Chapter-II

Short-term Power Market in India

1. Introduction

Prior to the Electricity Act 2003, the electricity industry recognized generation, transmission, and supply as three principal activities, and the legal provisions were also woven around these concepts. With the enactment of the Electricity Act 2003, the transactions involving purchase and sale of electricity has been recognized as a distinct licensed activity. Recognition of trading as a separate activity is in sync with the overall framework of encouraging competition in all segments of the electricity industry. The Electricity Act 2003, laid down provisions for promoting competition in the Indian power market. Introduction of non-discriminatory open access in electricity sector provided further impetus for enhancing competition in the market. The responsibility of developing the market in electricity has been vested with the Regulatory Commissions. The open access regulations, inter-state trading regulations, power market regulations, etc., of the Central Commission have facilitated power trading in an organized manner. In exercise of the powers conferred under section 178 of the Electricity Act, 2003, the Commission had notified the CERC (Procedure, Terms and Conditions for grant of trading licence and other related matters) Regulations, 2009 in February 2009 and the CERC (Fixation of Trading Margin) Regulations, 2010 in January 2010.

Over the years, the Indian power sector has undergone many developments like increased volume of electricity traded on power exchanges, introduction of new type of energy procurement & sale contracts, cross border trade of electricity, etc. Considering the developments, the Commission notified the CERC (Procedure, Terms and Conditions for grant of Trading Licence and other related matters) Regulations, 2020 in January 2020, repealing the earlier Regulations.

The Regulations specify the terms and conditions for grant of trading licence and other related matters including but not limited to capital adequacy and liquidity requirements, obligations of the trading licensees, requirements for submission of

information, penalties for contravention and non-compliance by the trading licensees and the trading margin that shall be charged by the trading licensees for various types of contracts.

Initially, when the two Power Exchanges, viz., Indian Energy Exchange (IEX) and Power Exchange India Ltd. (PXIL) started operations in 2008, only Day Ahead contracts were offered on their platform. Later, vide Orders dated 31.08.2009, the Commission approved the introduction of additional contracts, i.e., Day-ahead Contingency contracts, Intra-day contracts, Daily contracts & Weekly contracts.

To serve the growing volumes of electricity trade and increasing penetration of renewable energy in the grid, the Commission has also introduced new market segments on the Power Exchanges, namely the Real Time Market (RTM) and the Green Term Ahead Market (GTAM), in the year 2020-21. RTM was commenced on the power exchanges from 1st June 2020, to enable better portfolio management by the utilities with efficient power procurement planning, scheduling, and imbalance handling. The market provides the buyers & sellers, an organized platform for trading electricity closer to real time.

Providing a new avenue for renewable energy generators to sell power and for obligated entities to fulfill their RPOs, the GTAM was introduced on the Power exchanges from 1st August 2020. It is a market-based mechanism wherein RE surplus and RE deficit States can trade RE power and balance their RPO targets. This would incentivize RE resource-rich States to develop RE capacity beyond their obligation and aid in the development of RE capacity in India. The contracts in GTAM are similar to contracts in TAM.

With a view to provide avenues to existing and prospective Renewable Energy generators for sale of RE through the Power Exchange and to provide more options to the Obligated Entities to fulfil their RPOs, the Commission granted approval for introduction of Green Day Ahead Contract (GDAC) in Day Ahead Market (DAM) as Green-Day Ahead Market (G-DAM) on the power exchanges in 2021-22. In G-DAM, the contracts enable buyers & seller to trade RE power on day ahead basis. The sellers are provided option to transfer their uncleared bids to DAM with flexibility to specify

different price for uncleared bids in G-DAM. These contracts have been introduced on IEX from 27th October 2021 and on PXIL from 20th December 2021.

The Commission granted approval for introduction of hydropower contracts in Green Term Ahead Market on IEX on 24th February 2022. These contracts are aimed to provide an additional avenue for the existing and prospective hydropower generators to sell the power. The obligated entities could procure hydropower through these contracts and thus meet their HPO requirements. These hydro GTAM contracts have been approved on similar lines to existing contracts under GTAM.

In 2022-23, the Commission approved the introduction of longer duration contracts, which were earlier restricted up to 11 days, in the Term-Ahead market and Green Term-Ahead Market. The introduction of these contracts has been made possible due to the outcome of the Hon'ble Supreme Court of India Order dated 6th October 2021, which favourably disposed of the jurisdictional matter between CERC and SEBI in terms of the agreement reached between the two that the CERC will regulate all the physical delivery contracts, whereas the SEBI will regulate the financial contracts. These contracts are allowed as non-transferable specific delivery-based forward contracts (NTSD contracts) at power exchanges under both conventional as well as renewable energy segments. The Commission approved these contracts for a maximum duration of three months at present. These contract segment would enable optimization of power procurement costs and would help in hedging the risk of price volatility. These contracts are provided with robust payment security mechanisms and provide immense opportunities for open access consumers to buy power at competitive prices for longer duration. The Commission allowed the introduction of Daily, Weekly, Monthly and Any day single-sided contracts, and trading commenced in June 2022.

The Commission also approved the introduction of High Price Day Ahead Market (HP-DAM) in the Integrated Day Ahead Market (IDAM) at IEX on 16th February 2023. The dedicated market segment has been introduced to enable high-cost generators, who have otherwise not been able to participate in the day-ahead market due to the existing price ceiling. The bid price range initially was between ₹0/kWh to ₹50/kWh in this segment, later revised to ₹0/kWh to ₹20/kWh w.e.f. 11th April 2023.

Scheduling for HP-DAM transactions is carried out as per NLDC procedure for collective transactions. At present, only following categories are eligible for participation in HP-DAM as sellers:

(i) Gas based generating stations using imported RLNG and Naphtha;
(ii) Imported coal based generating stations using only imported coal; and
(iii) Battery Energy Storage Systems (BESS)

The above list is subject to review by the Commission. Both buyers and eligible sellers in IDAM, can also opt for carry forward of their unselected bids from DAM to HP-DAM submitting a price premium in such case. Buyers are given option to quote their maximum quantum of unselected bids from conventional DAM that they would like to carry forward to the HP-DAM segment. Trading in the HP-DAM segment commenced from 10th March 2023.

With a view to increasing the competition among the power exchanges, providing more avenues to eligible sellers who have not been able to participate in TAM and Contingency contracts due to the existing price ceiling, and for creating a level playing field across different market segments, the Commission vide orders dated 24.07.2023, 21.09.2023 and 16.10.2023 to HPX, PXIL and IEX, respectively, approved the introduction of High Price Term Ahead Market (HP-TAM) and High Price Contingency contracts on the three power exchanges.

In the interest of grid security and for market development, the Commission vide Order dated 28.04.2023 accorded approval for introducing Tertiary Ancillary Service (TRAS) in the power exchanges in accordance with the CERC (Ancillary Services) Regulations 2022.

The Commission also notified the CERC (Deviation Settlement Mechanism and Related Matters) Regulations, 2022 on 14th March, 2022. These regulations shall be applicable to all grid connected regional entities and other entities engaged in Inter-state sale and purchase of electricity. As per the new regulations, all entities to adhere to schedule and any deviation shall be managed through Ancillary Services. As Ancillary services are deployed, the charges for deviation should be such that it covers the cost of

deployed Ancillary Services. Accordingly, the normal rate of deviation for a time block shall be equal to be weighted average Ancillary Service Charge (paisa/kWh) computed on the basis of the total quantum of ancillary services deployed and net charges payable to all the ancillary service providers for all the regions for that time block. Provided that for a period of one year from the date of effect of these regulations, normal rate of charges of deviation for a given time block shall be equal to the highest of the weighted average ACP of the Day Ahead Market segments of all the Power Exchanges or the weighted average ACP of the Real-Time Market segments of all the Power Exchanges or the Weighted Average Ancillary Service Charge of all the regions for that time block.

The DSM Regulations 2022 came into effect on 5th December 2022. However, the Commission observed that the normal deviation charge reached as high as ₹40/kWh in some blocks due to the high cost of ancillary services deployed. While such charges serve as a deterrent for over-drawl and under-injection, in cases where the receivables are linked to the normal rate of deviation charge, this has the potential of creating a perverse incentive to under-draw or over-inject. Therefore, the Commission, vide its Suo Motu order dated 26.12.2022, decided to resolve this issue by putting a cap of ₹12/kWh on the normal rate of charges of deviation. Thereafter, vide its Suo Motu Order dated 06.02.2023, the Commission revised the charges of deviation. As per the Order, the normal rate of charges of deviation shall be equal to the higher of the weighted average ACP of the Day Ahead Market segments of all the Power Exchanges and the weighted average ACP of the Real-Time Market segments of all the Power Exchanges, for that time block, subject to a ceiling of Rs 12/kWh. Subsequently, with the introduction of HP-DAM in the Power Exchange and the revision in the price ceiling in various market segments in Power Exchanges, the Normal Rate of Charge for Deviation was aligned vide Order dated 09.04.2023. As per the Order, the normal rate of charges of deviation shall be equal to the higher of the weighted average ACP of the Day Ahead Market segments of all the Power Exchanges and the weighted average ACP of the Real-Time Market segments of all the Power Exchanges, for that time block, subject to a ceiling of Rs 10/kWh. It was further provided that for a Seller whose bid is cleared in the HP-DAM, the Normal Rate of Charges for Deviation by way of 'under-injection' for a time block shall be equal to the highest of the weighted average ACP of the HP-DAM Market segments of all the Power Exchanges; or the weighted

average ACP of the Day Ahead Market segments of all the Power Exchanges; or the weighted average ACP of the Real Time Market segments of all the Power Exchanges, for that time block for the quantum of power sold though HP-DAM.

The chapter, in the following sections, provides a brief analysis of short-term electricity transactions and DSM volume over the years. Here, "short-term transactions of electricity" refers to the contracts of less than one year for the trades given below. "DSM Volume" includes the volume recorded under Deviation Settlement Mechanism.

(a) Electricity traded under bilateral transactions through Inter-State Trading Licensees (only inter-state trades)
(b) Direct Bilateral Transactions between entities
(c) Electricity traded through Power Exchanges

The analysis includes:

(i) Yearly/monthly/daily trends in short-term transactions of electricity & DSM volume
(ii) Time of the day variation in volume and price of electricity transacted through traders and power exchanges
(iii) Trading margin charged by trading licensees for bilateral transactions
(iv) Analysis of open access consumers on power exchanges
(v) Major sellers and buyers of electricity in the short-term market
(vi) Effect of congestion on volume of electricity transacted through power exchanges
(vii) Ancillary services operations

2. Yearly Trends in Short-term Transactions of Electricity & DSM Volume (2009-10 to 2023-24)

The analysis of yearly trends in short-term transactions & DSM volume includes the electricity transacted through the following segments:

- Trading licensees (inter-state part only) under bilateral transactions or "bilateral trader" segment;

- Power exchange segment with transactions in Day Ahead Market, Green Day Ahead Market, High Price Day Ahead Market, Term Ahead Market, Green Term Ahead Market, High Price Term Ahead Market and Real Time Market;
- Direct bilateral transactions of electricity between entities; and
- DSM

Interstate trading licensees (traders) have been undertaking trading in electricity since 2004, and the power exchanges started operations in 2008. As of 31st March 2024, there were a total of 59[3] inter-state trading licensees (refer to Annexure II) and three power exchanges operating in the country. The three power exchanges, namely, Indian Energy Exchange (IEX), Power Exchange India Ltd. (PXIL) and Hindustan Power Exchange (HPX) started their operations in June 2008 and October 2008 and July 2022, respectively.

2.1 Total Short-term Transactions of Electricity & DSM Volume with respect to Total Electricity Generation

The total volume of short-term transactions of electricity & DSM increased from 65.90 BU in 2009-10 to its all-time high of 218.22 BU in 2023-24. During this period, the volume of short-term transactions of electricity increased at a higher rate, i.e., at a (CAGR of 8.9%) as compared to the increase in total electricity generation (CAGR of 6.0%)[4]. The volume of short-term transactions of electricity as a percentage of total electricity generation varied from 8.9% to 12.5% during the period (Table-9).

Table-9: Volume of Short-term Transactions of Electricity & DSM with respect to Total Electricity Generation, 2009-10 to 2023-24

Year	Volume of Short-term Transactions of Electricity & DSM (BU)	Total Electricity Generation (BU)	Volume of Short-term Transactions of Electricity & DSM as % of Total Electricity Generation
2009-10	65.90	768.43	9.6%
2010-11	81.56	852.35	9.6%
2011-12	94.51	927.75	10.2%
2012-13	98.94	969.29	10.2%

[3] *This does not include Global Energy Pvt. Ltd.*
[4] *Total electricity generation is the gross electricity generation in India as defined by CEA.*

2013-14	104.64	1026.34	10.2%
2014-15	98.99	1110.07	8.9%
2015-16	115.23	1172.78	9.8%
2016-17	119.23	1241.70	9.6%
2017-18	127.62	1308.15	9.8%
2018-19	145.20	1375.86	10.6%
2019-20	137.16	1390.93	9.9%
2020-21	146.01	1380.06	10.6%
2021-22	186.75	1491.85	12.5%
2022-23	194.35	1624.47	12.0%
2023-24	218.22	1739.09	12.5%

Total Generation is the gross generation in India as defined by CEA
Source: NLDC & CEA

The analysis of yearly trends of short-term transactions of electricity & DSM for various segments is presented in the following sections.

2.1.1 Electricity Transacted through Traders and Power Exchanges

Table-10(a), Table-10(b), Table-10(c) and Figure-8 show details of the volume of electricity transacted through traders under bilateral transactions and through power exchanges under collective transactions (DAM, G-DAM, HP-DAM, RTM), Contingency contracts and Term-Ahead Market.

The volume of electricity transacted through traders increased from 26.72 BU in 2009-10 to 41.02 BU in 2023-24 (Table-10(a)) at a CAGR of 3.1%. The share of volume transacted through traders as a percentage of total volume of short-term transactions & DSM varied from 17.4% to 40.5% during this period.

Table-10(a): Volume of Electricity transacted through Traders (BU), 2009-10 to 2023-24

Year	Electricity Transacted through Traders	Volume of Short-term Transactions of Electricity & DSM (BU)	Electricity Transacted through Traders as % to Total Volume of Short-term & DSM
2009-10	26.72	65.90	40.5%
2010-11	27.70	81.56	34.0%
2011-12	35.84	94.51	37.9%
2012-13	36.12	98.94	36.5%
2013-14	35.11	104.64	33.6%
2014-15	34.56	98.99	34.9%

2015-16	35.43	115.23	30.7%
2016-17	33.51	119.23	28.1%
2017-18	38.94	127.62	30.5%
2018-19	47.32	145.20	32.6%
2019-20	29.95	137.16	21.8%
2020-21	26.67	146.01	18.3%
2021-22	39.47	186.75	21.1%
2022-23	33.80	194.35	17.4%
2023-24	41.02	218.22	18.8%

Source: NLDC and Power Exchanges data

The volume of electricity transacted through all three power exchanges under different market segments increased from 7.19 BU in 2009-10 to 121.49 BU in 2023-24 (Table-10(b)). The CAGR in volume of this segment during 2009-10 to 2023-24 was 22.4%. The share of electricity transacted through power exchanges as a percentage of total volume of short-term transactions of electricity & DSM increased from about 10.9% in 2009-10 to 55.7% in 2023-24 (Table-10 (b)).

Table-10(c) provides a further break-up of transactions in the Contingency and Term-Ahead Market of the power exchanges, including Day-Ahead Contingency contracts, Intra-Day Contingency contracts, Daily, Weekly and Monthly contracts, and Any-Day single-sided (ADSS) contracts. As can be observed from the table, day-ahead Contingency and Daily contracts recorded the maximum volume in the Term-ahead market segment, followed by the ADSS contracts.

Table-10(b): Volume of Electricity transacted through Power Exchanges (BU), 2009-10 to 2023-24

Year	Electricity Transacted through IEX							Electricity Transacted through PXIL							Electricity Transacted through HPX							Electricity Transacted through Power Exchange	Volume of Short-term Transactions of Electricity & DSM (BU)	Electricity Transacted through PXs as % to Total Volume of Short-term & DSM
	DAM	GDAM	HPDAM	TAM	GTAM	HPTAM	RTM	DAM	GDAM	HPDAM	TAM	GTAM	HPTAM	RTM	DAM	GDAM	HPDAM	TAM	GTAM	HPTAM	RTM			
2009-10	6.17	-	-	0.10	-	-	-	0.92	-	-	0.003	-	-	-	-	-	-	-	-	-	-	7.19	65.90	10.9%
2010-11	11.80	-	-	0.91	-	-	-	1.74	-	-	1.07	-	-	-	-	-	-	-	-	-	-	15.52	81.56	19.0%
2011-12	13.79	-	-	0.62	-	-	-	1.03	-	-	0.11	-	-	-	-	-	-	-	-	-	-	15.54	94.51	16.4%
2012-13	22.35	-	-	0.48	-	-	-	0.68	-	-	0.04	-	-	-	-	-	-	-	-	-	-	23.54	98.94	23.8%
2013-14	28.92	-	-	0.34	-	-	-	1.11	-	-	0.30	-	-	-	-	-	-	-	-	-	-	30.67	104.64	29.3%
2014-15	28.12	-	-	0.22	-	-	-	0.34	-	-	0.72	-	-	-	-	-	-	-	-	-	-	29.40	98.99	29.7%
2015-16	33.96	-	-	0.33	-	-	-	0.14	-	-	0.58	-	-	-	-	-	-	-	-	-	-	35.01	115.23	30.4%
2016-17	39.78	-	-	0.74	-	-	-	0.25	-	-	0.35	-	-	-	-	-	-	-	-	-	-	41.12	119.23	34.5%
2017-18	44.84	-	-	1.37	-	-	-	0.73	-	-	0.75	-	-	-	-	-	-	-	-	-	-	47.70	127.62	37.4%
2018-19	50.06	-	-	2.10	-	-	-	0.09	-	-	1.26	-	-	-	-	-	-	-	-	-	-	53.52	145.20	36.9%
2019-20	49.11	-	-	4.77	-	-	-	0.05	-	-	2.52	-	-	-	-	-	-	-	-	-	-	56.45	137.16	41.2%
2020-21	60.38	-	-	3.27	0.79	-	9.47	0.24	-	-	5.45	0.0004	-	0.002	-	-	-	-	-	-	-	79.59	146.01	54.5%
2021-22	65.14	0.92	-	5.56	4.02	-	19.91	0.04	0.00	-	4.43	1.43	-	0.00	-	-	-	-	-	-	-	101.45	186.75	54.3%
2022-23	51.18	3.82	-	10.10	1.39	-	24.17	0.19	0.00	-	8.22	1.10	-	0.01	0.001	0.00	-	2.71	0.07	-	0.00	102.95	194.35	53.0%
2023-24	53.39	2.50	0.03	14.94	0.73	0.00	30.12	0.08	0.00	0.01	8.68	0.19	0.19	0.03	0.078	0.00	0.00	9.35	0.52	0.62	0.03	121.49	218.22	55.7%

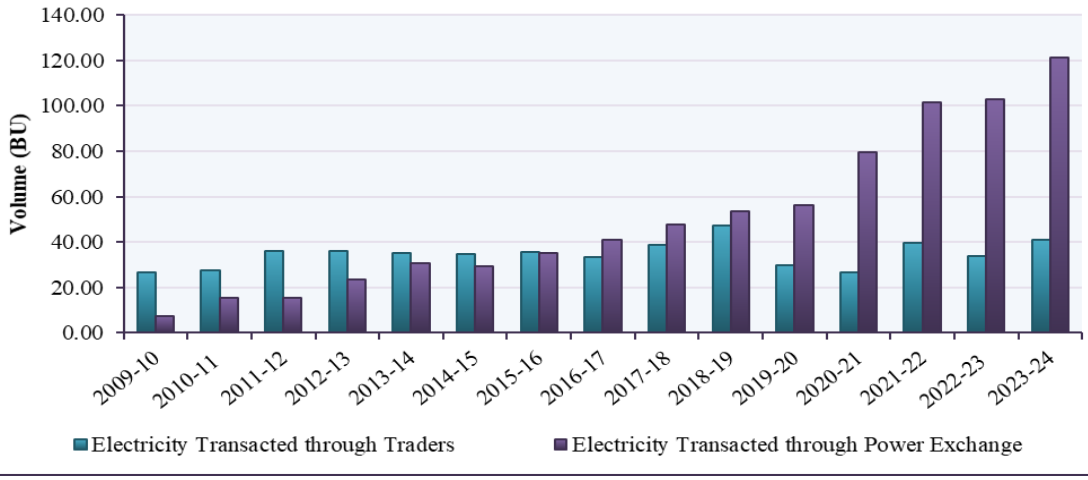
Note: *TAM includes Contingency and TAM contracts*

Table-10(c): Volume of Electricity transacted through Term Ahead Market at Power Exchanges (BU), 2009-10 to 2023-24

Year	Electricity Transacted through IEX						Electricity Transacted through PXIL						Electricity Transacted through HPX					
	ID	DAC	DAILY	WEEKLY	MONTHLY	ADSS	ID	DAC	DAILY	WEEKLY	MONTHLY	ADSS	ID	DAC	DAILY	WEEKLY	MONTHLY	ADSS
2009-10	0.005	0.01	0.00	0.08	-	-	0.00	0.003	0.00	0.00	-	-	-	-	-	-	-	-
2010-11	0.01	0.02	0.02	0.86	-	-	0.00	0.01	0.00	1.05	-	-	-	-	-	-	-	-
2011-12	0.02	0.01	0.07	0.51	-	-	0.00	0.002	0.00	0.11	-	-	-	-	-	-	-	-
2012-13	0.08	0.08	0.11	0.21	-	-	0.01	0.01	0.002	0.02	-	-	-	-	-	-	-	-
2013-14	0.13	0.09	0.05	0.07	-	-	0.06	0.01	0.12	0.11	-	-	-	-	-	-	-	-
2014-15	0.16	0.04	0.00	0.02	-	-	0.16	0.00	0.28	0.27	-	-	-	-	-	-	-	-
2015-16	0.20	0.08	0.00	0.05	-	-	0.30	0.02	0.23	0.04	-	-	-	-	-	-	-	-
2016-17	0.19	0.26	0.08	0.21	-	-	0.24	0.00	0.10	0.0001	-	-	-	-	-	-	-	-
2017-18	0.34	0.85	0.18	0.00	-	-	0.29	0.00	0.29	0.17	-	-	-	-	-	-	-	-
2018-19	0.43	0.99	0.38	0.30	-	-	0.56	0.00	0.46	0.24	-	-	-	-	-	-	-	-
2019-20	0.68	1.30	1.86	0.94	-	-	0.85	0.001	0.77	0.90	-	-	-	-	-	-	-	-
2020-21	0.12	0.30	2.32	0.53	-	-	0.23	0.0001	5.21	0.00	-	-	-	-	-	-	-	-
2021-22	0.05	1.93	3.57	0.00	-	-	0.39	2.08	1.96	0.00	-	-	-	-	-	-	-	-
2022-23	0.04	6.59	1.82	0.71	0.55	0.38	0.07	5.62	2.33	0.15	0.00	0.05	0.00	2.34	0.01	0.14	0.15	0.06
2023-24	0.07	4.90	3.05	0.60	1.46	4.86	0.11	4.32	1.53	0.31	0.61	1.80	0.06	4.71	1.24	0.17	1.01	2.16

A comparison between the volume of electricity transacted through traders and power exchanges is shown in Figure 8 below.

Figure-8: Volume of Electricity Transacted through Traders and Power Exchanges, 2009-10 to 2023-24



The weighted average price of electricity transacted through traders and power exchanges are shown in Table-11(a) and Table-11(b), respectively.

