Energy received in column A, B, C and D will be energy injected net of applicable transmission and wheeling losses. Therefore, surplus injection will be total energy injected net of wheeling loss minus total energy consumption from all sources to meet demand.

Annexure 3 Table 15: Category-wise consumption from LT consumers under ToD

DISCOM:	
Financial Year:	
Voltage level	LT

Consumer Category	Voltage	Date	ToD Slot	Total Energy injected from DISCOM (MUs) [A]	Total Energy purchased / injected from OA (MUs) [B]	Total Energy purchased / injected from captive (MUs) [C]	Total Energy purchased / injected from RTPV system (MUs) [D]	Total consumption / Drawal by consumers (MUs) [E]	Surplus injection (MUs)
		Going from 1 April to 31 March	Each of the 5 slots						=(A+B+C+D)-(E)

Note: Energy received in column A, B, C and D will be energy injected net of applicable transmission and wheeling losses. Therefore, surplus injection will be total energy injected net of wheeling loss minus total energy consumption from all sources to meet demand. For the Agriculture category, drawal from solar projects under the KUSUM scheme should be reported under net metering.

Annexure 3 Table 16: Metering status for HT consumers

DISCOM:	
Financial Year:	
Consumer Category	
Voltage:	HT and above

Number of consumers	Total	With demand > 1 MW	With demand <1 MW
Total Metered (=a+b+c+d)			
(a)_SEM/technology with 15 min recording			
(b)_ AMI/technology with hourly recording			
c)_Slot-wise recording for at least 5 slots			
(d)_Meters without min 5 slots recording			

Annexure 3 Table 17: Metering status for LT consumers

DISCOM:	
Financial Year:	
Consumer Category	
Voltage:	LT

Number of consumers	Total	With demand > 25 HP (18.6 kW)	With demand > 10 kw	With demand < 10 kw
Total Metered (=a+b+c+d)				
(a)_SEM/technology with 15 min recording				
(b)_ AMI/technology with hourly energy recording				
c)_Slot-wise recording for at least 5 slots				
(d)_ Meters without min 5 slots recording				
(e)_Unmetered				

Annexure 3 Table 18: Metering plan for LT and HT consumers

Metering Technology	Year	Year 1 (t)		Year 2 (t+1)		Year 3 (t+2)		Year 4 (t+3)		Year 5 (t+4)	
	Plan v/s Achievement	Plan	Achievement	Plan	Achievement	Plan	Achievement	Plan	Achievement	Plan	Achievement
	Demand threshold	Cons. Nos	Cons. Nos	Cons. Nos	Cons. Nos	Cons. Nos	Cons. Nos	Cons. Nos	Cons. Nos	Cons. Nos	Cons. Nos
(a)SEM /technology for 15 min recording	HT consumer >1 MW										
	HT consumer < 1 MW										
	LT consumer > 25 HP										
	LT consumer > 10 kw										
	LT consumer < 10 kw										
(b)AMI technology for hourly recording	HT consumer >1 MW										
	HT consumer < 1 MW										
	LT consumer > 25 HP										
	LT consumer > 10 kw										
	LT consumer < 10 kw										
(c)_Slot-wise recording for min. 5 slots	HT consumer >1 MW										
	HT consumer < 1 MW										
	LT consumer > 25 HP										
	LT consumer > 10 kw										
	LT consumer < 10 kw										
(d)_Meters without recording for min. 5 slots.	HT consumer >1 MW										
	HT consumer < 1 MW										
	LT consumer > 25 HP										
	LT consumer > 10 kw										
	LT consumer < 10 kw										
Total number of consumers											

Note: The plan for metering should be filled in for all years in the first year itself. Subsequent revisions can be updated in future filings. The commission can also ask for this information on category-wise basis

9 List of abbreviations

BU	Billion Units
CEA	Central Electricity Authority
DAM	Day Ahead Market
DISCOM	Electricity Distribution Company
EAC	Energy Assessment Committee
EPS	Electric Power Survey
GW	Giga Watt
HT	High Tension
IEX	India Energy Exchange
kW	kilo Watt
LT	Low Tension
MERC	Maharashtra Electricity Regulatory Commission
MMC	Monthly Marginal Cost
MOD	Merit Order Dispatch
MW	Mega Watt
NRLDC	Northern Regional Load Dispatch Centre
OA	Open Access
p.p.	Percentage Point
PPA	Power Purchase Agreement
PSA	Power Sale Agreement
RDSS	Revamped Distribution Sector Scheme
RE	Renewable Energy
RERC	Rajasthan Electricity Regulatory Commission
RTM	Real Time Markets
RUVNL	Rajasthan Urja Vikas Nigam Limited
SERC	State Electricity Regulatory Commission
SLDC	State Load Dispatch Centre
SSMC	Slot-Specific Marginal Cost
TANGEDCO	Tamil Nadu Generation and Distribution Corporation Limited
ToD	Time of Day
UT	Union Territory/ies
WBES	Web Based Energy Scheduling

The Rajasthan Electricity Regulatory Commission commissioned Prayas (Energy Group) to design Time of Day (ToD) tariffs for the state's three distribution companies. The study analyzed five years of 15-minute block-wise demand-supply patterns and estimated average and marginal costs across different time blocks to assess variations in DISCOM costs with changing demand and supply patterns. Drawing from these trends and ToD practices across states, the study proposes a forward-looking framework with a clear trajectory until 2029-30, enabling consumers and DISCOMs to optimize their operations and investments. Key recommendations include a simplified two-season structure with enhanced solar hour rebates to reflect Rajasthan's growing renewable energy capacity. The framework recommends phasing out night and early morning rebates in response to the state's evolving demand patterns. The study proposes universal implementation of ToD tariffs through a phased approach, aligned with the existing metering infrastructure and planned improvements.

Prayas (Energy Group)