Table-11(a): Price of Electricity Transacted through Traders, 2009-10 to 2023-24

Year	Weighted Average Price of Electricity transacted through Traders (₹/kWh)
2009-10	5.26
2010-11	4.79
2011-12	4.18
2012-13	4.33
2013-14	4.29
2014-15	4.28
2015-16	4.11
2016-17	3.53
2017-18	3.59
2018-19	4.28
2019-20	4.51
2020-21	3.47
2021-22	3.72
2022-23	5.85
2023-24	7.33

Source: Traders data

Table-11(b): Price of Electricity Transacted through Power Exchanges, 2009-10 to 2023-24

Year	Electricity Transacted through IEX							Electricity Transacted through PXIL							Electricity Transacted through HPX						
	DAM	GDAM	HPDAM	TAM	GTAM	HPTAM	RTM	DAM	GDAM	HPDAM	TAM	GTAM	HPTAM	RTM	DAM	GDAM	HPDAM	TAM	GTAM	HPTAM	RTM
2009-10	4.98	-	-	4.70	-	-	-	4.79	-	-	4.45	-	-	-	-	-	-	-	-	-	-
2010-11	3.38	-	-	4.07	-	-	-	3.87	-	-	3.38	-	-	-	-	-	-	-	-	-	-
2011-12	3.47	-	-	5.37	-	-	-	3.56	-	-	6.07	-	-	-	-	-	-	-	-	-	-
2012-13	3.67	-	-	3.94	-	-	-	3.55	-	-	3.66	-	-	-	-	-	-	-	-	-	-
2013-14	2.90	-	-	3.32	-	-	-	2.60	-	-	3.54	-	-	-	-	-	-	-	-	-	-
2014-15	3.50	-	-	4.37	-	-	-	3.09	-	-	3.58	-	-	-	-	-	-	-	-	-	-
2015-16	2.72	-	-	3.36	-	-	-	2.66	-	-	2.73	-	-	-	-	-	-	-	-	-	-
2016-17	2.48	-	-	3.18	-	-	-	2.56	-	-	2.90	-	-	-	-	-	-	-	-	-	-
2017-18	3.42	-	-	3.96	-	-	-	3.80	-	-	3.98	-	-	-	-	-	-	-	-	-	-
2018-19	4.22	-	-	4.96	-	-	-	4.29	-	-	4.72	-	-	-	-	-	-	-	-	-	-
2019-20	3.16	-	-	3.71	-	-	-	3.38	-	-	3.87	-	-	-	-	-	-	-	-	-	-
2020-21	2.99	-	-	2.89	3.81	-	3.06	2.98	-	-	2.78	4.61	-	2.61	-	-	-	-	-	-	-
2021-22	4.79	4.83	-	4.61	4.49	-	4.54	3.68	-	-	4.73	5.04	-	-	-	-	-	-	-	-	-
2022-23	6.03	5.64	-	7.31	6.21	-	5.67	6.16	5.34	-	8.00	6.88	-	11.55	6.51	-	-	7.09	6.79	-	-
2023-24	5.16	5.06	17.00	7.09	6.20	-	4.98	9.71	-	16.31	7.85	5.98	15.09	10.00	10.00	-	-	7.58	5.40	15.07	9.91

Although the weighted average price of electricity transacted through traders and power exchanges broadly followed a similar trend, there have been variations between the two, due to a number of reasons. The nature and duration of the contract influence the price of electricity; for instance, the delivery of electricity through traders is mostly at the state periphery, whereas in the case of power exchanges, the delivery of electricity is at the regional periphery. Also, the electricity contracts in case of bilateral transactions take place well in advance (i.e., weekly/monthly upto one year). In contrast, the electricity contract in the case of DAM of power exchanges is one day before the delivery.

The total size of the bilateral electricity market (through traders) and power exchange market increased from ₹17622 crores in 2009-10 to ₹100729 crores in 2023-24, at a CAGR of 13.3% (Table-12). The variation in volume and price affected the size of the bilateral and power exchange market.

Table-12: Size of Bilateral Electricity Market and Power Exchanges, 2009-10 to 2023-24

Year	Size of Bilateral Trader market in ₹ Crore	Size of Power Exchange market in ₹ Crore	Total Size of Bilateral Trader market + Power Exchange market in ₹ Crore
2009-10	14055	3568	17622
2010-11	13268	5385	18654
2011-12	14979	5553	20532
2012-13	15624	8648	24272
2013-14	15061	8891	23952
2014-15	14801	10288	25089
2015-16	14557	9539	24096
2016-17	11844	10280	22124
2017-18	13970	16457	30427
2018-19	20255	22809	43064
2019-20	13516	18303	31820
2020-21	9245	23731	32976
2021-22	14688	47598	62286
2022-23	24771	59886	84657
2023-24	30061	70669	100729

2.1.2 Direct Bilateral Transactions of Electricity

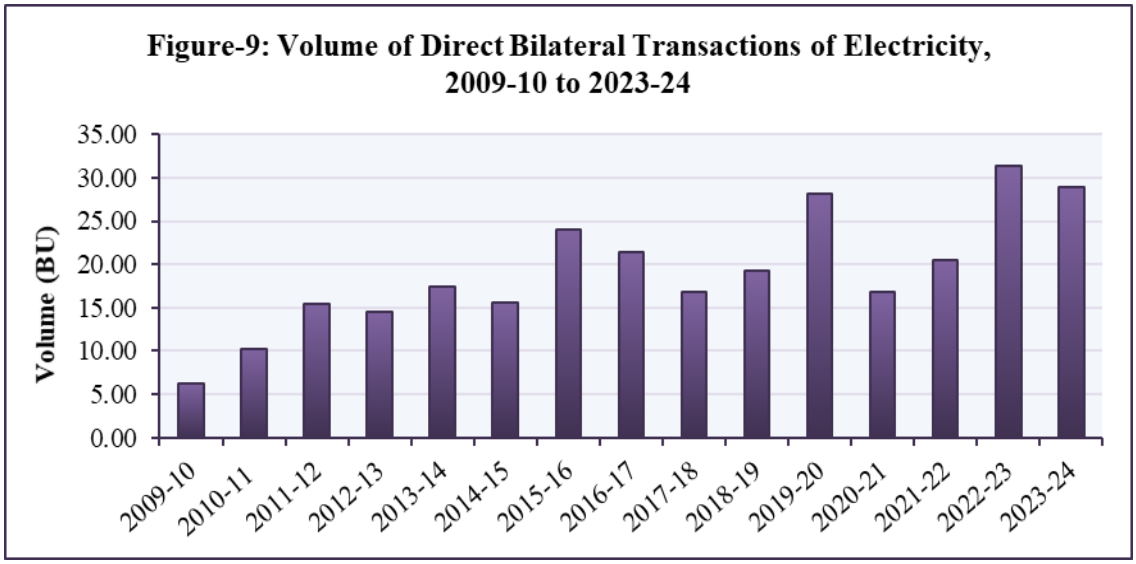
The volume of direct bilateral transactions of electricity between entities is shown in Table-13 and Figure-9. As may be seen from the Table, the volume of direct bilateral transactions increased from 6.19 BU in 2009-10 to 28.92 BU in 2023-24. The volume of direct bilateral transactions as a percentage of the total volume of short-term transactions of electricity & DSM volume varied from 9.4% to 20.9% during the period.

Table-13: Volume of Direct Bilateral transactions of Electricity, 2009-10 to 2023-24

Year	Direct Bilateral Transaction Volume (BU)	Total Volume of Short-term & DSM (BU)	Volume of Direct Bilateral as % of Total Volume of Short-term & DSM
2009-10	6.19	65.90	9.4%
2010-11	10.25	81.56	12.6%
2011-12	15.37	94.51	16.3%
2012-13	14.52	98.94	14.7%
2013-14	17.38	104.64	16.6%
2014-15	15.58	98.99	15.7%
2015-16	24.04	115.23	20.9%
2016-17	21.38	119.23	17.9%
2017-18	16.77	127.62	13.1%
2018-19	19.23	145.20	13.2%
2019-20	28.17	137.16	20.5%
2020-21	16.84	146.01	11.5%
2021-22	20.56	186.75	11.0%
2022-23	31.30	194.35	16.1%
2023-24*	28.92	218.22	13.3%

Source: NLDC

** With change in the regime on implementation of GNA Regulations from 1st October 2023, the volume here are not strictly comparable to the volumes in previous years.*



2.1.3 DSM Volume and Charge

DSM volume and charge are shown in Table-14 and Figure-10. The volume of DSM as a percentage of total short-term & DSM volume declined significantly from its high of 39.2% in 2009-10 to 12.3% in 2023-24. Since the DSM is not a market mechanism, the decline in DSM volume is considered good for the market. So far as the short-term electricity market is concerned, the volume in this segment should be as minimal as possible. DSM charge plays an important role in ensuring system balance and secure reliable grid operation. The weighted average charge of DSM was ₹5.73/kWh in 2023-24 (Table-14).

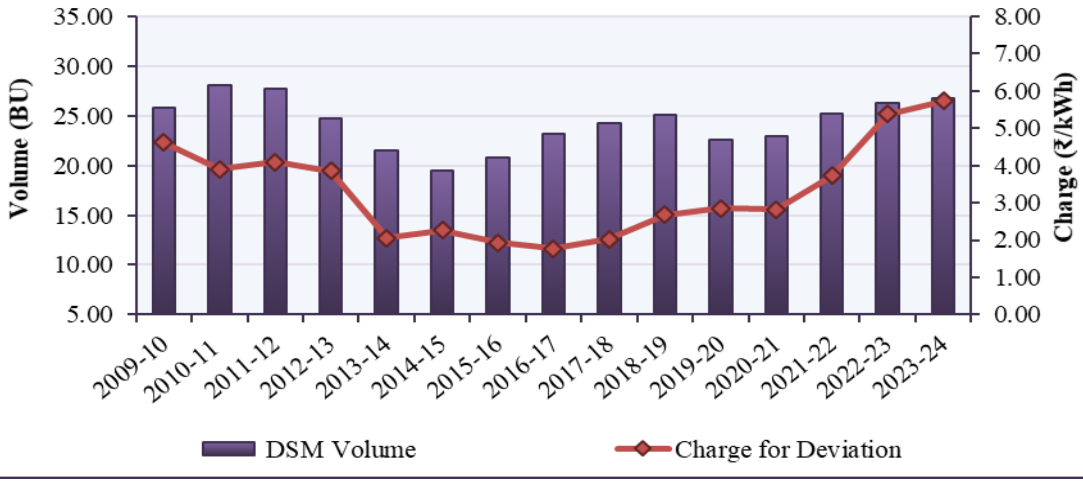
Table-14: DSM Volume and Charge, 2009-10 to 2023-24

Year	DSM Volume	Total Volume of Short-term & DSM (BU)	Volume of DSM as % of Short-term & DSM	Weighted Avg. Charge for Deviation(₹/kWh)
2009-10	25.81	65.90	39.2%	4.62
2010-11	28.08	81.56	34.4%	3.91
2011-12	27.76	94.51	29.4%	4.09
2012-13	24.76	98.94	25.0%	3.86
2013-14	21.47	104.64	20.5%	2.05
2014-15	19.45	98.99	19.6%	2.26
2015-16	20.75	115.23	18.0%	1.93
2016-17	23.22	119.23	19.5%	1.76
2017-18	24.21	127.62	19.0%	2.03
2018-19	25.13	145.20	17.3%	2.68
2019-20	22.59	137.16	16.5%	2.85
2020-21	22.91	146.01	15.7%	2.82

2021-22	25.27	186.75	13.5%	3.73
2022-23	26.30	194.35	13.5%	5.39
2023-24	26.78	218.22	12.3%	5.73

Source: NLDC

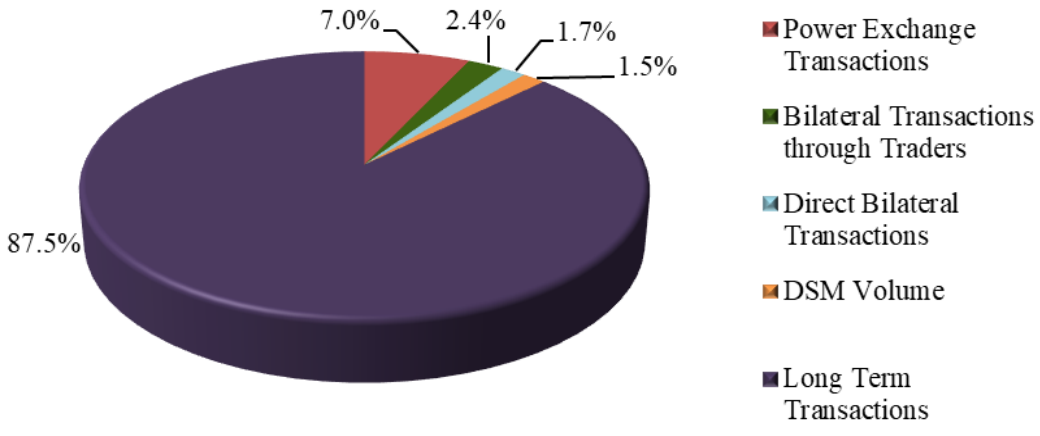
Figure-10: DSM Volume and Charge, 2009-10 to 2023-24



3. Monthly Trends in Short-term Transactions of Electricity & DSM Volume (April 2023-March 2024)

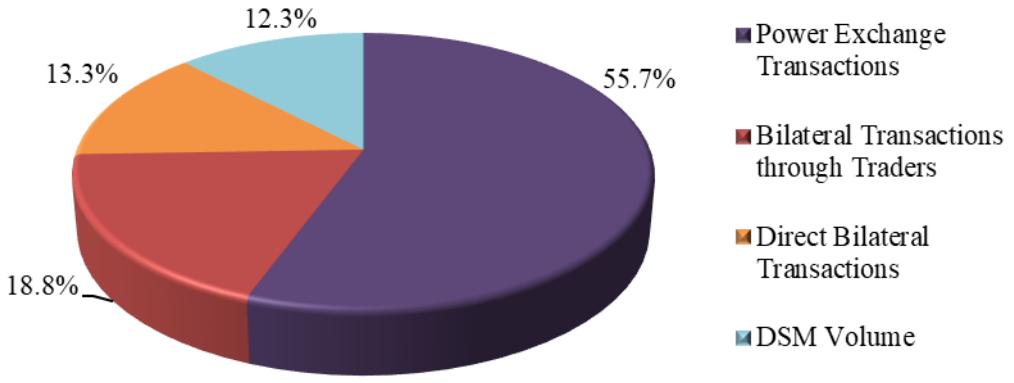
During 2023-24, the share of total short-term volume & DSM volume, as a percentage of total electricity generation in the country, was 12.5% (Figure-11).

Figure-11: Share of Market Segments in Total Electricity Generation, 2023-24



The share of different market segments within the total short-term transactions & DSM volume in 2023-24 is shown in Figure-12 below.

Figure-12: Share of Market Segments in Short Term Transactions & DSM Volume, 2023-24



Of the total short-term transactions & DSM volume in 2023-24, the volume of electricity transacted through power exchanges was maximum (55.7%), followed by bilateral transactions through traders (18.8%), direct bilateral transactions between entities (13.3%) and DSM volume (12.3%).

3.1 Volume of Short-term Transactions of Electricity & DSM

The month-wise volume of short-term transactions of electricity & DSM in 2023-24 with detailed break-up for different market segments is shown in Table-15 (a), Table-15(b), Table-15 (c), Figure-13 (a) and Figure-13(b).

As can be observed from Table-15(a), the volume of short-term transactions of electricity as percentage of total electricity generation varied from 11.2% and 14.0% during April 2023 to March 2024.

Table-15(a): Volume of Short-term Transaction of Electricity & DSM Volume (BU), 2023-24

Month	Bilateral through Traders*	Direct Bilateral Transactions*	Total Bilateral	Power Exchange Transactions (All Segments)	DSM Volume	Total Short-term Transactions & DSM Volume	Total Electricity Generation	Short-term Transactions & DSM as % of Total Electricity Generation
Apr-23	4.31	2.89	7.20	9.13	2.10	18.42	140.55	13.1%
May-23	3.27	2.70	5.97	9.08	2.24	17.28	147.32	11.7%
Jun-23	4.38	3.28	7.66	9.81	2.34	19.80	149.99	13.2%
Jul-23	4.18	4.14	8.32	9.09	2.34	19.76	149.06	13.3%
Aug-23	4.02	3.71	7.73	11.37	2.24	21.34	161.17	13.2%
Sep-23	3.73	3.61	7.34	11.39	2.27	21.00	150.45	14.0%
Oct-23	2.28	1.48	3.76	11.73	2.18	17.67	148.91	11.9%
Nov-23	3.08	0.92	4.00	8.79	2.17	14.96	128.82	11.6%
Dec-23	3.08	1.01	4.09	8.99	2.20	15.27	132.71	11.5%
Jan-24	2.02	1.32	3.34	10.49	2.25	16.07	144.09	11.2%
Feb-24	2.59	1.51	4.10	10.77	2.14	17.00	136.78	12.4%
Mar-24	4.08	2.36	6.44	10.88	2.32	19.64	149.25	13.2%
Total	**41.02**	**28.92**	**69.94**	**121.49**	**26.78**	**218.22**	**1739.09**	**12.5%**

** With change in the regime on implementation of GNA Regulations from 1st October 2023, the volume here are not strictly comparable to the volumes in previous years.*
Source: NLDC & CEA

Table-15(b): Volume of Power Exchange Transaction of Electricity (BU), 2023-24

Month	DAM	GDAM	HP-DAM	TAM	GTAM	HP-TAM	RTM	Total
Apr-23	4.41	0.16	0.00	2.25	0.15	0.00	2.15	9.13
May-23	4.00	0.20	0.00	2.23	0.22	0.00	2.43	9.08
Jun-23	4.12	0.17	0.00	2.64	0.20	0.00	2.68	9.81
Jul-23	3.97	0.21	0.00	2.22	0.15	0.00	2.54	9.09
Aug-23	3.90	0.16	0.00	4.16	0.19	0.22	2.74	11.37
Sep-23	3.44	0.13	0.01	4.54	0.18	0.15	2.92	11.39
Oct-23	4.75	0.18	0.02	3.94	0.02	0.37	2.44	11.73
Nov-23	5.20	0.18	0.00	1.03	0.01	0.00	2.36	8.79
Dec-23	4.77	0.22	0.00	1.56	0.03	0.00	2.41	8.99
Jan-24	5.59	0.21	0.00	2.25	0.06	0.00	2.39	10.49
Feb-24	4.75	0.26	0.00	3.24	0.11	0.07	2.34	10.77
Mar-24	4.66	0.41	0.00	2.90	0.12	0.00	2.79	10.88
Total	**53.55**	**2.50**	**0.04**	**32.98**	**1.44**	**0.81**	**30.18**	**121.49**

Source: NLDC & Power Exchanges

Table-15(c): Contract-wise Volume of Electricity transacted through Term Ahead & Contingency Market Segments (BU), 2023-24

Year	Term Ahead Market						Green Term Ahead Market						High Price Term Ahead Market					
	ID	DAC	DAILY	WEEKLY	MONTHLY	ADSS	ID	DAC	DAILY	WEEKLY	MONTHLY	ADSS	ID	DAC	DAILY	WEEKLY	MONTHLY	ADSS
Apr-23	0.02	1.48	0.15	0.14	0.31	0.15	0.0001	0.08	0.04	0.01	0.02	0.003	0.00	0.00	0.00	0.00	0.00	0.00
May-23	0.03	1.34	0.49	0.13	0.00	0.23	0.00	0.14	0.01	0.01	0.004	0.07	0.00	0.00	0.00	0.00	0.00	0.00
Jun-23	0.05	2.00	0.09	0.00	0.00	0.50	0.00	0.16	0.01	0.00	0.004	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Jul-23	0.02	1.74	0.07	0.08	0.00	0.32	0.00	0.15	0.001	0.00	0.004	0.001	0.00	0.00	0.00	0.00	0.00	0.00
Aug-23	0.03	2.72	0.34	0.11	0.07	0.89	0.00	0.19	0.00	0.00	0.004	0.00	0.08	0.07	0.06	0.00	0.00	0.00
Sep-23	0.02	1.85	1.06	0.14	0.00	1.47	0.0004	0.17	0.001	0.00	0.004	0.01	0.01	0.05	0.09	0.00	0.00	0.00
Oct-23	0.03	0.79	1.22	0.38	0.23	1.30	0.00	0.01	0.01	0.00	0.00	0.00	0.06	0.14	0.17	0.00	0.00	0.00
Nov-23	0.002	0.12	0.41	0.05	0.06	0.40	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec-23	0.02	0.35	0.54	0.07	0.14	0.45	0.00	0.003	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Jan-24	0.04	0.59	0.67	0.00	0.32	0.66	0.00	0.004	0.01	0.00	0.002	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Feb-24	0.01	0.59	0.32	0.00	0.94	1.39	0.00	0.05	0.01	0.00	0.00	0.04	0.00	0.07	0.00	0.00	0.00	0.00
Mar-24	0.01	0.37	0.46	0.00	1.00	1.06	0.0001	0.10	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.24**	**13.93**	**5.82**	**1.08**	**3.07**	**8.83**	**0.001**	**1.06**	**0.11**	**0.02**	**0.04**	**0.21**	**0.15**	**0.33**	**0.33**	**0.00**	**0.00**	**0.00**

As may be observed from Figure-13(a), the volume of short-term transactions & DSM followed a cyclical pattern with a subdued demand during the initial months and an increase from July 2023 onwards. The bilateral transactions followed a similar trend. The trend in power exchange transactions is slightly different as compared to bilateral transactions. As expected, there is no specific trend in the transactions through DSM since these transactions do not move by seasonal variations.

Figure-13(a): Volume of Short-term Transactions of Electricity & DSM, 2023-24

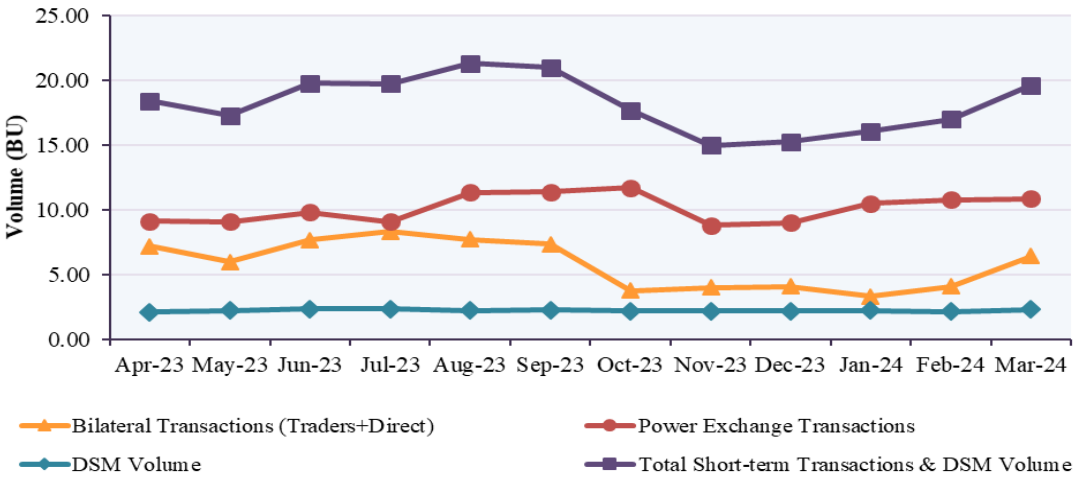


Figure-13(b): Volume of Power Exchange Transactions of Electricity, 2023-24

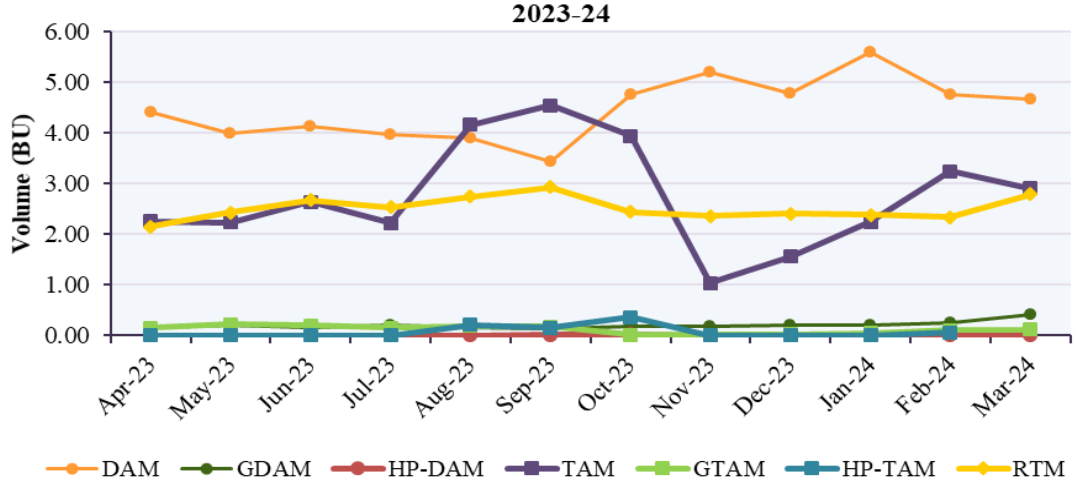


Figure 13(b) depicts the month-wise variation in volume under different market segments of the power exchanges. Volume in DAM witnessed an increase from September 2023 onwards, whereas TAM volume saw a significant reduction from October 2023 after reaching its peak in September 2023. RTM volume remained range

bound with a marginal increase witnessed during July-Sep 2023. Variation in volume in other segments including G-DAM, G-TAM, HP-DAM and HP-TAM was insignificant.

As on 31.3.2024, there were a total of 59[5] inter-state trading licensees; of which, 39 have undertaken either short-term or both short & long-term trading of electricity during 2023-24 (Table-16).

Herfindahl-Hirschman Index (HHI), a commonly accepted index to calculate market concentration, has been used to analyze competition among trading licensees (Table-16). Increase in the HHI generally indicates a decrease in competition and an increase of market power, and vice-versa. HHI value below 0.15 indicates un-concentration of market power, the value between 0.15 to 0.25 indicates moderate concentration, the value above 0.25 indicates high concentration of market power. The HHI, based on the volume of electricity transacted through traders during 2023-24 was 0.1721, which indicates moderate concentration of market power among the traders. As compared to 2022-23 with HHI value of 0.1874, the level of market concentration has decreased in 2023-24.

Table-16: Share of Electricity Transacted by Traders and HHI, 2023-24

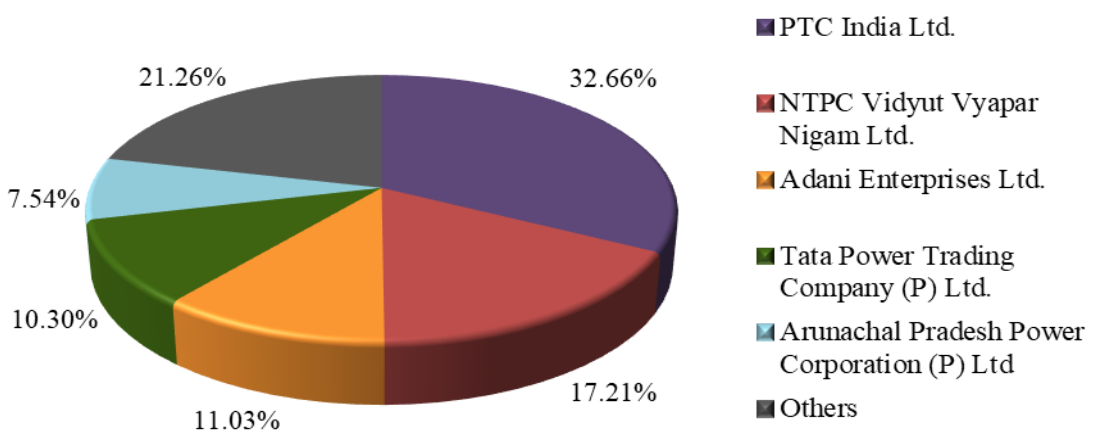
Sr No	Name of the Trading Licensee	Share of Electricity traded by Licensees
1	PTC India Ltd.	32.66%
2	NTPC Vidyut Vyapar Nigam Ltd.	17.21%
3	Adani Enterprises Ltd.	11.03%
4	Tata Power Trading Company (P) Ltd.	10.30%
5	Arunachal Pradesh Power Corporation (P) Ltd	7.54%
6	Manikaran Power Ltd.	7.02%
7	GMR Energy Trading Ltd.	3.78%
8	JSW Power Trading Company Ltd	2.18%
9	Gita Power & Infrastructure Private Limited	1.22%
10	Instinct Infra & Power Ltd.	1.12%
11	Kreate Energy (I) Pvt. Ltd.	0.82%
12	Ambitious Power Trading Company Ltd.	0.75%
13	RPG Power Trading Company Ltd.	0.69%
14	Statkraft Markets Pvt. Ltd.	0.64%
15	Greenko Energies Pvt Ltd	0.54%
16	NTPC Ltd.	0.37%
17	Shree Cement Ltd.	0.37%

[5] *This does not include Global Energy Pvt. Ltd.*

18	Kundan International Pvt. Ltd.	0.28%
19	Refex Industries Ltd.	0.25%
20	Abja Power Private Limited	0.21%
21	Shubheksha Advisors Pvt. Ltd.	0.17%
22	Saranyu Power Trading Private Limited	0.17%
23	NLC India Ltd.	0.13%
24	Instant Ventures Pvt. Ltd.	0.13%
25	Ideal Energy Solution Pvt. Ltd.	0.09%
26	Adarsh Stainless Pvt. Ltd.	0.08%
27	SJVN Ltd.	0.06%
28	Energyedge Power Trading Pvt. Ltd.	0.06%
29	Powerfull Energy Trading Pvt. Ltd.	0.04%
30	Customized Energy Solutions India (P) Ltd.	0.04%
31	Phillip Commodities India (P) Ltd.	0.02%
32	ReNew Energy Markets Pvt. Ltd.	0.01%
33	Saini Power Transactor	0.01%
34	VEH Global India Pvt. Ltd.	0.005%
35	Shell Energy Marketing and Trading India Pvt. Ltd.	0.003%
36	Renesys Solar Pvt. Ltd.	0.002%
37	REL Power Trading LLP	0.001%
38	Altilium Energie Private Limited	0.001%
39	Reneurja Power LLP	0.0001%
Total Volume		**100.00%**
Share of the Top 5 Trading		**78.74%**
Herfindahl-Hirschman Index (HHI)		**0.1721**
Note: Percentage share in total volume traded by Licensees in 2023-24 is based on volume traded by inter-state trading licensees through bilateral and power exchanges.		
Source: Information submitted by Trading Licensees.		

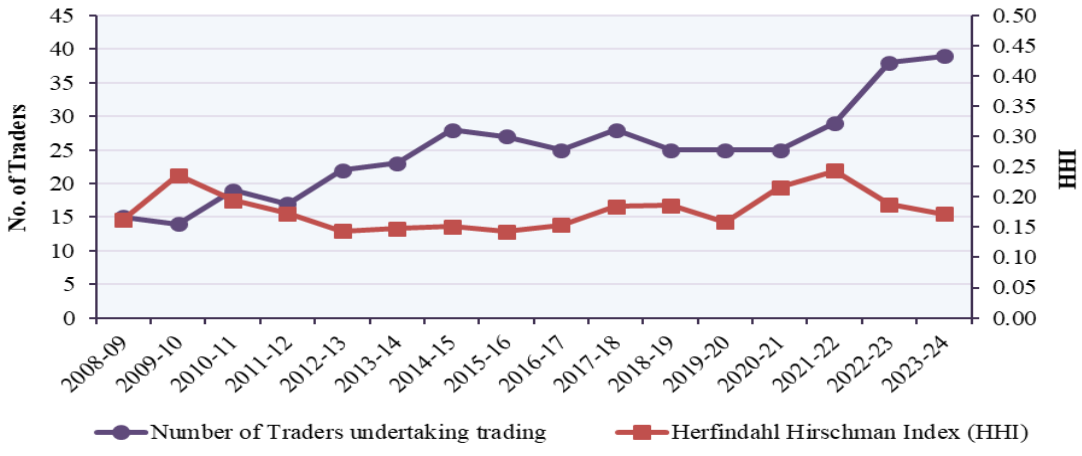
The percentage share of electricity transacted by major traders in the total volume of electricity transacted by all the traders is shown in Figure-14.

Figure-14: Share of Electricity transacted by Traders, 2023-24



The concentration of market power based on the volume of electricity transacted through traders and the number of traders is shown in Figure-15. As may be observed from the figure, the number of traders who were undertaking trading bilaterally or through power exchanges or through both, increased from 15 in 2008-09 to 39 in 2023-24.

Figure-15: Concentration of Market Power in Bilateral Transactions through Traders, 2008-09 to 2023-24



3.2 Price of Short-term Transactions of Electricity & DSM Charge

The monthly trends in price of short-term transactions of electricity in different market segments & DSM charge are shown in Table-17(a), Table-17(b), Table-17(c), Figure-16(a) and Figure-16(b). The price analysis is based on the average charge for deviation and the weighted average price of other short-term transactions of electricity. The price of bilateral trader transactions represents the price of electricity transacted through traders. The trend in price of electricity transacted through traders (bilateral trader transactions) is discussed separately for total transactions as well as for the transactions undertaken during Round the Clock (RTC), Peak and Off-peak periods.

Table-17(a): Price of Transactions through Traders (₹/kWh), 2023-24

Month	Bilateral through Traders			
	RTC	Peak	Off-peak	Weighted Average
Apr-23	8.44	-	8.50	8.45
May-23	8.16	8.25	8.61	8.24
Jun-23	7.80	8.78	8.82	8.04
Jul-23	6.88	-	6.62	6.85

Aug-23	6.64	-	6.59	6.64
Sep-23	7.32	-	5.70	7.21
Oct-23	6.94	-	4.00	6.77
Nov-23	6.46	-	6.12	6.40
Dec-23	6.31	-	6.51	6.35
Jan-24	6.70	-	6.59	6.66
Feb-24	7.36	-	6.79	7.22
Mar-24	8.04	9.95	7.35	8.07

(-) No price due to no transactions during the month.

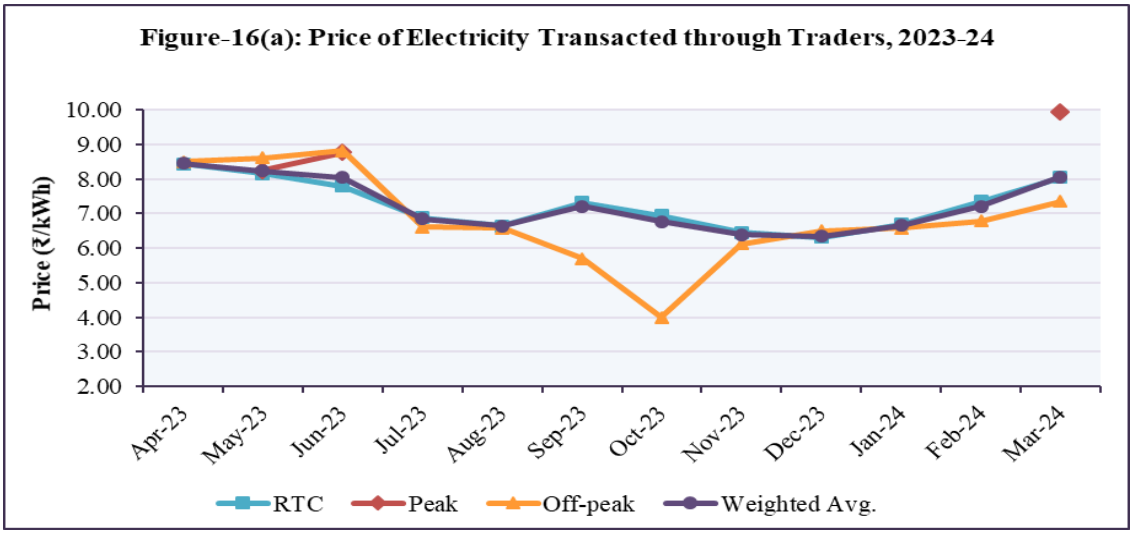
Table-17(b): Price of Power Exchange Transactions of Electricity (₹/kWh), 2023-24

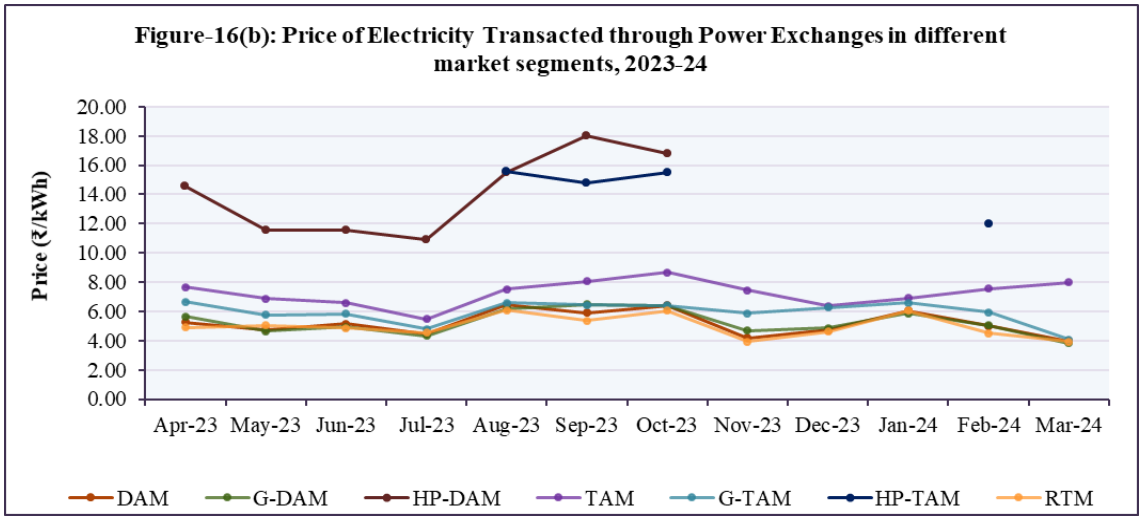
Month	Power Exchanges						
	DAM	G-DAM	HP-DAM	TAM	G-TAM	HP-TAM	RTM
Apr-23	5.24	5.67	14.59	7.65	6.65	-	4.90
May-23	4.77	4.66	11.55	6.85	5.76	-	5.03
Jun-23	5.16	4.95	11.52	6.58	5.83	-	4.85
Jul-23	4.47	4.31	10.91	5.48	4.77	-	4.55
Aug-23	6.44	6.19	15.49	7.52	6.59	15.60	6.07
Sep-23	5.91	6.47	18.01	8.05	6.44	14.76	5.36
Oct-23	6.40	6.37	16.81	8.68	6.40	15.47	6.06
Nov-23	4.17	4.69	-	7.43	5.86	-	3.93
Dec-23	4.70	4.86	-	6.37	6.25	-	4.61
Jan-24	6.05	5.87	-	6.92	6.57	-	6.04
Feb-24	5.01	5.05	-	7.56	5.93	11.99	4.51
Mar-24	3.96	3.81	-	7.98	4.08	-	3.91

(-) No price due to no transactions during the month.

Table-17(c): Charge for Deviation (₹/kWh), 2023-24

Month	Avg. Charge for Deviation
Apr-23	5.92
May-23	5.42
Jun-23	5.71
Jul-23	5.14
Aug-23	7.40
Sep-23	6.63
Oct-23	6.87
Nov-23	4.36
Dec-23	5.59
Jan-24	6.28
Feb-24	5.22
Mar-24	4.31





The trend in the price of electricity transacted through traders during RTC, Peak and Off-peak periods are shown in Table-17(a) above and Figure-16(a). It can be observed from the Figure 16(a) that the price of electricity transacted bilaterally through traders largely followed a cyclical trend, except for off-peak prices which witnessed a sharp fall in October 2023 and revival from November 2023 onwards. There is no price mentioned for electricity transacted during peak for some of the months in 2023-24 because there was no volume of electricity transacted exclusively during the peak period in these months. It can also be observed from the Figure-16(a), price of electricity transacted during RTC was normally high when compared to the price of electricity transacted during Off-peak period, except for a few months.

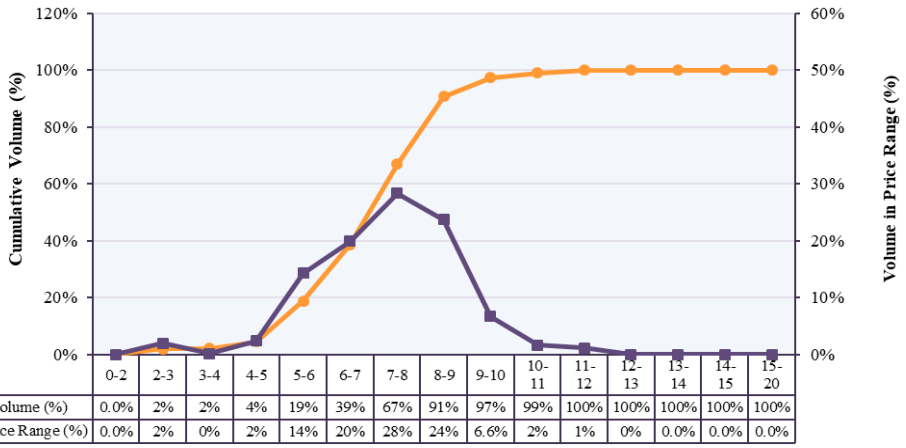
The trend in the price of electricity transacted through Power Exchanges in the various market segments is shown in Table-17(b) and Figure-16(b). The price of electricity transacted in RTM was lowest in most of the months. The price of electricity transacted in TAM was relatively high when compared with the price of electricity transacted in other market segments. This may be attributed to the difference in the nature and duration of contracts transacted, and difference in price discovery methodology. The average price in the high price market segments, including HP-DAM and HP-TAM was about ₹14/kWh in 2023-24.

3.3 Volume of Electricity Transacted in various Price Slabs

The volume of electricity transacted in various price slabs is shown for the bilateral trader segment and power exchange segment separately. In the case of power exchanges, DAM, G-DAM, RTM, HP-DAM segments have been considered separately. Since no trade happened in the G-DAM segment at PXIL and HPX, and in HP-DAM segments at HPX, the same is not discussed.

The volume of bilateral transactions at different price slabs in 2023-24 is depicted in Figure-17. The figure shows that only 4% of the volume of electricity was transacted through traders at less than ₹5/kWh and 91% of the volume of electricity was transacted through traders at less than ₹9/kWh.

Figure-17: Volume of Bilateral Transaction through Traders at different Price Slabs, 2023-24

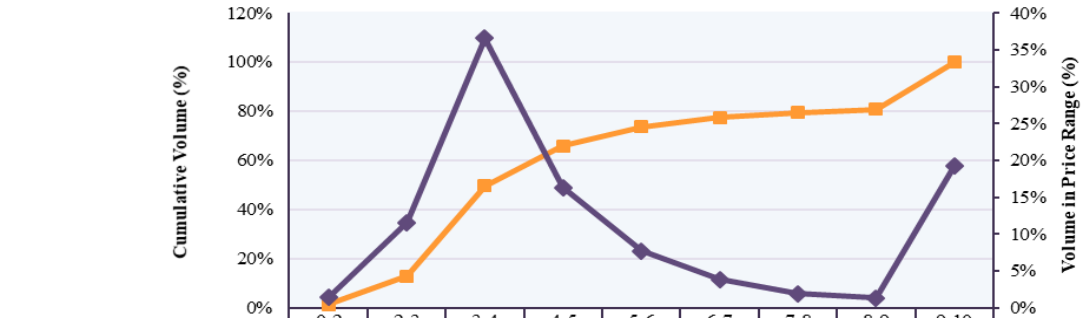


	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-20
Cumulative Volume (%)	0.0%	2%	2%	4%	19%	39%	67%	91%	97%	99%	100%	100%	100%	100%	100%
Volume in Price Range (%)	0.0%	2%	0%	2%	14%	20%	28%	24%	6.6%	2%	1%	0%	0.0%	0.0%	0.0%

The volume of electricity transacted in IEX at different price slabs in DAM, G-DAM, RTM and HP-DAM segments during 2023-24 are depicted in Figure-18(a),

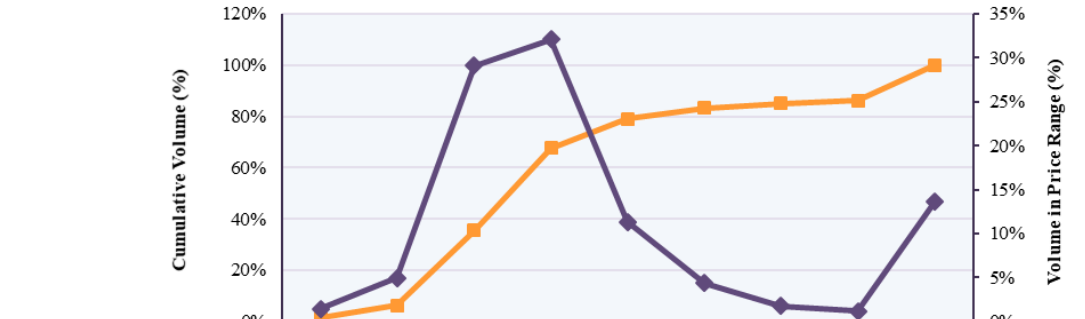
18(b), 18(c) and 18(d) respectively. The figure shows that 66% of the volume of electricity in DAM was transacted at less than ₹5/kWh and 81% of the volume of electricity was transacted at less than ₹9/kWh. In case of G-DAM, about 68% of the volume of electricity was transacted at less than ₹5/kWh and 86% of the volume of electricity was transacted at less than ₹9/kWh. Similarly, under RTM segment, 66% of the volume of electricity was transacted at less than ₹5/kWh and 84% of the volume of electricity was transacted at less than ₹9/kWh. In case of High-Price DAM, only 1% of the volume of electricity was transacted at less than ₹10/kWh and 9% of the volume of electricity was transacted at less than ₹15/kWh.

Figure-18(a): Volume of IEX Transactions in Day Ahead Market at different Price Slabs, 2023-24



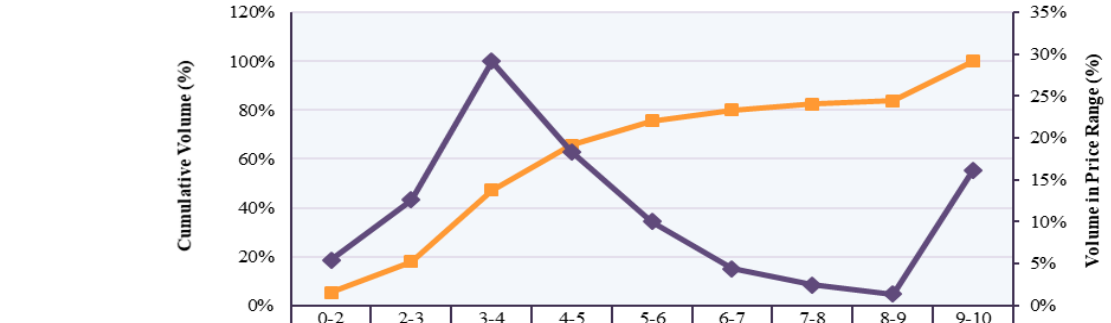
	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	1%	13%	50%	66%	74%	77%	79%	81%	100%
Volume in Price Range (%)	1%	12%	37%	16%	8%	4%	2%	1%	19%

Figure-18(b): Volume of IEX Transactions in Green Day Ahead Market at different Price Slabs, 2023-24



	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	1%	6%	35%	68%	79%	83%	85%	86%	100%
Volume in Price Range (%)	1%	5%	29%	32%	11%	4%	2%	1%	14%

Figure-18(c): Volume of IEX Transactions in Real Time Market at different Price Slabs, 2023-24



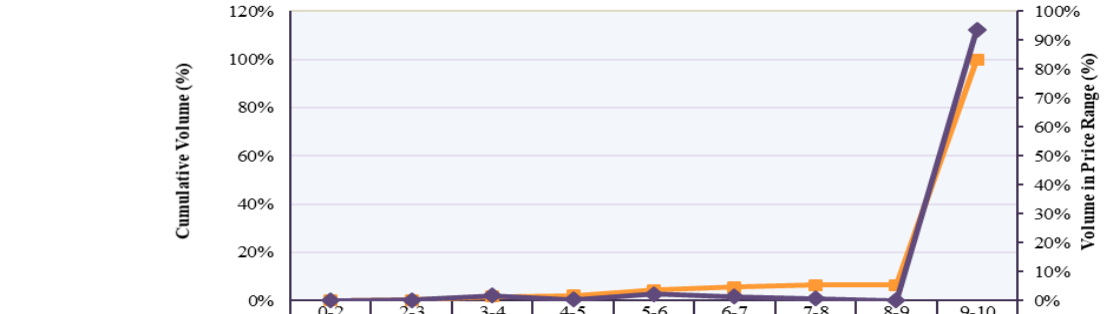
	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	5%	18%	47%	66%	76%	80%	83%	84%	100%
Volume in Price Range (%)	5%	13%	29%	18%	10%	4%	2%	1%	16%

Figure-18(d): Volume of IEX Transactions in High Price Day Ahead Market at different Price Slabs, 2023-24

	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-20
Cumulative Volume (%)	0%	0%	0%	0%	0%	0%	0%	0%	1%	3%	3%	4%	8%	9%	100%
Volume in Price Range (%)	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%	1%	0.1%	4%	1%	91%

The volume of electricity transacted in PXIL at different price slabs in DAM, RTM and HP-DAM is depicted in Figure-19 (a), 19(b) and 19(c) respectively. The figure shows that only 2% of the volume of electricity in DAM was transacted at less than ₹5/kWh, and about 6% of the volume of electricity was transacted at less than ₹9/kWh. There was no trade in G-DAM at PXIL. There were very few transactions through PXIL in RTM and HP-DAM during 2023-24. In case of RTM, there were no transactions at less than ₹9/kWh. Similarly, in case of HP-DAM, there were no transactions at less than 10/kWh and 100% of the volume of electricity was transacted at less than ₹15/kWh.

Figure-19(a): Volume of PXIL Transactions in Day Ahead Market at different Price Slabs, 2023-24

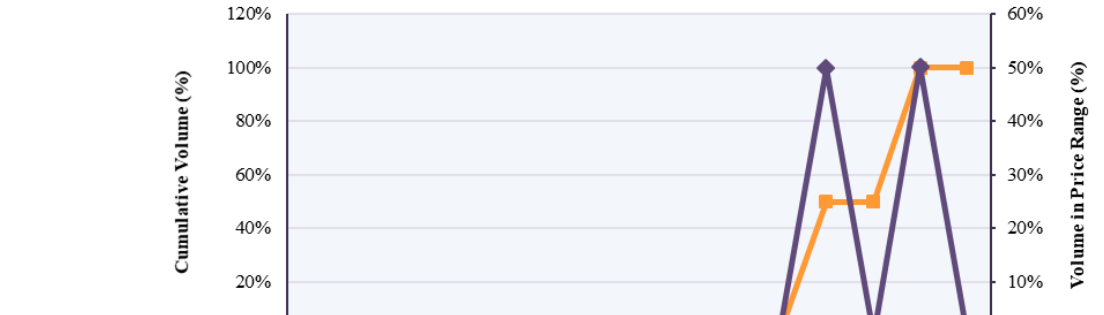


	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0%	0%	2%	2%	4%	6%	6%	6%	100%
Volume in Price Range (%)	0%	0%	2%	0%	2%	1%	1%	0%	94%

Figure-19(b): Volume of PXIL Transactions in Real Time Market at different Price Slabs, 2023-24

	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0%	0%	0%	0%	0%	0%	0%	0%	100%
Volume in Price Range (%)	0%	0%	0%	0%	0%	0%	0%	0%	100%

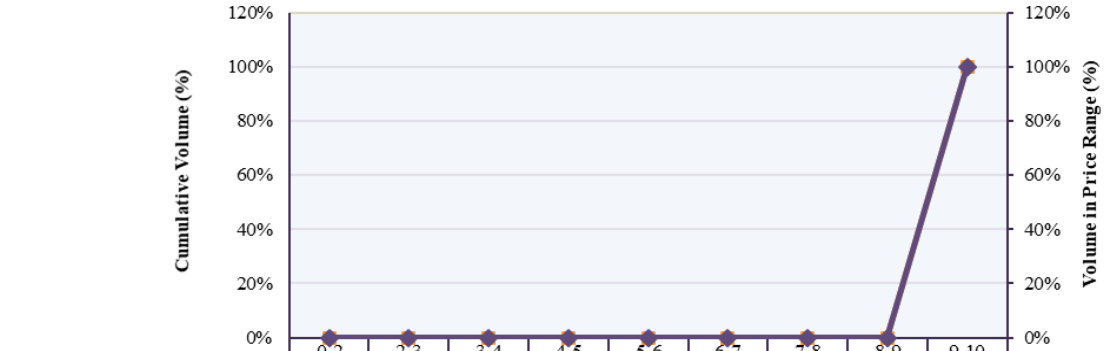
Figure-19(c): Volume of PXIL Transactions in High Price Day Ahead Market at different Price Slabs, 2023-24



	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-20
Cumulative Volume (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	50%	100%	100%
Volume in Price Range (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	50%	0%

The volume of electricity transacted at HPX at different price slabs in DAM and RTM is depicted in Figure-20(a) and 20(b), respectively. There were very few transactions in DAM and RTM at HPX during 2023-24. Figure-20(a) shows that there were no transactions in DAM at less than ₹5/kWh and ₹9/kWh. Similarly, Figure 20(b) shows that that there were no transactions in RTM at less than ₹5/kWh and about 1% of the volume of electricity was transacted at less ₹9/kWh. There was no trade in G-DAM and HP-DAM at HPX.

Figure 20(a): Volume of HPX Transactions in Day Ahead Market at different Price Slabs, 2023-24



	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0%	0%	0%	0%	0%	0%	0%	0%	100%
Volume in Price Range (%)	0.0%	0%	0%	0%	0%	0%	0%	0%	100%

Figure-20(b): Volume of HPX Transactions in Real Time Market at different Price Slabs, 2023-24

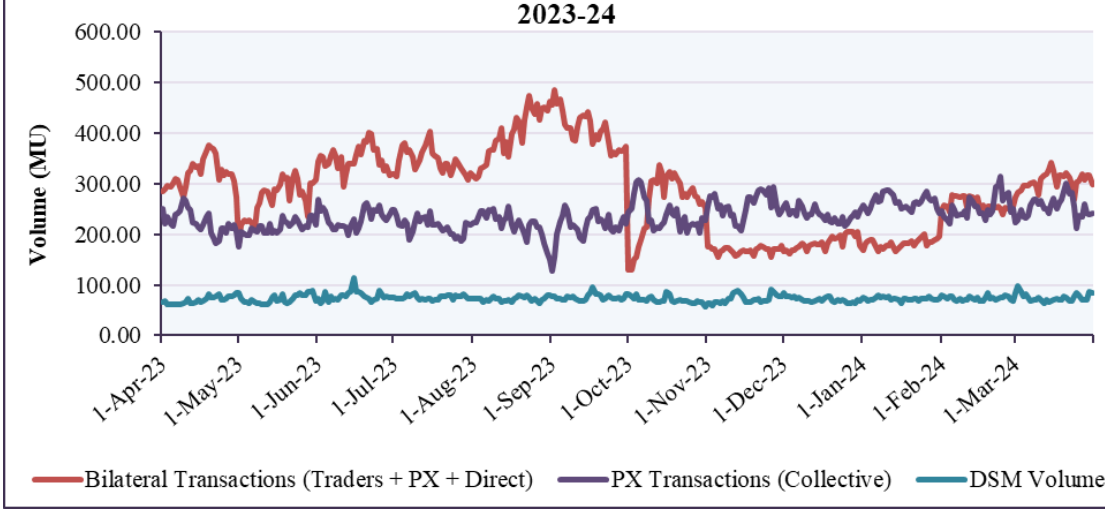
	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0%	0%	0%	0%	0%	0%	1%	1%	100%
Volume in Price Range (%)	0%	0%	0%	0%	0%	0%	1%	0%	99%

4. Daily Trends in Short-term Transactions of Electricity & DSM Volume (1st April 2023 to 31st March 2024)

4.1 Volume of Short-term Transactions of Electricity & DSM

Trends in daily volume of short-term transactions and DSM are shown in Figure-21. It can be observed from the figure that the volume of bilateral transactions remained high as compared to power exchanges until September 2023, post which transactions in power exchange increased vis-à-vis bilateral transactions. The volume of bilateral transactions witnessed an increase from February 2024 onwards.

Figure-21: Volume of Short-term Transactions of Electricity & DSM, 2023-24



4.2 Price of Short-term Transactions of Electricity

Price and its volatility in the daily price of short-term transactions of electricity through power exchanges (collective transactions) have been analysed in this section. Volatility has been computed using the historical volatility formula (see Annexure-III for the formula).

4.2.1 Price and its Volatility in Power Exchanges

The weighted average price of electricity transacted through IEX in DAM, G-DAM, RTM and HP-DAM segments with their respective volatility levels are shown in Figure-22(a), 22(b), 22(c), and 22(d), respectively. Volatility in the price of electricity transacted through IEX has been computed using daily data for 2023-24, and it works

out to be 14.94% in the case of DAM, 11.82% in G-DAM, 20.71% in RTM and 21.97% in HP-DAM.

Figure-22(a): Price and its Volatility in DAM on IEX during 2023-24

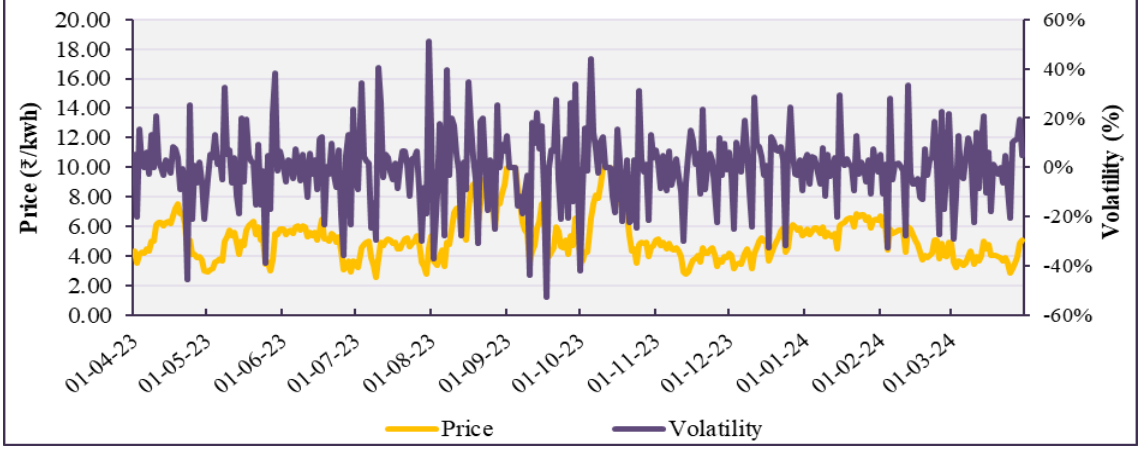


Figure-22(b): Price and its Volatility in G-DAM on IEX during 2023-24

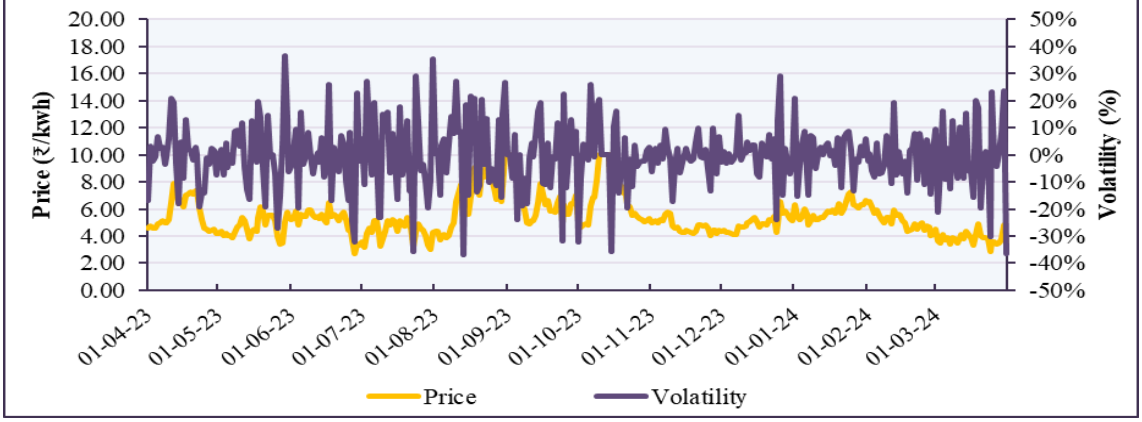
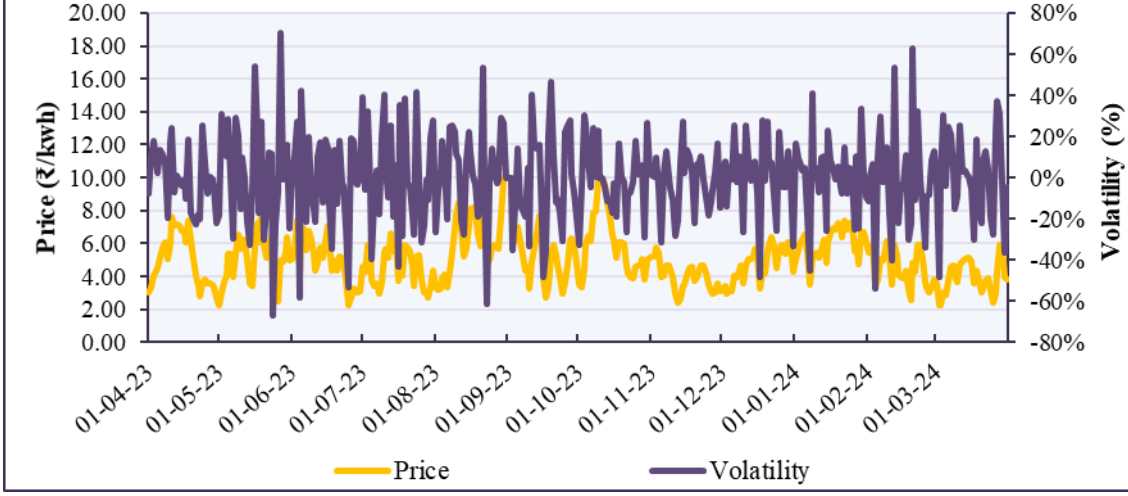
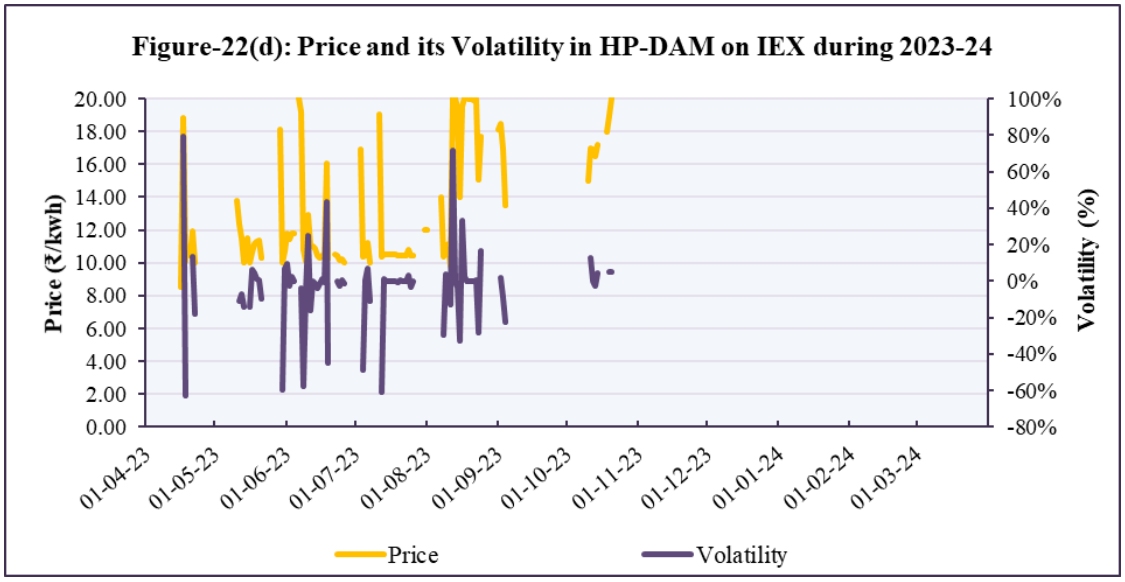
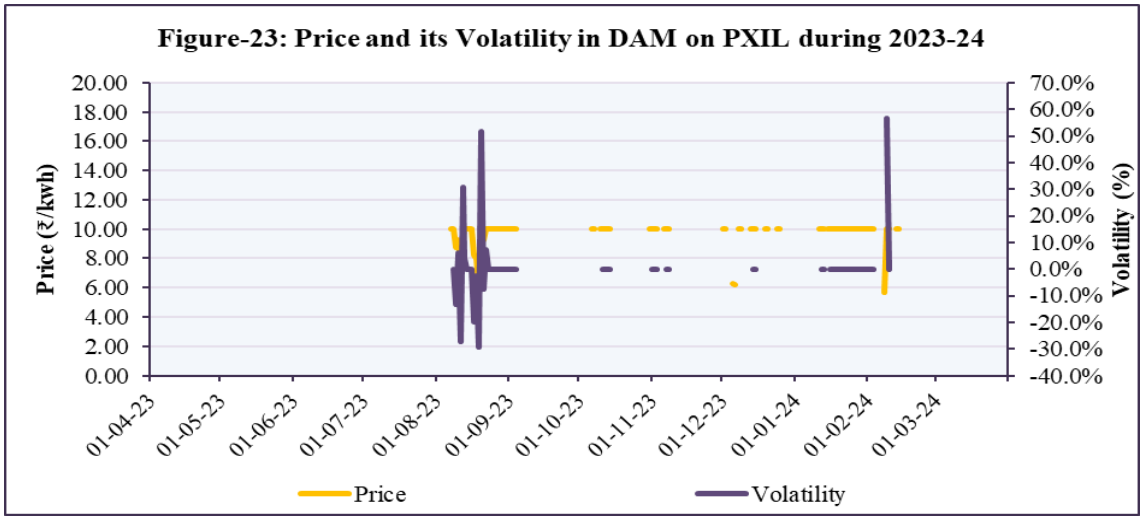


Figure-22(c): Price and its Volatility in RTM on IEX during 2023-24





The weighted average price of electricity transacted through PXIL in DAM and its Volatility are shown in Figure-23. The price and its volatility for the electricity transacted through PXIL in GDAM, RTM and HP-DAM are not depicted here due to low liquidity and transactions took place only on a few days in 2023-24. Volatility in the price of electricity transacted through PXIL in DAM has been computed using daily data for 2023-24, and it works out to be 11.60%.



The weighted average price of electricity transacted through HPX in DAM and its Volatility has not been depicted here as the transactions took place only on a few days in 2023-24 and at the same price. Similarly, in the case of RTM, transactions took

place only on a few days in 2023-24. Further, no volume was transacted in GDAM and HP-DAM at HPX during 2023-24.

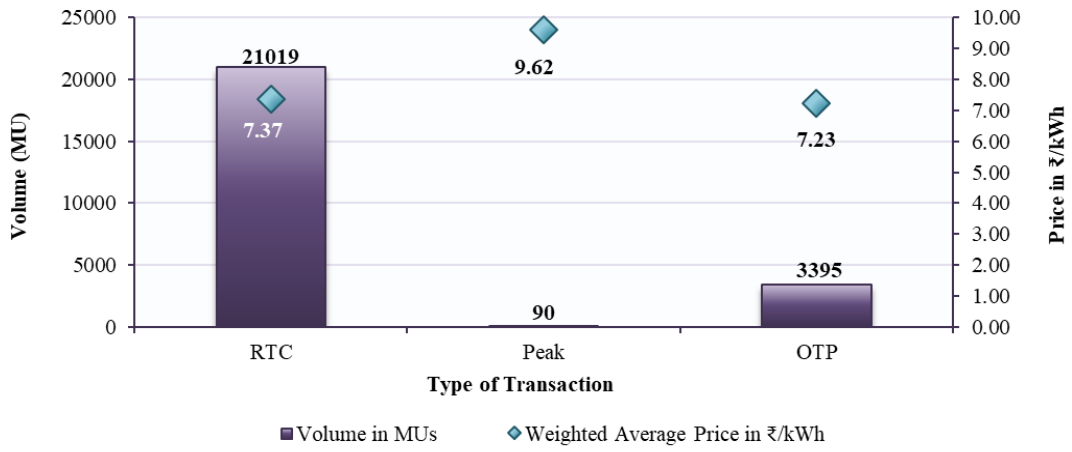
5. Time of the Day Variation in Volume and Price of Electricity Transacted through Traders and Power Exchanges

In this section, time of the day variation in volume and price of electricity transacted through traders has been illustrated for RTC (Round the Clock), Peak period and other than RTC & Peak period. Time of the day variation in volume and price of electricity transacted through power exchanges (collective transactions) is shown block-wise. Price of electricity transacted through power exchanges is discussed both region-wise and block-wise.

5.1 Time of the Day Variation in Volume and Price of Electricity Transacted through Traders

Time of the day variation in volume and price of electricity transacted bilaterally through traders during 2023-24 is shown in Figure-24. The volume of electricity transacted through traders represent inter-state transactions, i.e., excluding banking transactions. Time of the day variation in volume is shown during RTC (Round the Clock), Peak period and OTP (other than RTC & Peak period). Of the total volume, 85.8% was transacted during RTC, followed by 13.9% during OTP and 0.4% during peak period. It can be observed from the figure that the share of electricity transacted during peak period is much low with less than 1% of the total transactions. It can also be observed that the weighted average price during Peak period was relatively high (₹9.62/kWh), as compared to price of electricity transacted during RTC (₹7.37/kWh) and OTP (₹7.23/kWh).

Figure-24: Volume and Price of Electricity Transacted through Traders during RTC, Peak and OTP, 2023-24



5.2 Time of the Day Variation in Volume and Price of Electricity Transacted through Power Exchanges

Time of the day variation in volume and price of electricity transacted under DAM, G-DAM, RTM and HP-DAM at IEX during 2023-24 are shown block-wise in Figure-25(a), 25(b), 25(c) and 25(d), respectively. It can be observed from the figure that high price was witnessed during morning and evening peak hours in DAM and RTM, and low prices witnessed during the off-peak hours. In case of G-DAM, it can be observed that the market clearing volume increases during day time, i.e., solar hours. With increase in supply during the day time, prices in G-DAM segment remained low, whereas high prices were observed during morning and evening peak when corresponding supply of RE power was low.

Figure-25(a): Block-wise Market Clearing Volume and Price in DAM on IEX during 2023-24

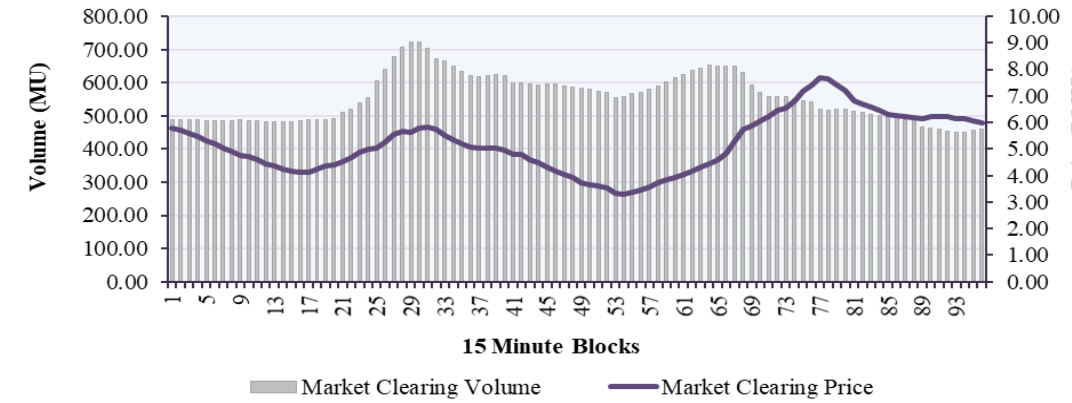


Figure-25(b): Block-wise Market Clearing Volume and Price in G-DAM on IEX during 2023-24

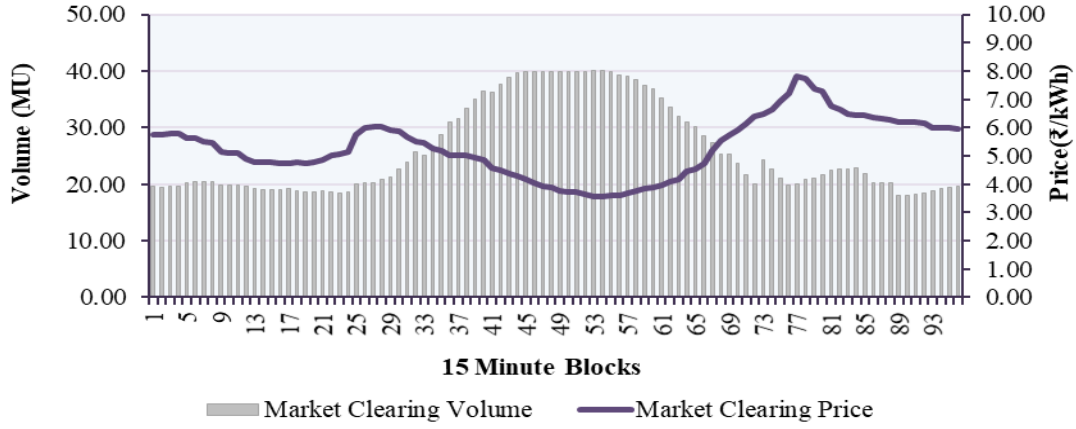


Figure-25(c): Block-wise Market Clearing Volume and Price in RTM on IEX during 2023-24

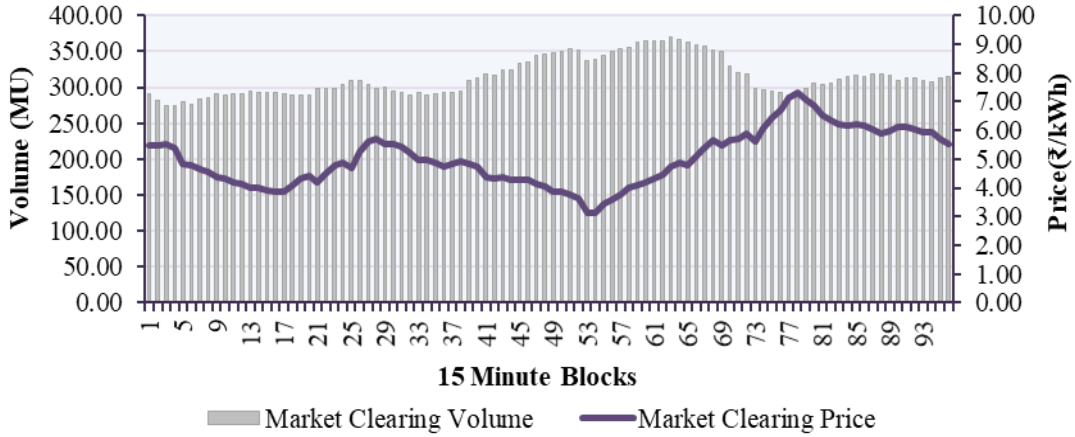
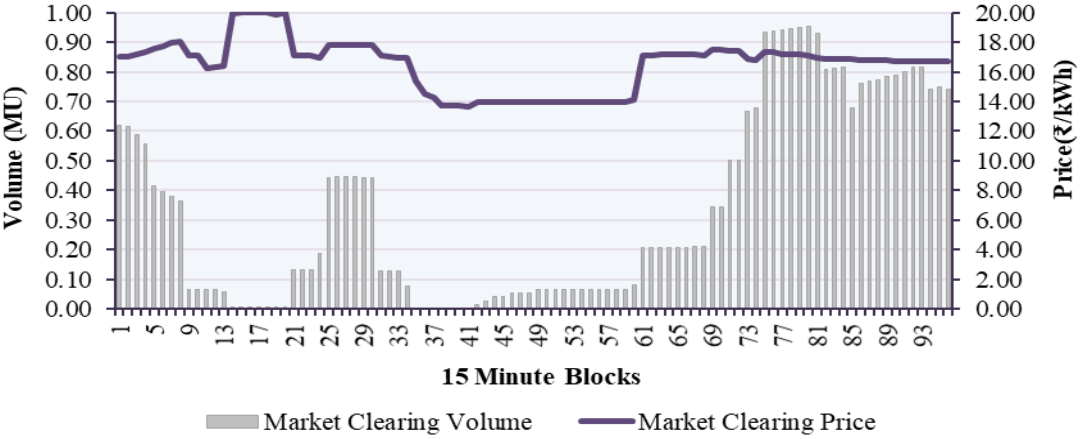
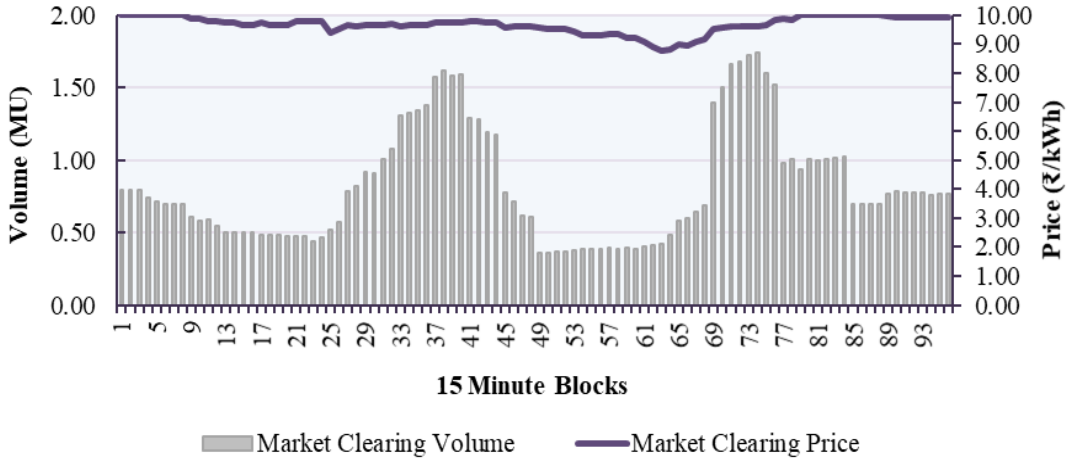


Figure-25(d): Block-wise Market Clearing Volume and Price in HP-DAM on IEX during 2023-24



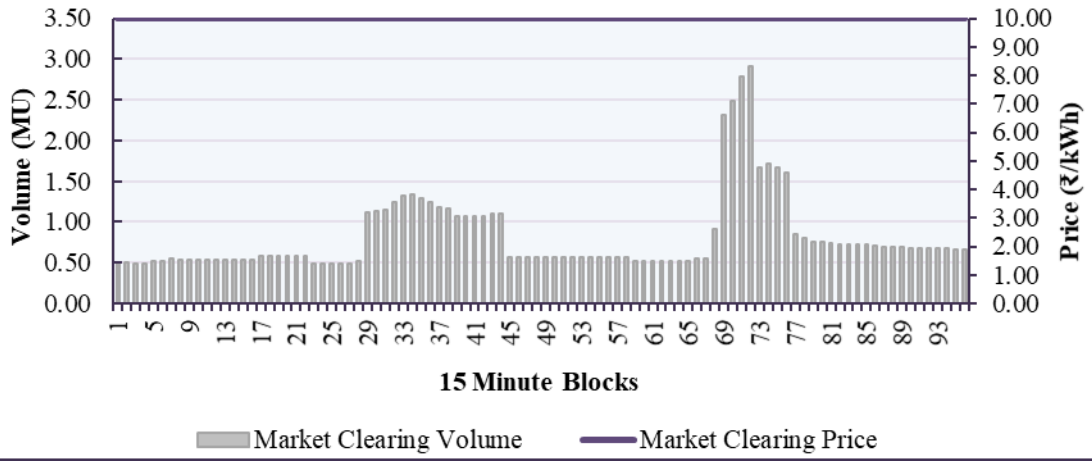
Time of the day variation in volume and price of electricity transacted through DAM on PXIL during 2023-24 is shown block-wise in Figure-26. It may be observed from the figure that the prices in DAM largely remained high at ceiling price, except for a few blocks during off-peak solar hours. Due to very limited number of transactions, the time of the day variation in volume and price of electricity transacted through RTM and HP-DAM at PXIL is not depicted. No transactions took place in GDAM at PXIL.

Figure-26: Block-wise Market Clearing Volume and Price in DAM on PXIL during 2023-24



Time of the day variation in volume of electricity transacted through DAM at HPX during 2023-24 is shown block-wise in Figure-27. Transactions took place only on few days in DAM and an increase in volume was witnessed mainly during evening peak hours. No time of day variation observed in price, as the transactions took place only at the ceiling price of Rs. 10/kWh. Due to very limited number of transactions, the time of the day variation in volume and price of electricity transacted through RTM at HPX is not depicted here. No transactions took place in GDAM and HP-DAM at HPX during 2023-24.

Figure-27: Block-wise Market Clearing Volume and Price in DAM on HPX during 2023-24



Region-wise and hour-wise average price (simple average) of electricity transacted through IEX in DAM, G-DAM, RTM and HP-DAM are shown in Figure-28(a), 28(b), 28(c) and 28(d), respectively. It can be observed that during 2023-24, the price of electricity in all the regions was almost similar, which is indicative of very few instances of congestion. In case of DAM, price was slightly lower in the N3 region (Figure 28(a)) and in case of RTM, price was marginally higher in S3 region, mainly during peak hours (Figure 28(c)). HP-DAM segment witnessed very low liquidity in 2023-24. Price in NR and NER regions was relatively lower compared to other regions and MCP, in a few blocks.

Figure-28(a): Region-wise and Block-wise Price of Electricity Transacted in DAM through IEX, 2023-24

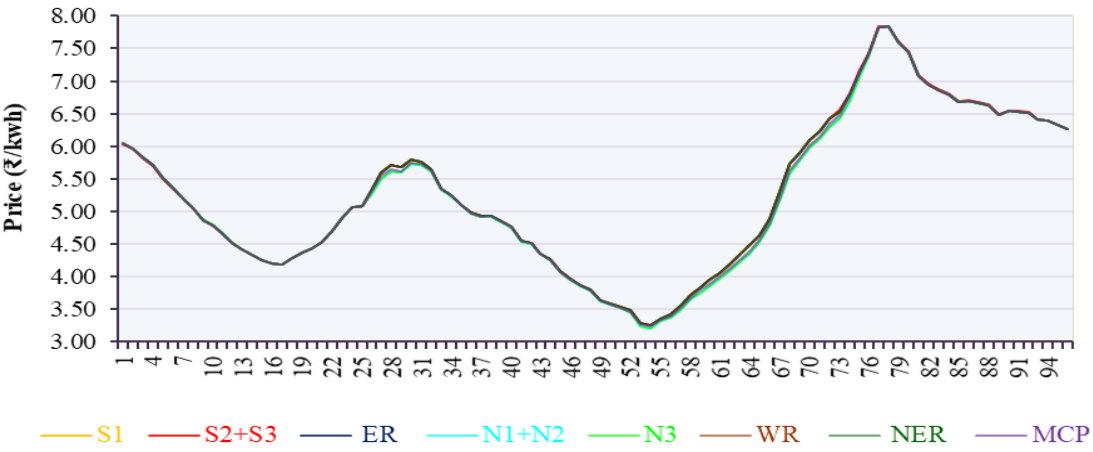


Figure-28(b): Region-wise and Block-wise Price of Electricity Transacted in G-DAM through IEX, 2023-24

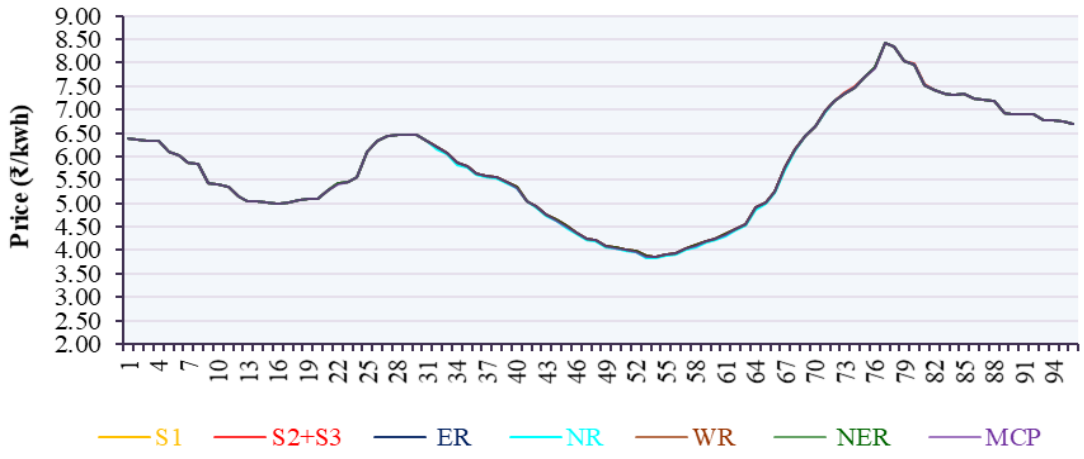


Figure-28(c): Region-wise and Block-wise Price of Electricity Transacted in RTM through IEX, 2023-24

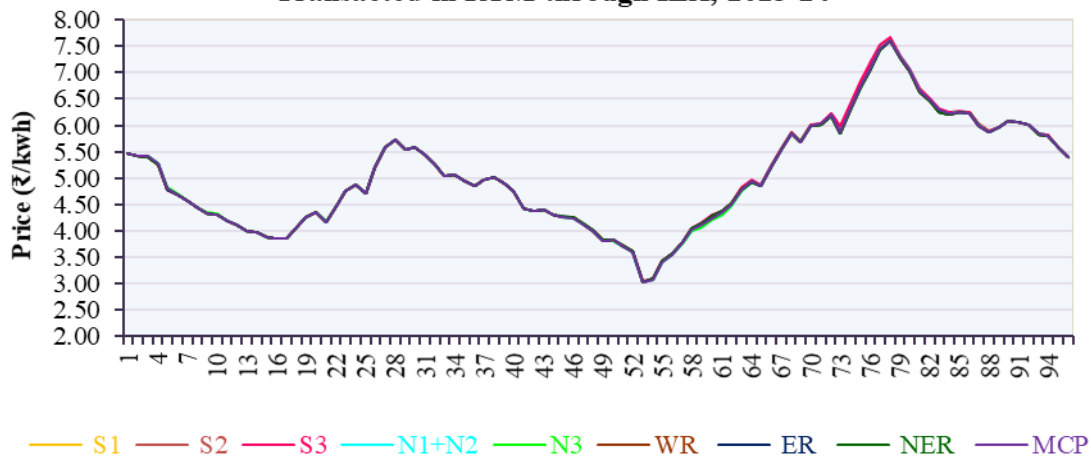
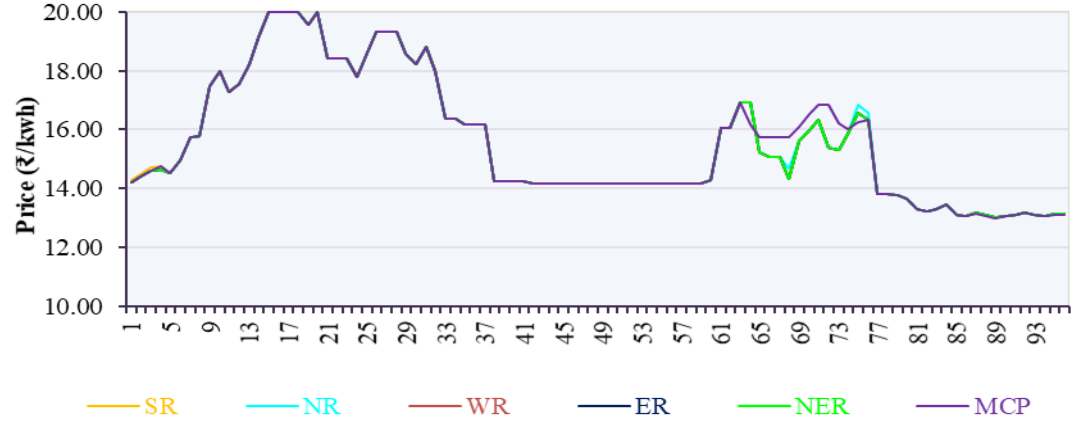
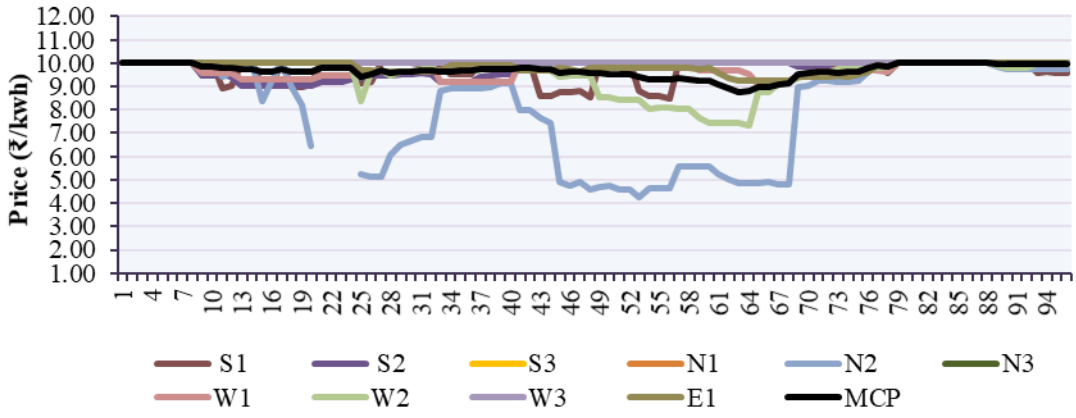


Figure-28(d): Region-wise and Block-wise Price of Electricity Transacted in HP-DAM through IEX, 2023-24



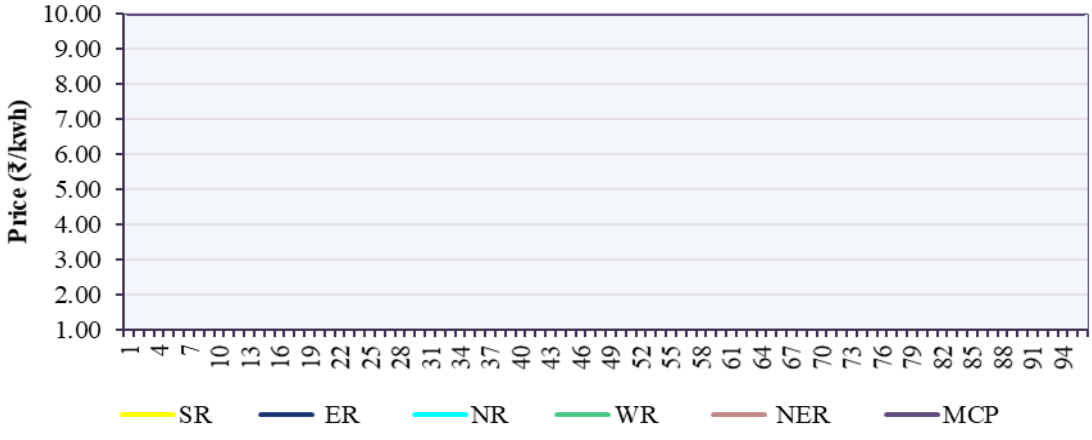
Region-wise and hour-wise price of electricity transacted through PXIL in DAM are shown in Figure-29. No consistent trend can be observed in price in different regions, as there was low liquidity in DAM. There were very few transactions in RTM and HP-DAM through PXIL during 2023-24, due to which the region-wise and hour-wise prices of electricity transacted are not depicted in figure separately. No transactions took place in GDAM at PXIL.

Figure-29: Region-wise and Block-wise Price of Electricity Transacted in DAM through PXIL, 2023-24



Region-wise and hour-wise price of electricity transacted through HPX in DAM in 2023-24 are shown in Figure-30. Transactions in HPX took place only on a few days in DAM, and one price (ceiling price of Rs. 10/kWh) was observed across regions. No transactions were there in G-DAM and RTM in HPX during 2023-24.

Figure-30: Region-wise and Block-wise Price of Electricity Transacted in DAM through HPX, 2023-24



6. Trading Margin Charged by Trading Licensees

During the year 2004-05, when trading started through licensees, the licensees voluntarily charged 5 paise/kWh or less as the trading margin for bilateral transactions. However, the trading margin increased in 2005, and the weighted average trading margin charged by the licensees went up to 10 paise/kWh during the April to September 2005 period. This necessitated fixing trading margin for inter-state trading of electricity. The trading margin was fixed at 4 paise/kWh, vide CERC (Fixation of Trading Margin) Regulations notification dated 26.01.2006. As a result of these trading margin regulations, the licensees charged a trading margin of 4 paise or less from 26.01.2006 onwards until the revised Trading Margin Regulations 2010 came into existence on 11.01.2010 (Table-18 & Figure-31).

Based on feedback and experience gained from the 2006 Regulations and considering various risks associated with the electricity trading business, CERC revised the trading margin in 2010. As per the CERC (Fixation of Trading Margin) Regulations, 2010, the trading licensees are allowed to charge a trading margin up to 7 paise/kWh in case the sale price exceeds ₹3/kWh and 4 paise/kWh where the sale price is less than or equal to ₹3/kWh.

To increase the volume of trading, some of the trading licensees misunderstood the intention of the trading margin regulations and charged negative trading margins for some of the transactions. Keeping this in view and to avoid negative trading margin, the Commission, in the CERC (Procedure, Terms and Conditions for grant of trading licence and other related matters) Regulations, 2020, has prescribed a trading margin of not less than zero (0.0) paise/kWh and not exceeding seven (7.0) paise/kWh w.e.f. 31st January, 2020. In these regulations, the applicability of trading margin has been clearly specified separately for transactions under (a) short-term contracts, (b) long-term contracts, (c) banking contracts, (d) back-to-back contracts and (e) cross-border trade of electricity. The trading licensees have been charging the trading margin as per the regulations. Due to stiff competition among the trading licensees, the trading margin charged by the trading licensees was always less than the ceiling margin allowed in the trading margin regulations. The new trading margin regulations restrict the trading

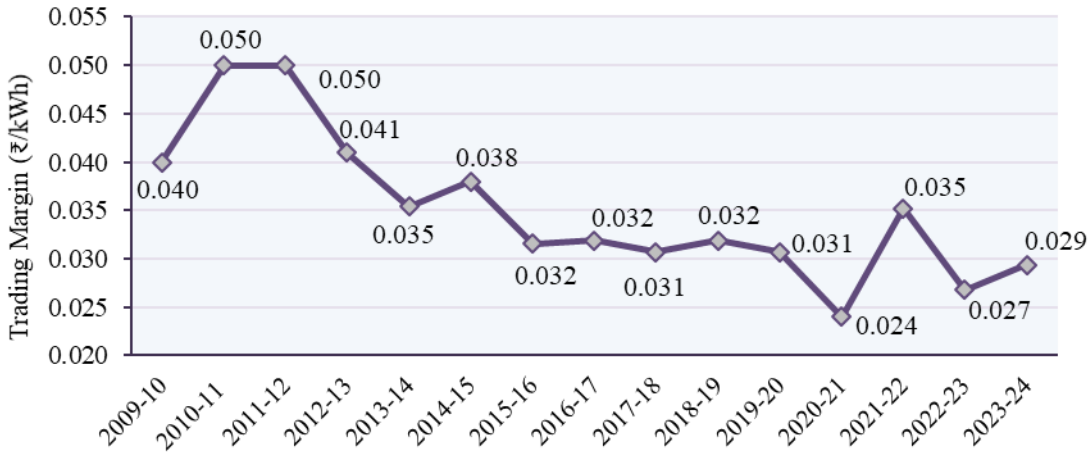
licensees from charging negative trading margin, i.e., less than zero (0.0) paisa/kWh. The weighted average trading margin charged by the trading licensees for bilateral transactions from 2009-10 to 2023-24 is provided in Table-18 and Figure-31.

Table-18: Trading Margin Charged by Trading Licensees, 2009-10 to 2023-24

Period	Trading Margin (₹/kWh)
2009-10	0.040
2010-11	0.050
2011-12	0.050
2012-13	0.041
2013-14	0.035
2014-15	0.038
2015-16	0.032
2016-17	0.032
2017-18	0.031
2018-19	0.032
2019-20	0.031
2020-21	0.024
2021-22	0.035
2022-23	0.027
2023-24	0.029

Note 1: Weighted Average Trading Margin is computed based on all Inter-state Trading Transactions, excluding Banking Transactions

Figure-31: Trading Margin Charged by Trading Licensees, 2009-10 to 2023-24



It can be observed from the above figure that the trading margin charged by the trading licensees witnessed a downward trend over the years, except for a few years. This may be attributed to the increasing competition among the trading licensees.

7. Open Access Consumers on Power Exchanges

This section discusses the various types of participants in power exchanges and provides analysis of open access consumers in DAM, G-DAM, HP-DAM and RTM segments of power exchanges. Open Access consumers include Industrial & Bulk Consumers and Captive Power Plants. The discussion on price and volume transacted by the OA consumers in this section refers to collective transactions only.

7.1 Types of Participants in Power Exchanges

As shown in Figure-32(a), 32(b), 32(c) and 32(d) during the year 2023-24, there were five types of participants at IEX under DAM, G-DAM, RTM and HP-DAM. In case of DAM, the major sellers of electricity at IEX were independent power producers/merchants power plants (IPPs/MPPs) and state utilities, while the major buyers of electricity were state utilities followed by private distribution licensees and open access consumers {Figure-32(a)}. In case of G-DAM, the major sellers of electricity were independent power producers followed by state utilities, while the major buyers of electricity were open access consumers, private distribution licensees and state utilities {Figure-32(b)}. In case of RTM, the major sellers of electricity were state utilities followed by IPPs/MPPs, and the major buyers were state utilities followed by open access consumers {Figure-32(c)}. In case of HP-DAM, the major sellers of electricity were ISGS/CGS followed by IPPs/MPPs, whereas, the major buyers were state utilities followed by private distribution licensees {Figure-32(d)}.

Figure-32(a): Sell and Buy Volume of Various Types of Participants in DAM on IEX, 2023-24

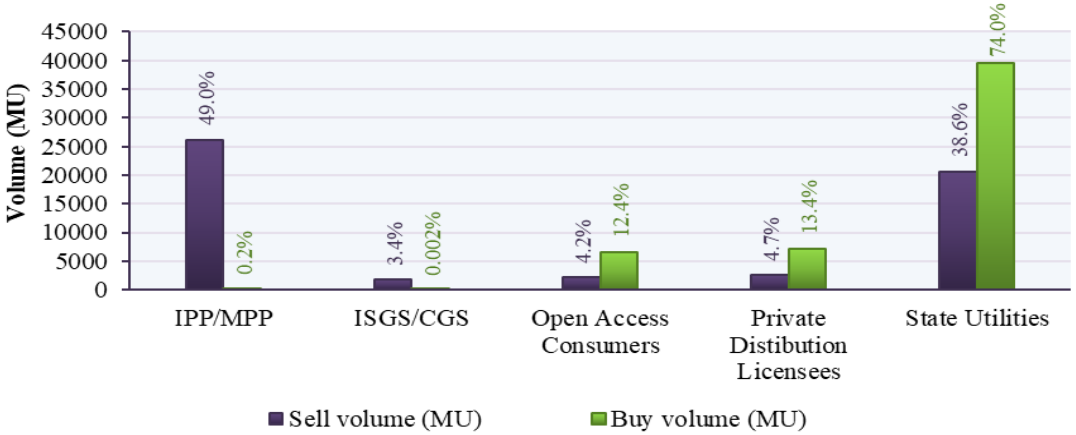


Figure-32(b): Sell and Buy Volume of Various Types of Participants in G-DAM on IEX, 2023-24

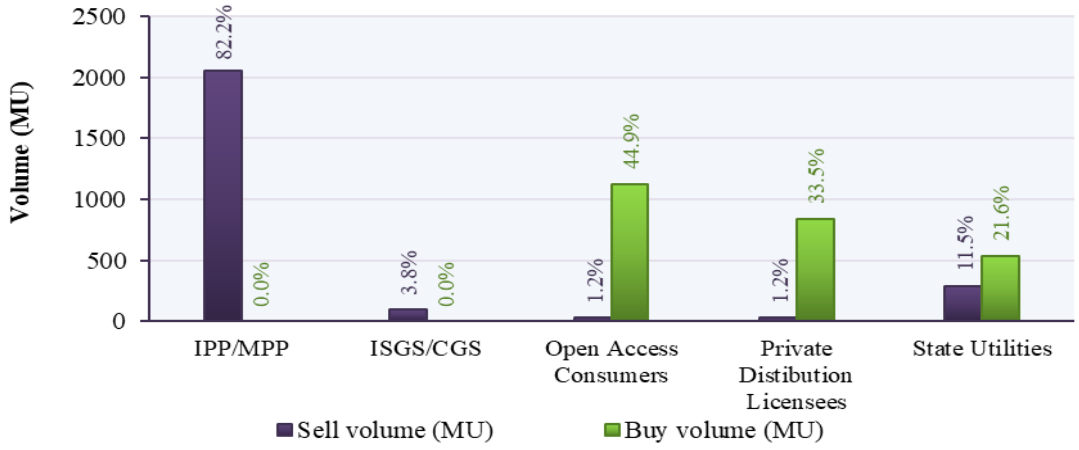


Figure-32(c): Sell and Buy Volume of Various Types of Participants in RTM on IEX, 2023-24

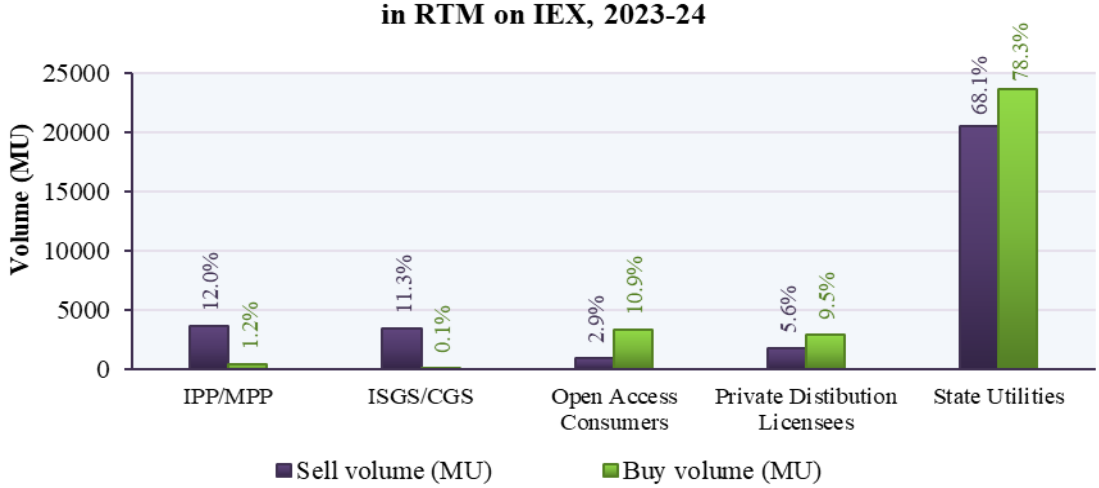
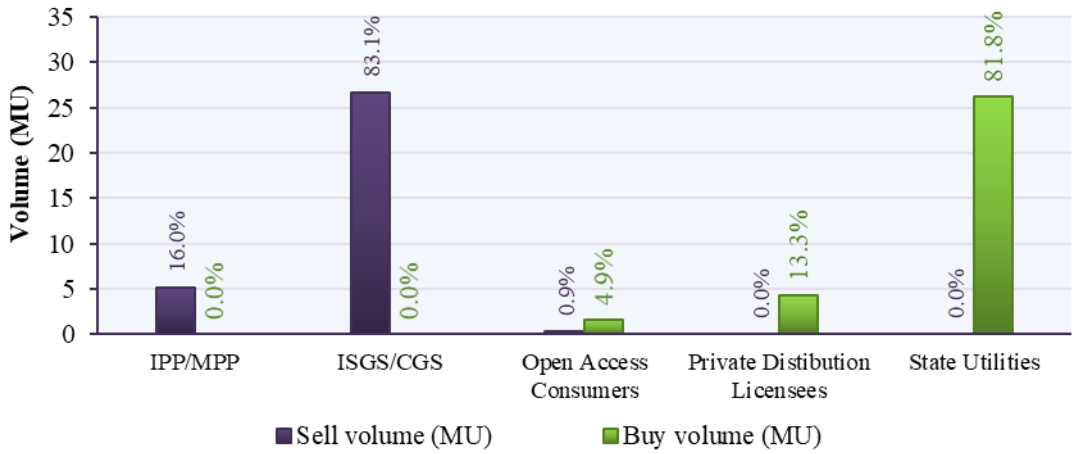
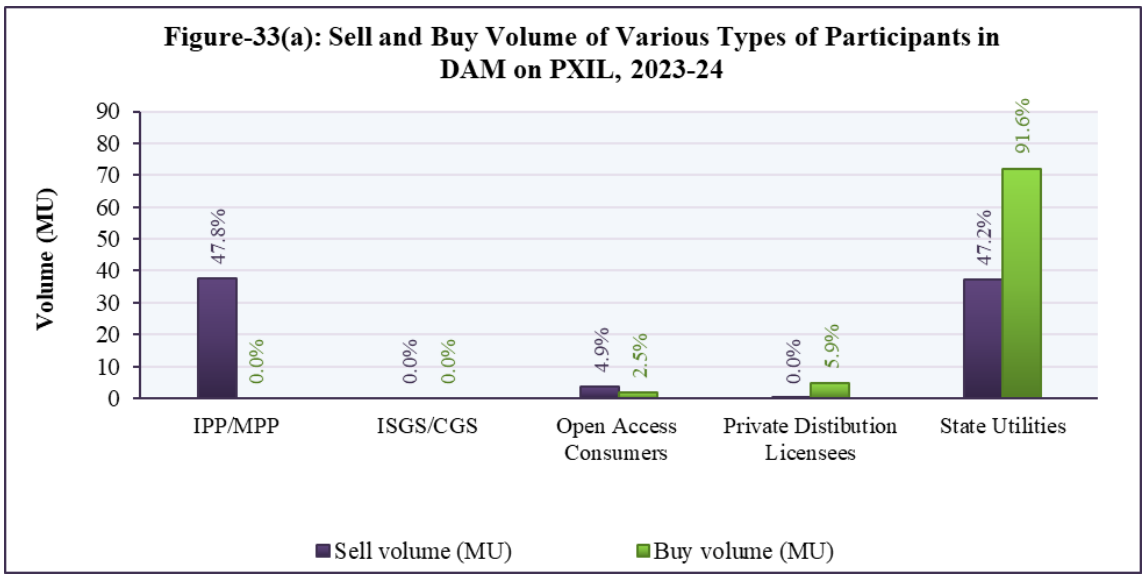
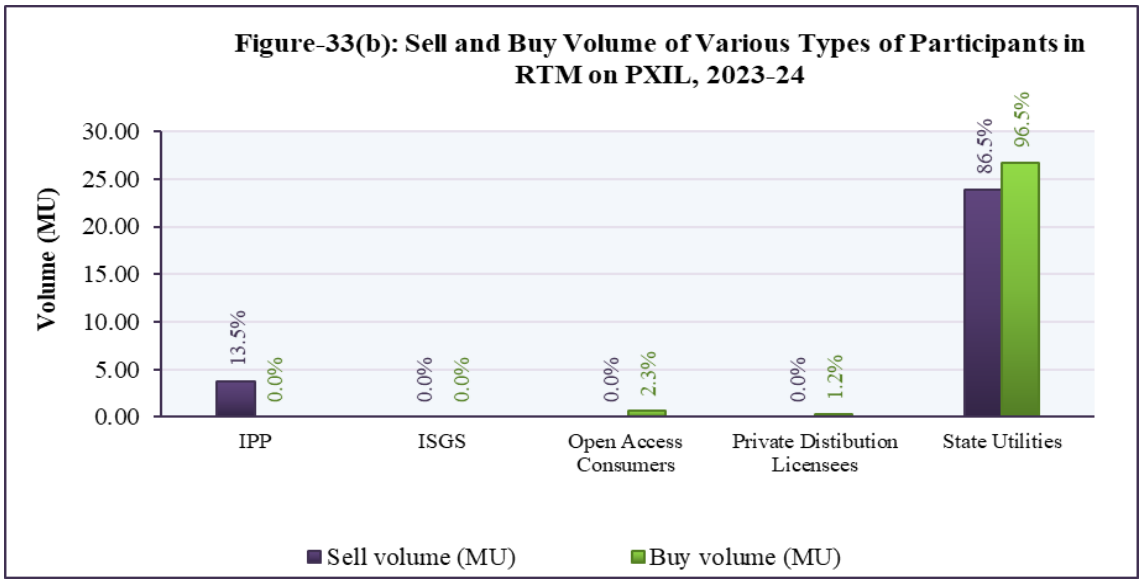


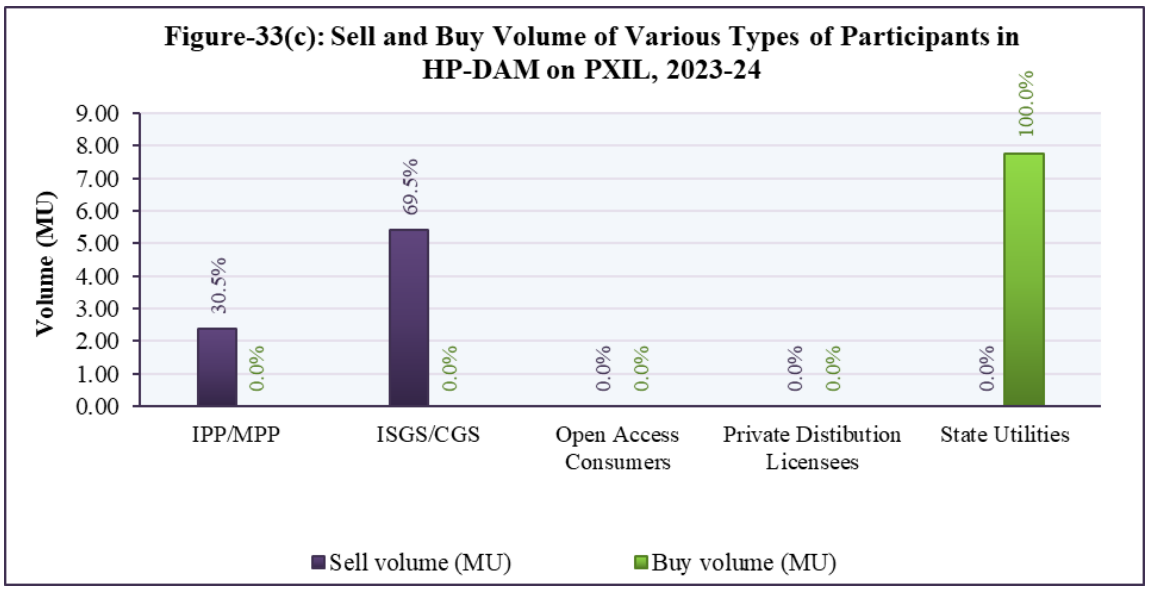
Figure-32(d): Sell and Buy Volume of Various Types of Participants in HP-DAM on IEX, 2023-24



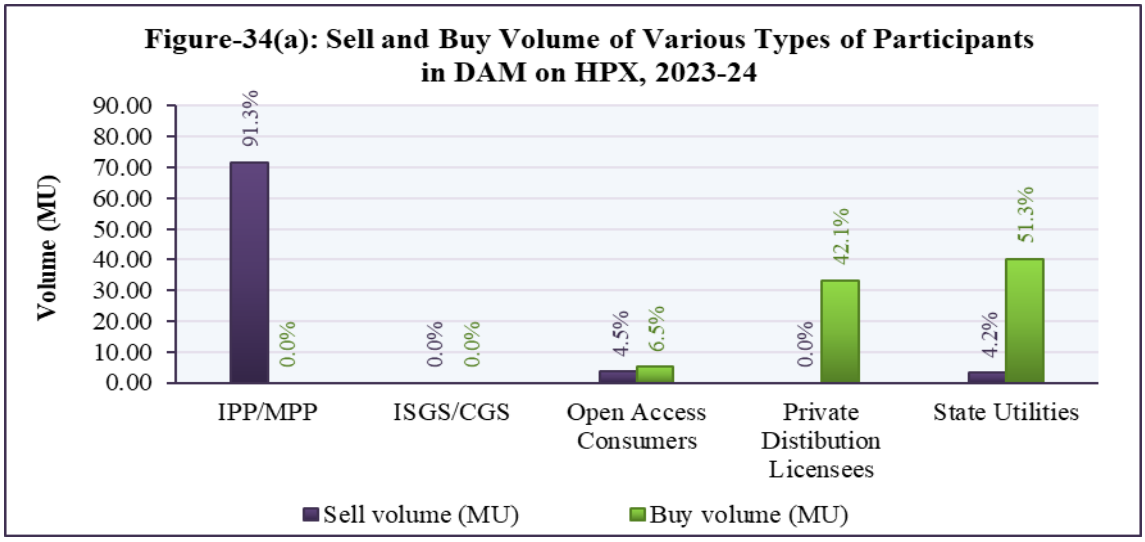
There were five types of participants (IPPs/MPPs, ISGS, Open Access Consumers, Private Distribution Licensees and State Utilities) at PXIL during 2023-24. Details of share of various participants in DAM, RTM and HP-DAM segments are shown in Figure-33(a), 33(b) and 33(c), respectively. It can be observed from the figure that major sellers of electricity at PXIL in DAM were IPPs/ MPPs and state utilities, while major buyers in DAM were state utilities. In case of RTM, state utilities were the major buyers and sellers of electricity. In case of HP-DAM, the major sellers were ISGS and IPPs, whereas state utilities were the only buyers. No transactions took place in G-DAM at PXIL during 2023-24.

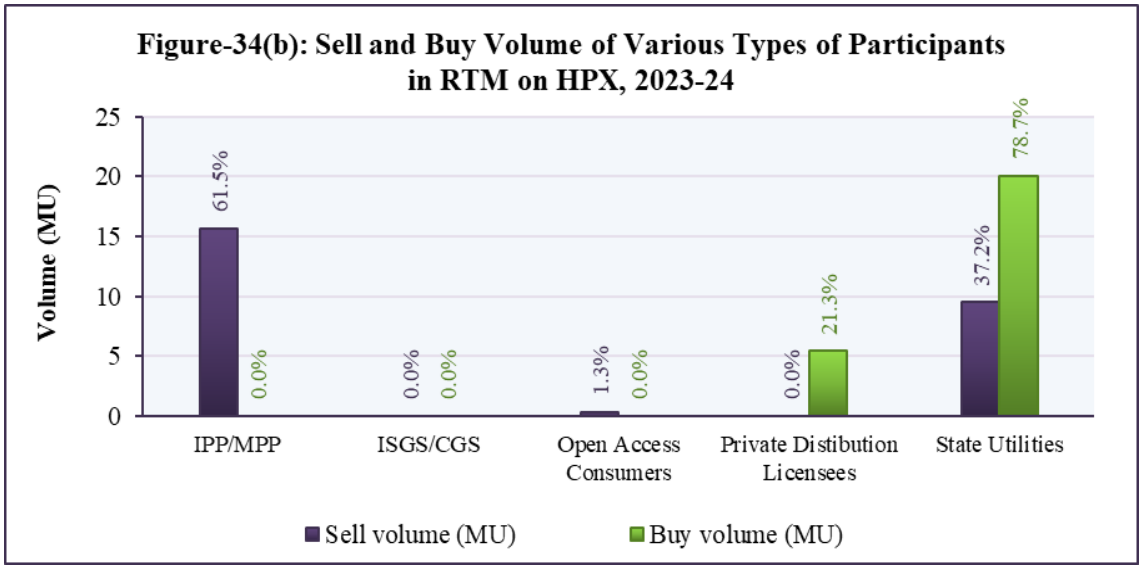






At HPX in DAM during 2023-24, the major sellers were IPPs/ MPPs, whereas, major buyers were State Utilities and Private Distribution Licensees {Figure-34(a)}. In case of RTM, the major sellers were IPPs/ MPPs followed by state utilities, whereas, major buyers were State Utilities and Private Distribution Licensees {Figure-34(b)}. No transactions took place at HPX in G-DAM and HP-DAM during 2023-24.





7.2 Analysis of Open Access Consumers on Power Exchanges

The year 2010-11 witnessed collective open access transactions, which marked a significant development in procurement of power by the industrial consumers through power exchanges. The number of Open Access (OA) Consumers at both IEX and PXIL increased from 825 and 170 respectively in 2010-11 to 5244 and 825, respectively in 2023-24 (Table-19). During the period, the percentage of open access consumers in total portfolios varied between 89.4% to 96.2% at IEX, whereas the percentage varied between 16.1% to 89.5% at PXIL. The number of OA consumers at IEX and PXIL increased at a CAGR of 15%, and 13%, respectively. In case of HPX, which commenced its operations in July 2022, the number of OA consumers were 265 in 2023-24, as compared to 239 in 2022-23 (Table-19). Though there is an increasing trend in the number of OA consumers at PXIL during the last few years, the percentage of open access consumers in total portfolio of PXIL declined significantly from the high of about 90% in 2010-11 to about 19.8% in 2023-24. In case of HPX, the percentage of open access consumers in total portfolio was 41.1% in 2023-24.

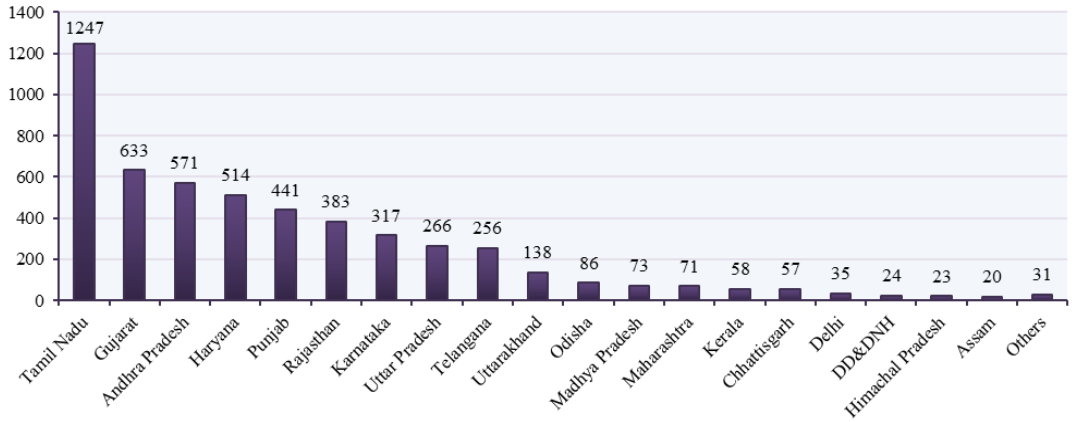
Table-19: Number of Open Access Consumers in Power Exchanges, 2010-11 to 2023-24

Year	IEX			PXIL			HPX		
	No. of Open Access Consumers	Total No. of Portfolios	% of Open Access Consumers	No. of Open Access Consumers	Total No. of Portfolios	% of Open Access Consumers	No. of Open Access Consumers	Total No. of Portfolios	% of Open Access Consumers
2010-11	825	863	95.6%	170	190	89.5%	-	-	-
2011-12	968	1073	90.2%	231	465	49.7%	-	-	-
2012-13	2110	2227	94.7%	336	379	88.7%	-	-	-
2013-14	2958	3083	95.9%	473	1399	33.8%	-	-	-
2014-15	3269	3407	95.9%	517	1779	29.1%	-	-	-
2015-16	3650	3796	96.2%	527	2924	18.0%	-	-	-
2016-17	4071	4281	95.1%	542	3277	16.5%	-	-	-
2017-18	4248	4502	94.4%	559	3422	16.3%	-	-	-
2018-19	4362	4633	94.2%	588	3657	16.1%	-	-	-
2019-20	4555	4857	93.8%	615	3780	16.3%	-	-	-
2020-21	4768	5114	93.2%	632	3805	16.6%	-	-	-
2021-22	4967	5376	92.4%	661	3923	16.8%	-	-	-
2022-23	5159	5640	91.5%	769	4070	18.9%	239	483	49.5%
2023-24	5244	5868	89.4%	825	4172	19.8%	265	645	41.1%

Note: Status as on 31st March of respective year

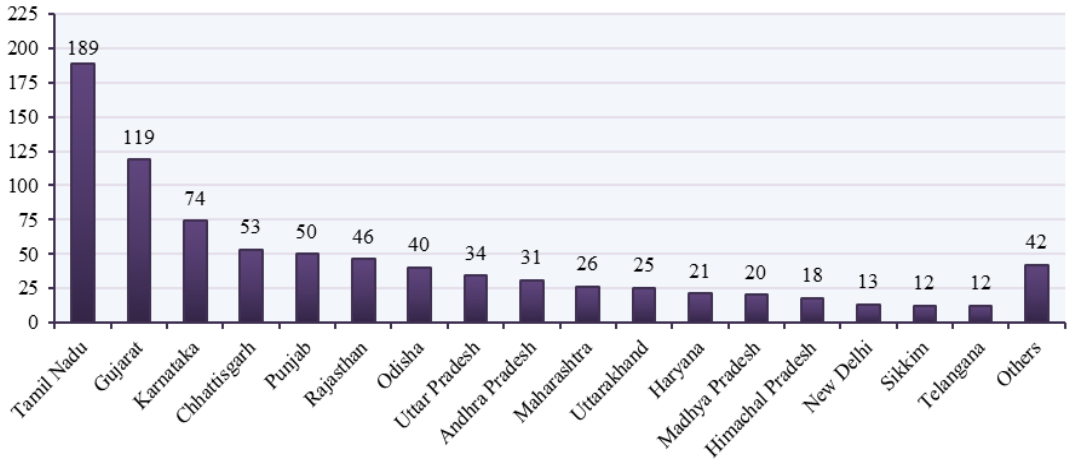
As on March 2024, there were 5244 OA consumers at IEX. These consumers were mostly located in Tamil Nadu, Gujarat, Andhra Pradesh, Haryana and Punjab (Figure-35). The weighted average price of electricity bought by OA consumers at IEX (₹3.76/kWh) in collective transactions was lower when compared to the weighted average price of electricity transacted through IEX in collective transactions (₹5.10/kWh).

Figure-35: State-wise Number of Open Access Consumers in IEX, March 2024



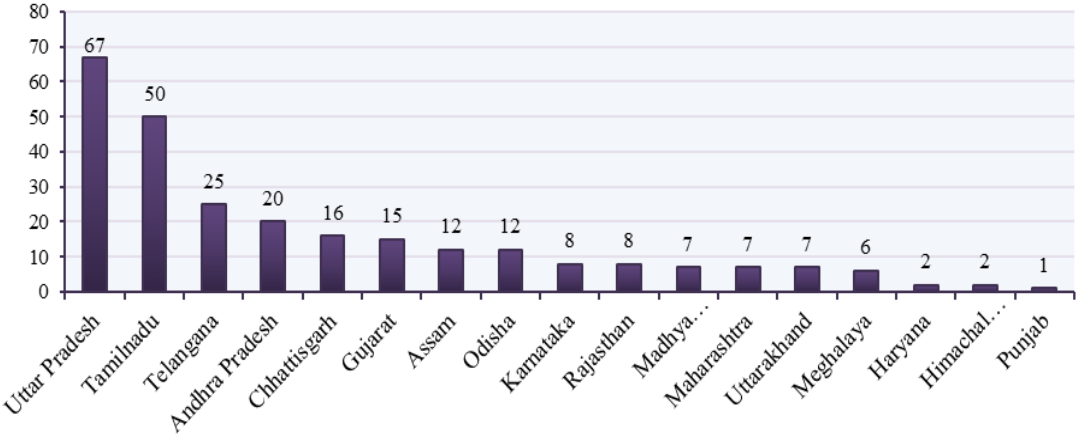
As on March 2024, there were 825 OA consumers at PXIL. These consumers were mostly located in Tamil Nadu, Gujarat, Karnataka, Chhattisgarh, Punjab (Figure-36). The weighted average price of electricity bought by open access consumers at PXIL (₹7.39/kWh) was lower when compared to the weighted average price of total electricity transacted through PXIL (₹10.23/kWh).

Figure-36: State-wise Number of Open Access Consumers in PXIL, March 2024



In case of HPX, there were 265 OA consumers as on March 2024. These consumers were mostly located in Uttar Pradesh, Tamil Nadu, Telangana, Andhra Pradesh and Chhattisgarh (Figure-37). The weighted average price of electricity bought by open access consumers at HPX (₹10.00/kWh) was slightly higher when compared to the weighted average price of total electricity transacted through HPX (₹9.98/kWh).

Figure-37: State-wise Number of Open Access Consumers in HPX, March 2024



Annual comparison between purchase volume of OA consumers and total volume in DAM of IEX, PXIL and HPX during 2010-11 to 2023-24 is shown in Table-20(a). As may be seen in the Table below, in case of IEX, during 2010-11 to 2023-24 the volume of electricity procured by OA consumers as a percentage of total volume

transacted varied between 9.2% to 60.8%, while in case of PXIL it was between 0.1% to 57.6% during the same period. In case of HPX, the volume of electricity procured by OA consumers as a percentage of total volume transacted was 6.5% in 2023-24 as compared to 0.9% in 2022-23.

Table-20(a): Volume of Purchase by Open Access Consumers in Day Ahead Market of Power Exchanges, 2010-11 to 2023-24

Year	IEX			PXIL			HPX		
	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation
2010-11	4056.51	11800.58	34.4%	92.72	1740.17	5.3%	-	-	-
2011-12	6275.30	13798.88	45.5%	306.58	2057.60	14.9%	-	-	-
2012-13	10410.13	22374.78	46.5%	263.41	687.96	38.3%	-	-	-
2013-14	17575.17	28924.84	60.8%	503.03	1106.42	45.5%	-	-	-
2014-15	12084.18	28140.72	42.9%	102.95	340.77	30.2%	-	-	-
2015-16	20284.49	34066.52	59.5%	78.78	136.84	57.6%	-	-	-
2016-17	23999.77	39830.66	60.3%	44.06	248.54	17.7%	-	-	-
2017-18	14728.37	44925.11	32.8%	5.70	730.48	0.8%	-	-	-
2018-19	11219.07	50136.03	22.4%	21.02	86.40	24.3%	-	-	-
2019-20	14452.80	49126.10	29.4%	9.96	46.63	21.3%	-	-	-
2020-21	14383.05	60376.03	23.8%	0.24	241.19	0.1%	-	-	-
2021-22	7888.34	65143.03	12.1%	0.03	42.61	0.1%	-	-	-
2022-23	4707.73	51177.54	9.2%	28.65	187.13	15.3%	0.01	1.43	0.9%
2023-24	6613.69	53389.29	12.4%	1.95	78.57	2.5%	5.13	78.46	6.5%

The volume purchased by OA consumers vis-à-vis total volume in case of G-DAM is given in Table-20 (b). As may be seen from the table, the volume of electricity procured by OA consumers as a percentage of total volume transacted in IEX was 44.9% in 2023-24, while, no transactions took place in GDAM at PXIL and HPX in 2023-24.

Table-20(b): Volume of Purchase by Open Access Consumers in Green Day Ahead Market of Power Exchanges, 2021-22 to 2023-24

Year	IEX			PXIL			HPX		
	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation	OAC Purchase Volume	Total Volume (MU)	% OAC Purchase Partici-pation
2021-22	194.99	920.45	21.2%	0.00	0.00	-	-	-	-
2022-23	434.04	3816.60	11.4%	0.41	0.41	100.0%	-	-	-
2023-24	1121.20	2499.21	44.9%	-	-	-	-	-	-

The volume purchased by OA consumers vis-à-vis total volume in case of RTM, is given in Table-20(c). As may be seen from the Table, the volume of electricity

procured by OA consumers as a percentage of total volume transacted was around 10.9% in case of IEX and 2.3% in case of PXIL in 2023-24. There was no procurement of electricity by OA consumers in RTM through HPX.

Table-20(c): Volume of Purchase by Open Access Consumers in Real Time Market of Power Exchanges, 2020-21 to 2023-24

Year	IEX			PXIL			HPX		
	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation
2020-21	776.73	9467.94	8.2%	0.00	2.29	0.0%	-	-	-
2021-22	1658.36	19908.07	8.3%	0.00	0.00	-	-	-	-
2022-23	2430.71	24173.73	10.1%	0.29	12.57	2.3%	0.00	0.00	-
2023-24	3282.83	30124.78	10.9%	0.63	27.64	2.3%	0.00	25.52	-

Note: RTM is operational on the Power Exchanges from 1st June 2020

The volume purchased by OA consumers vis-à-vis total volume in case of HP-DAM is given in Table-20(d). As may be seen from the Table, the volume of electricity procured by OA consumers as a percentage of total volume transacted was around 4.9% in case of IEX. There was no procurement of electricity by OA consumers in HP-DAM through PXIL. No transactions took place in HP-DAM at HPX in 2023-24.

Table-20(d): Volume of Purchase by Open Access Consumers in High Price Day Ahead Market of Power Exchanges, 2023-24

Year	IEX			PXIL			HPX		
	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation	OAC Purchase Volume (MU)	Total Volume (MU)	% OAC Purchase Partici-pation
2023-24	1.57	32.07	4.9%	0.00	7.77	0.0%	0.00	0.00	-

Note: HP-DAM is operational from 10th March 2023

8. Major Sellers and Buyers of Electricity in the Short-term market

Details of the top 10 sellers and buyers of electricity through traders (bilateral trader segment transactions) in 2023-24 are given in Table-21 and Table-22 respectively. The volume of electricity transacted by these major sellers and buyers, their share in total volume and the price at which they have sold or purchased are also provided in the tables.

Table 21: Major Sellers of Electricity through Traders, 2023-24

S.No.	Seller	State	Volume (MU)	Approximate Percentage of total volume transacted through Traders	Weighted Average Price (₹/kWh)
1	Jindal Power Ltd.	Chhattisgarh	3593.65	14.67%	7.40
2	IL&FS Tamil Nadu Power Company Ltd.	Tamil Nadu	2615.25	10.67%	7.82
3	Jaypee Nigrie STPP	Madhya Pradesh	2254.90	9.20%	6.93
4	Raipur Energen Ltd.	Chhattisgarh	1489.63	6.08%	8.57
5	Simhapuri Energy Ltd.	Andhra Pradesh	1454.26	5.93%	7.85
6	JITPL	Odisha	1057.01	4.31%	5.68
7	Mahan Energen Ltd.	Madhya Pradesh	932.61	3.81%	8.72
8	OPG Power Generation Pvt. Ltd.	Tamil Nadu	893.01	3.64%	8.01
9	Jhabua Power Ltd.	Madhya Pradesh	807.46	3.30%	5.56
10	Coastal Energen Pvt. Ltd.	Tamil Nadu	677.17	2.76%	8.33

Note : Volume sold by major sellers and total volume transacted through traders does not include the volume through banking arrangements.

Table 22: Major Buyers of Electricity through Traders, 2023-24

S.No.	Buyer	State/ Regional Entity	Volume (MU)	Approximate percentage of total volume transacted through traders	Weighted Avearage Price (₹/kWh)
1	APPCC	Andhra Pradesh	4230.69	17.27%	8.38
2	HPPC	Haryana	4122.30	16.82%	7.14
3	TANGEDCO	Tamil Nadu	2457.68	10.03%	8.40
4	GUVNL	Gujarat	1936.03	7.90%	6.85
5	BRPL	Delhi	1301.13	5.31%	7.50
6	RUVNL	Rajasthan	1292.29	5.27%	6.73
7	UPPCL	Uttar Pradesh	1244.86	5.08%	10.04
8	KSEB	Kerala	1167.43	4.76%	5.65
9	TORRENT POWER LIMITED - Distribution	Gujarat	1083.16	4.42%	7.57
10	MSEDCL	Maharashtra	1024.86	4.18%	7.63

Note : Volume bought by major buyers and total volume transacted through traders does not include the volume through banking arrangements.
Note :
1. Volume bought by Torrent Power Ltd. includes operations at Ahmedabad, Gandhinagar, Surat and Dahej
2. Volume bought by APPCC includes all distribution companies of Andhra Pradesh

As can be observed from Table-22, the weighted average purchase prices of electricity of some of the major buyers from traders (bilateral transactions) like APPCC, TANGEDCO and UPPCL were higher than the weighted average price for the bilateral trader segment (₹7.33/kWh).

Details of the top 10 sellers in DAM, G-DAM, RTM and HP-DAM segments of IEX in 2023-24 are given in Table-23(a), 23(b), 23(c) and 23(d), respectively, and details of the top 10 buyers of electricity in DAM, G-DAM, RTM and HP-DAM

segments of IEX are given in Table-24(a), 24(b), 24(c) and 24(d) respectively. Table-25 (a), 25(b) and 25 (c) provides details of the top sellers of electricity in DAM, RTM and HP-DAM respectively, of PXIL and Table-26(a), 26(b), 26(c) provides details of top buyers of electricity in DAM, RTM and HP-DAM respectively, of PXIL. There was no trade of electricity in G-DAM at PXIL in 2023-24. Table-27 (a) and 27 (b) provide details of the top sellers of electricity traded in DAM and RTM, respectively of HPX and Table 28(a) and 28(b) provide details of the top buyers of electricity traded in DAM and RTM, respectively of HPX. There was no trade of electricity in G-DAM and HP-DAM of HPX in 2023-24.

Table-23(a): Major Sellers of Electricity in the Day Ahead Market of IEX, 2023-24

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the Total Volume Transacted in IEX	Weighted Average Sell Price (₹/kWh)
1	UPPCL	Uttar Pradesh	5222.94	9.78%	4.24
2	CSPDCL	Chhattisgarh	3934.91	7.37%	3.87
3	Mahan Energen Ltd.	Madhya Pradesh	2106.04	3.94%	5.24
4	BSPHCL	Bihar	2085.47	3.91%	4.20
5	DB Power Ltd.	Chhattisgarh	1954.81	3.66%	5.25
6	Jindal Power Ltd Stage II	Chhattisgarh	1895.64	3.55%	5.38
7	Adani Raipur TPP	Chhattisgarh	1873.82	3.51%	5.51
8	JITPL	Odisha	1672.82	3.13%	5.22
9	Jaypee Nigrie STPP	Madhya Pradesh	1471.22	2.76%	5.77
10	HPPC	Haryana	1263.62	2.37%	4.21

Note: Total Volume transacted through Day Ahead Market in IEX was about 53389.29 MU.

Table-23(b): Major Sellers of Electricity in the Green Day Ahead Market of IEX, 2023-24

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the Total Volume Transacted in IEX	Weighted Average Sell Price (₹/kWh)
1	APCPDCL	Andhra Pradesh	221.19	8.85%	5.26
2	Adani Wind Energy Kutchh Four Ltd.	Gujarat	210.76	8.43%	4.68
3	Ostro Kannada Power Pvt. Ltd.	Karnataka	134.87	5.40%	4.96
4	ReNew Surya Ravi Pvt. Ltd.	Rajasthan	126.32	5.05%	4.14
5	Adani Renewable Energy Holding Four Ltd.	Gujarat	122.97	4.92%	3.79
6	Singoli Bhatwari HEP	Uttarakhand	99.56	3.98%	5.38
7	Continuum Power Trading (TN) Pvt. Ltd.	Gujarat	89.68	3.59%	5.24
8	Wind Five Renergy Ltd.	Gujarat	75.34	3.01%	5.15
9	Magpie Hydel Construction Operation Industries Pvt. Ltd.	Jammu & Kashmir	72.23	2.89%	6.64
10	TSSPDCL	Telangana	64.52	2.58%	3.95

Note: Total Volume transacted through Green Day Ahead Market in IEX was about 2499.21 MU.

Table-23(c): Major Sellers of Electricity in the Real Time Market of IEX, 2023-24

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the Total Volume Transacted in IEX	Weighted Average Sell Price (₹/kWh)
1	MPPMCL	Madhya Pradesh	4230.95	14.04%	4.74
2	BSPHCL	Bihar	3183.02	10.57%	4.29
3	RUVNL	Rajasthan	2115.17	7.02%	4.30
4	CSPDCL	Chhattisgarh	1306.67	4.34%	5.55
5	UPPCL	Uttar Pradesh	1169.94	3.88%	4.67
6	GRIDCO	Odisha	1079.50	3.58%	5.19
7	WBSEDCL	West Bengal	888.42	2.95%	5.59
8	JBVNL	Jharkhand	690.70	2.29%	3.63
9	PSPCL	Punjab	631.37	2.10%	6.80
10	TSSPDCL	Telangana	624.92	2.07%	5.45

Note: Total Volume transacted through Real Time Market in IEX was about 30124.78 MU.

Table-23(d): Major Sellers of Electricity in the High Price Day Ahead Market of IEX, 2023-24

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the Total Volume Transacted in IEX	Weighted Average Sell Price (₹/kWh)
1	Ratnagiri Gas & Power Private Limited	Maharashtra	7.68	23.94%	16.03
2	NTPC Dadri GPS RLNG	Uttar Pradesh	4.31	13.45%	18.03
3	NTPC Auraiya GPS RLNG	Uttar Pradesh	3.75	11.69%	17.99
4	NTPC Kawas GPS COMGAS	Gujarat	2.60	8.10%	18.16
5	NTPC Ltd Jhanor Gandhar Gas Power Project ComRLNG	Gujarat	2.38	7.42%	18.31
6	DGEN MEGA POWER PROJECT	Gujarat	2.25	7.02%	17.26
7	NTPC ANTA GPS Spot RF	Rajasthan	1.67	5.20%	17.63
8	Ratnagiri Gas and Power Private Limited LTRLNG	Maharashtra	1.56	4.88%	14.18
9	Torrent Power Ltd 382.5 MW Unosugen Kamrej	Gujarat	1.17	3.64%	16.40
10	NTPC Ltd Jhanor Gandhar Gas Power Project RLNG	Gujarat	1.10	3.42%	17.00

Note: Total Volume transacted through High Price Day Ahead Market in IEX was about 32.07 MU.

Table-24(a): Major Buyers of Electricity in the Day Ahead Market of IEX, 2023-24

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in IEX	Weighted Average Buy Price (₹/kWh)
1	APSPDCL	Telangana	6744.59	12.63%	5.06
2	GUVNL	Gujarat	4807.29	9.00%	5.90
3	MSEDCL	Maharashtra	3685.86	6.90%	5.51
4	WBSEDCL	West Bengal	3391.10	6.35%	5.62
5	APCPDCL	Andhra Pradesh	3297.03	6.18%	6.39
6	PSPCL	Punjab	3090.23	5.79%	4.79
7	JKPCL	Jammu & Kashmir	2363.36	4.43%	4.33
8	RUVNL	Rajasthan	1623.72	3.04%	6.27
9	UKPCL	Uttarakhand	1580.26	2.96%	4.40
10	Torrent Ahmedabad	Gujarat	1333.04	2.50%	4.45

Note: Total Volume transacted through Day Ahead Market in IEX was about 53389.29 MU.

Table-24(b): Major Buyers of Electricity in the Green Day Ahead Market of IEX, 2023-24

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in IEX	Weighted Average Buy Price (₹/kWh)
1	Arcelor Mittal Nippon Steel India Ltd (AMNSIL)	Gujarat	470.80	18.84%	4.89
2	Central Railway	Maharashtra	240.20	9.61%	4.86
3	DVC	DVC	144.40	5.78%	5.97
4	NDMC	Delhi	124.93	5.00%	4.96
5	PSPCL	Punjab	118.68	4.75%	3.86
6	BALCO	Chhattisgarh	112.94	4.52%	4.09
7	Hyundai Motor India Ltd.	Tamil Nadu	95.30	3.81%	4.12
8	Tata Steel Ltd.	DVC	94.73	3.79%	3.50
9	South Western Railway	Karnataka	73.88	2.96%	5.94
10	North Central Railway (Prayagraj Division)	Uttar Pradesh	59.43	2.38%	5.80

Note: Total Volume transacted through Green Day Ahead Market in IEX was about 2499.21 MU.

Table-24(c): Major Buyers of Electricity in the Real Time Market of IEX, 2023-24

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in IEX	Weighted Average Buy Price (₹/kWh)
1	TSSPDCL	Telangana	4539.33	15.07%	4.78
2	PSPCL	Punjab	2989.32	9.92%	4.84
3	KSEB	Kerala	1838.44	6.10%	4.38
4	APCPDCL	Andhra Pradesh	1594.87	5.29%	5.98
5	RUVNL	Rajasthan	1518.18	5.04%	5.70
6	MSEDCL	Maharashtra	1425.24	4.73%	4.91
7	WBSEDCL	West Bengal	1242.25	4.12%	4.63
8	JKPCL	Jammu & Kashmir	1113.08	3.69%	4.81
9	PCKL	Karnataka	1047.41	3.48%	6.15
10	TANGEDCO	Tamil Nadu	699.37	2.32%	6.56

Note: Total Volume transacted through Real Time Market in IEX was about 30124.78 MU.

Table-24(d): Major Buyers of Electricity in the High Price Day Ahead Market of IEX, 2023-24

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in IEX	Weighted Average Buy Price (₹/kWh)
1	TANGEDCO	Tamil Nadu	20.98	65.43%	17.65
2	CESC	West Bengal	4.22	13.15%	16.41
3	APCPDCL	Andhra Pradesh	3.00	9.36%	15.00
4	WBSEDCL	West Bengal	1.70	5.30%	16.92
5	Green Valliey Industries Limited	Meghalaya	1.57	4.88%	13.11
6	BSPHCL	Bihar	0.40	1.24%	19.31
7	CSPDCL	Chhattisgarh	0.16	0.49%	19.30
8	Eon Kharadi Infrastructure Private Ltd SEZ 1	Maharashtra	0.05	0.15%	13.74
9	TPCL	Maharashtra	0.001	0.004%	13.80
10	Hills Cement Company Ltd	Meghalaya	0.0001	0.0002%	20.00

Note: Total Volume transacted through High Price Day Ahead Market in IEX was about 32.07 MU.

From Table-24(a), it can be seen that the weighted average price of electricity for major buyers such as GUVNL, APCPDCL and RUVNL in the Day Ahead Market of IEX were higher than the weighted average price of the electricity transacted through the entire Day Ahead market of IEX (₹5.16/kWh). In case of the G-DAM segment (Table-24(b)), the weighted average prices of electricity for major buyers like DVC, South Western Railway and North Central Railway (Prayagraj Division) were higher than the weighted average price of the electricity transacted through the entire G-DAM of IEX (₹5.06/kWh). Similarly, in case of RTM in IEX, the weighted average prices of electricity for major buyers such as APCPDCL, RUVNL, PCKL and TANGEDCO were higher than the weighted average price of the electricity transacted through the entire real-time market of IEX (₹4.98/kWh) as may be seen in Table-24(c). In case of HP-DAM, the weighted average prices of electricity for major buyers such as BSPHCL, CSPDCL and Hills Cement Company Ltd. were higher than the weighted average price of the electricity transacted through the entire HP-DAM market of IEX (₹17.00/kWh) as may be seen in Table-24(d).

Table-25(a): Major Sellers of Electricity in Day Ahead Market of PXIL, 2023-24

S. No	Name of the Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of total volume transacted in PXIL	Weighted Average Sell Price (₹/kWh)
1	MB Power Ltd.	Madhya Pradesh	10.45	13.31%	10.00
2	PSPCL	Punjab	10.45	13.30%	10.00
3	Torrent Power 1147.5 MW Sugen CCPP Kamrej	Gujarat	8.19	10.43%	9.87
4	MPPMCL	Madhya Pradesh	8.10	10.31%	9.43
5	GRIDCO	Odisha	7.87	10.01%	9.96
6	JITPL	Odisha	7.20	9.16%	10.00
7	DoP, Govt. of Arunachal Pradesh	Arunachal Pradesh	5.52	7.03%	10.00
8	Torrent Power Ltd 382.5 MW Unosugen Kamrej	Gujarat	3.57	4.54%	10.00
9	UPPCL	Uttar Pradesh	3.20	4.08%	5.33
10	Coastal Energen Private Ltd	Tamil Nadu	1.96	2.50%	10.00

Note: Total Volume transacted in the Day Ahead Market of PXIL was about 78.57 MU.

Table-25(b): Major Sellers of Electricity in the Real Time Market of PXIL, 2023-24

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the Total Volume Transacted in PXIL	Weighted Average Sell Price (₹/kWh)
1	GUVNL	Gujarat	23.08	83.50%	10.00
2	Torrent Power 1147.5 MW Sugen Ccpp Kamrej	Gujarat	2.17	7.84%	10.00
3	DGEN Mega Power Project	Gujarat	1.10	3.98%	10.00
4	WBESDCL	West Bengal	0.58	2.08%	10.00
5	JSW Energy Limited	Karnataka	0.25	0.90%	10.00
6	GRIDCO	Odisha	0.24	0.86%	10.00
7	GMR Bajoli Holi Hydropower Pvt. Ltd.	Himachal Pradesh	0.23	0.82%	10.00
8	Torrent Power Ltd. - Ahmedabad Distribution	Gujarat	0.01	0.02%	10.00

Note: Total Volume transacted through Real Time Market in PXIL was about 27.64 MU.

Table-25(c): Major Sellers of Electricity in the High Price Day Ahead Market of PXIL, 2023-24

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the Total Volume Transacted in PXIL	Weighted Average Sell Price (₹/kWh)
1	Ratnagiri Gas and Power Private Limited-LTRLNG	Maharashtra	5.40	69.52%	17.00
2	DGEN Mega Power Project	Gujarat	1.47	18.90%	15.77
3	Torrent Power 1147.5 MW Sugen CCPP Kamrej	Gujarat	0.90	11.58%	13.00

Note: Total Volume transacted through High Price Day Ahead Market in PXIL was about 7.77 MU.

Table-26(a): Major Buyers of Electricity in Day Ahead Market of PXIL, 2023-24

Sr. No	Name of the Buyer	State/Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in PXIL	Weighted Average Buy Price (₹/kWh)
1	WBSEDCL	West Bengal	25.51	32.46%	10.00
2	GUVNL	Gujarat	16.61	21.14%	9.37
3	HPPC	Haryana	10.36	13.19%	10.00
4	TANGEDCO	Tamil Nadu	8.46	10.77%	9.51
5	UPPCL	Uttar Pradesh	6.03	7.67%	10.00
6	BRPL	Delhi	3.18	4.04%	10.00
7	APCPDCL	Andhra Pradesh	2.70	3.43%	9.59
8	RUVNL	Rajasthan	1.64	2.09%	10.00
9	Adani Electricity Mumbai Limited	Maharashtra	1.46	1.86%	10.00
10	Vedanta Ltd SEZ Unit Jharsuguda	Odisha	1.11	1.41%	3.89

Note: Total Volume transacted in the Day Ahead Market of PXIL was about 78.57 MU.

Table-26(b): Major Buyer of Electricity in the Real Time Market of PXIL, 2023-24

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in PXIL	Weighted Average Buy Price (₹/kWh)
1	UPPCL	Uttar Pradesh	23.41	84.67%	10.00
2	WBSEDCL	West Bengal	2.00	7.22%	10.00
3	Vedanta Ltd SEZ Unit Jharsuguda	Odisha	0.47	1.70%	10.00
4	DNH&DD PDCL	Daman & Diu - Dadra And Nagar Haveli	0.45	1.62%	10.00
5	BSPHCL	Bihar	0.40	1.45%	10.00
6	BRPL	Delhi	0.25	0.90%	10.00
7	GUVNL	Gujarat	0.19	0.67%	10.00
8	JBVNL	Jharkhand	0.17	0.60%	10.00
9	BALCO	Chhattisgarh	0.16	0.59%	10.00
10	Adani Electricity Mumbai Ltd.	Maharashtra	0.08	0.27%	10.00

Note: Total Volume transacted through Real Time Market in PXIL was about 27.64 MU.

Table-26(c): Major Buyers of Electricity in High Price Day Ahead Market of PXIL, 2023-24

Sr. No	Name of the Buyer	State/Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in PXIL	Weighted Average Buy Price (₹/kWh)
1	TANGEDCO	Tamil Nadu	6.86	88.35%	16.48
2	WBSEDCL	West Bengal	0.91	11.65%	15.00
Note: Total Volume transacted through High Price Day Ahead Market in PXIL was about 7.77 MU.					

From Table-26(a), it can be observed that the weighted average prices of electricity for major buyers such as WBSEDCL, HPPC, UPPCL, BRPL, RUVNL and Adani Electricity Mumbai Ltd. in the Day Ahead Market of PXIL were higher than the weighted average price of the electricity transacted through the entire Day Ahead market of PXIL (₹9.71/kWh). In case of RTM in PXIL, there were few transactions during 2023-24, and the weighted average price of electricity for major buyers was same as compared to the weighted average price of the electricity transacted through the entire real-time market of PXIL (₹10.00/kWh) as may be seen in Table-26(b). In case of HP-DAM {Table 26(c)} there were only two buyers (TANGEDO and WBSEDCL) and the weighted average price of the electricity transacted through these buyers was similar to the weighted average price of the electricity transacted through the entire HP-DAM market of PXIL (₹16.31/kWh).

Table-27(a): Major Sellers of Electricity in Day Ahead Market of HPX, 2023-24

S. No	Name of the Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of total volume transacted in HPX	Weighted Average Sell Price (₹/kWh)
1	MB Power Ltd.	Madhya Pradesh	23.75	30.27%	10.00
2	Adani Raipur TPP	Chhattisgarh	12.30	15.68%	10.00
3	Shree Cement Limited TPS	Rajasthan	10.18	12.97%	10.00
4	Adani Raigarh TPP	Chhattisgarh	8.77	11.18%	10.00
5	JITPL	Odisha	4.75	6.06%	10.00
6	GMR Warora Energy Ltd.	Maharashtra	4.59	5.85%	10.00
7	Shree Cement Limited CPP	Rajasthan	3.53	4.50%	10.00
8	GUVNL	Gujarat	3.33	4.24%	10.00
9	Mahan Energen Ltd.	Madhya Pradesh	3.04	3.88%	10.00
10	Adani Power Ltd-Stage-3 (U-9)	Gujarat	3.03	3.86%	10.00
Note: Total Volume transacted in the Day Ahead Market of HPX was about 78.46 MU.					

Table-27(b): Major Sellers of Electricity in the Real Time Market of HPX, 2023-24

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the Total Volume Transacted in HPX	Weighted Average Sell Price (₹/kWh)
1	DGEN MEGA Power Project	Gujarat	8.19	32.10%	10.00
2	GUVNL	Gujarat	7.78	30.47%	9.78
3	Torrent Power 1147.5 MW SUGEN CCPP Kamrej	Gujarat	4.35	17.03%	10.00
4	GMR Bajoli Holi Hydropower Pvt. Ltd.	Himachal Pradesh	2.13	8.34%	10.00
5	HPPC	Haryana	1.72	6.76%	10.00
6	Torrent Power 382.5 MW UNOSUGEN Kamrej	Gujarat	0.48	1.88%	10.00
7	BALCO	Chhattisgarh	0.33	1.27%	10.00
8	Adani Power Ltd-Stage-3 (U-9)	Gujarat	0.24	0.94%	7.00
9	JPL Simhapuri	Andhra Pradesh	0.11	0.42%	10.00
10	Dikchu HEP	Sikkim	0.11	0.42%	10.00

Note: Total Volume transacted through Real Time Market in HPX was 25.52 MU.

Table-28(a): Major Buyers of Electricity in Day Ahead Market of HPX, 2023-24

Sr. No	Name of the Buyer	State/Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in HPX	Weighted Average Buy Price (₹/kWh)
1	WBSEDCL	West Bengal	28.88	36.80%	10.00
2	Adani Electricity Mumbai Limited	Maharashtra	15.61	19.89%	10.00
3	BRPL	Delhi	13.98	17.82%	10.00
4	MPPMCL	Madhya Pradesh	4.62	5.89%	10.00
5	HPPC	Haryana	3.80	4.84%	10.00
6	NPCL	Uttar Pradesh	3.47	4.42%	10.00
7	Vedanta Ltd SEZ Unit Jharsuguda	Odisha	3.24	4.13%	10.00
8	KSEB	Kerala	2.05	2.61%	10.00
9	BALCO	Chhattisgarh	1.20	1.52%	10.00
10	Arcelor Mittal Nippon Steel India Ltd (AMNSIL)	Gujarat	0.70	0.89%	10.00

Note: Total Volume transacted in the Day Ahead Market of HPX was about 78.46 MU.

Table-28(b): Major Buyer of Electricity in the Real Time Market of HPX, 2023-24

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the Total Volume Transacted in HPX	Weighted Average Buy Price (₹/kWh)
1	UPPCL	Uttar Pradesh	19.14	75.01%	9.91
2	Adani Electricity Mumbai Ltd.	Maharashtra	4.83	18.92%	10.00
3	BRPL	Delhi	0.62	2.42%	10.00
4	TANGEDCO	Tamil Nadu	0.60	2.36%	8.81
5	WBSEDCL	West Bengal	0.33	1.27%	10.00
6	NDMC	Delhi	0.01	0.02%	10.00

Note: Total Volume transacted through Real Time Market in HPX was about 25.52 MU.

From Table-28(a), it can be observed that the weighted average prices of electricity for all major buyers was same as compared to the weighted average price of the electricity transacted through the entire day-ahead market of HPX (₹10.00/kWh). Similarly, in case of RTM, due to limited transactions, the weighted average prices of electricity for major buyers was similar as compared to the weighted average price of the electricity transacted through the entire real-time market of HPX (₹9.91/kWh).

As can be observed from the above analysis of the top buyers and sellers, the dominant sellers, both at the power exchanges and traders, are a mixed group comprising of independent power producers, distribution companies and state government agencies. The major buyers from traders and at the power exchanges are mostly state distribution companies and industrial consumers.

9. Effect of Congestion on the Volume of Electricity Transacted through Power Exchanges

The volume of electricity transacted through power exchanges is sometimes constrained due to transmission congestion. Details of congestion in the power exchanges are given in Table-29 and Table-30.

The effect of congestion on the volume of electricity transacted through power exchanges from 2009-10 to 2023-24 is shown in Table-29. The unconstrained cleared volume and actual volume transacted increased from 8.10 BU and 7.09 BU, respectively, in 2009-10 to 86.35 BU and 86.26 BU, respectively, in 2023-24. The volume of electricity that could not be cleared (the difference between unconstrained cleared volume and actual volume transacted) as % to unconstrained cleared volume varied between 3.7% to 17% during the period from 2009-10 to 2016-17, after which it was less than 1%. Congestion for the volume of electricity transacted through power exchanges has reduced to a great extent since grid integration (integration of NEW Grid and SR Grid) in December 2013, which resulted in a declining trend in the volume of electricity that could not be cleared as a percentage to unconstrained cleared volume in the power exchanges from 2013-14 onwards. From 2017-18 onwards, the volume of

electricity that could not be cleared as % to unconstrained cleared volume has been consistently less than 1%, which shows that the congestion remained insignificant.

Table-29: Effect of Congestion on the Volume of Electricity Transacted through Power Exchanges, 2009-10 to 2023-24

Year	Unconstrained Cleared Volume (BU)	Actual Cleared Volume and hence scheduled * (BU)	Volume of electricity that could not be cleared due to congestion (BU)	Volume of electricity that could not be cleared as % to Unconstrained Cleared Volume
2009-10	8.10	7.09	1.01	12.0%
2010-11	14.26	13.54	0.72	5.0%
2011-12	17.08	14.83	2.26	13.0%
2012-13	27.67	23.02	4.65	17.0%
2013-14	35.62	30.03	5.59	16.0%
2014-15	31.61	28.46	3.14	9.9%
2015-16	36.36	34.20	2.16	5.9%
2016-17	41.60	40.08	1.52	3.7%
2017-18	45.86	45.65	0.21	0.5%
2018-19	50.69	50.22	0.47	0.9%
2019-20	49.36	49.16	0.20	0.4%
2020-21	70.13	70.09	0.04	0.06%
2021-22	86.09	86.01	0.06	0.09%
2022-23	79.39	79.37	0.02	0.02%
2023-24	86.35	86.26	0.08	0.10%

** This is the power finally scheduled after factoring in congestion and/or other reasons for not scheduling, like real-time curtailment, etc.*

Source: Power Exchanges & NLDC

During 2023-24, in IEX, the unconstrained cleared volume and the actual volume transacted were 53.453 BU and 53.389 BU, respectively, in the DAM segment (Table-30), and 2.502 BU and 2.499 BU, respectively, in the GDAM segment. In case of RTM at IEX, the unconstrained cleared volume and the actual volume transacted was 30.140 BU and 30.125 BU, respectively. Therefore, the actual transacted volume was 0.12% lesser than the unconstrained volume in DAM, 0.10% in GDAM and 0.05% less than the unconstrained cleared volume in the RTM segment of IEX. There was no congestion in HP-DAM at IEX.

During 2023-24, in PXIL, the unconstrained cleared volume and the actual volume transacted were 0.02765 BU and 0.02764 BU, respectively, in the RTM segment (Table-30). Therefore, the actual transacted volume was 0.01% less than the

unconstrained volume in RTM at PXIL. There was no congestion in DAM and HP-DAM segment at PXIL, and there was no trade in G-DAM at PXIL. In case of HPX, there was no congestion in DAM and RTM, and no transactions in GDAM and HP-DAM during the period.

Table-30: Details of Congestion in Power Exchanges, 2023-24

	Items	IEX				PXIL				HPX				Total
		DAM	GDAM	HP-DAM	RTM	DAM	GDAM	HP-DAM	RTM	DAM	GDAM	HP-DAM	RTM	
A	Unconstrained Cleared Volume (BU)	53.453	2.502	0.032	30.140	0.079	0.000	0.008	0.02765	0.078	0.000	0.000	0.026	86.35
B	Actual Cleared Volume and hence scheduled* (BU)	53.389	2.499	0.032	30.125	0.079	0.000	0.008	0.02764	0.078	0.000	0.000	0.026	86.26
C	Volume of electricity that could not be cleared and hence not scheduled because of congestion (BU)	0.064	0.002	0.000	0.016	0.000	0.000	0.000	0.00000	0.000	0.000	0.000	0.000	0.08
D	Volume of electricity that could not be cleared as % to Unconstrained Cleared Volume	0.12%	0.10%	0.00%	0.05%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.10%

** This is the power finally scheduled after factoring in congestion and/or other reasons like real time curtailment, increase in volume due to combination of OCF Option & market splitting etc.*

Source: Power Exchanges & NLDC

Transmission congestion, consequent market splitting and the resultant difference in market prices in different regions give rise to congestion charges. The annual congestion charges of all the power exchanges for the period from 2008-09 to 2023-24 are provided in Table-31.

Table-31: Congestion Charges of Power Exchanges, 2008-09 to 2023-24

Year	Congestion Charges of IEX (₹ Crore)	Congestion Charges of PXIL (₹ Crore)	Congestion Charges of HPX (₹ Crore)	Total (₹ Crore)
2008-09	5.27	0.00	-	5.27
2009-10	255.40	22.39	-	277.79
2010-11	273.14	86.60	-	359.74
2011-12	419.13	65.62	-	484.75
2012-13	417.37	35.93	-	453.30
2013-14	387.23	5.10	-	392.33
2014-15	502.41	1.64	-	504.05
2015-16	214.08	0.14	-	214.22
2016-17	305.99	0.18	-	306.17
2017-18	56.56	0.003	-	56.56
2018-19	137.52	0.00	-	137.52
2019-20	55.65	0.00	-	55.65
2020-21	70.95	0.004	-	70.95
2021-22	23.35	0.001	-	23.36
2022-23	16.57	0.01	0.00	16.58
2023-24	25.20	0.00	0.00	25.20

Source: NLDC

10. Ancillary Services Operations

10.1 Background

Ancillary Services is one of the four essential pillars of Electricity Market design, viz., Scheduling and Despatch, Imbalance Settlement, Congestion Management and Ancillary Services. Ancillary Services are support services to maintain power system reliability and support its primary function of delivering energy to customers. These are deployed by the system operator over various timeframes to maintain the required instantaneous and continuous balance between aggregate generation and load. Ancillary Services consist of services required for (a) maintaining load-generation balance (frequency control), (b) maintaining voltage and reactive power support, and (c) maintaining generation and transmission reserves. Historically, ancillary services were provided by the vertically integrated utilities along with the energy supply services. With the unbundling of vertically integrated utilities and increasing private sector participation and competition introduced in the energy markets, there is an increasing need for administering such services so as to ensure reliable and secure grid operation. Ancillary Services are broadly classified as follows:

(i) **Frequency Control Ancillary Services (FCAS)**: Three levels of Frequency Control are generally used to maintain the balance between generation and load, i.e., Primary Frequency Control, Secondary Frequency Control and Tertiary Frequency Control. These three levels differ as per their time of response to a fluctuation and the methodology adopted to realize the fundamental operating philosophy of maintaining reliability and economy.

(ii) **Network Control Ancillary Services (NCAS)**: This can be further subdivided into Voltage Control Ancillary Service and Power Flow Control Ancillary Services.

(iii) **System Restart Ancillary Services (SRAS)**: It is used to restore the system after a full or partial blackout. Black start is vital and inexpensive service. The costs involved are primarily the capital cost of the equipment used to start the unit, the cost of the operators, the routine maintenance and testing of equipment and the cost of fuel when the service is required. At present this is a mandatory service.

10.2 Regulatory Framework of Ancillary Services

Ancillary Services are defined, under Regulation (2)(1)(b) of the CERC (Indian Electricity Grid Code), Regulations, 2010 (IEGC), as follows: *"…in relation to power system (or grid) operation, the services necessary to support the power system (or grid) operation in maintaining power quality, reliability and security of the grid, e.g. active power support for load following, reactive power support, black start, etc;…*"

The Commission notified the CERC (Ancillary Services Operations) Regulations on 13th August 2015. The objective of Reserves Regulation Ancillary Services (RRAS) is to restore the frequency level at the desired level and to relieve the congestion in the transmission network. Specifically, these regulations are the first step towards introducing Ancillary Services in the country that will enable the grid operator to ensure reliability and stability in the grid. The RRAS shall support both "Regulation Up" service (that provides capacity by responding to signals or instructions of the Nodal Agency to increase generation) and "Regulation Down" service (that provides capacity by responding to signals or instruction of the Nodal Agency to decrease generation).

The detailed procedures were laid out on the 08th March 2016, and Ancillary Services were implemented by the Nodal Agency, i.e., NLDC, in coordination with RLDCs from 12th April, 2016.

The existing framework of Ancillary Services predominantly utilises thermal power stations, which have ramping limitations, and as such, there is a need for a fast-response ancillary service. The fast response reserves become all the more essential in view of the increasing penetration of intermittent renewable energy sources. The present administered mechanism of RRAS cannot accommodate such resources, especially the new and emerging technologies/ resources like energy storage and demand side response. Given the changes in technology, generation mix and, increasing decentralized generation, and location-specific requirements for ancillary services, the Commission felt the need for a comprehensive framework of Ancillary Services and notified the CERC (Ancillary Services) Regulations, 2022, on 31st January 2022.

These regulations aim to provide mechanisms for procurement, through administered as well as market-based mechanisms, deployment and payment of Ancillary Services at the regional and national level for maintaining the grid frequency close to 50 Hz and restoring the grid frequency within the allowable band as specified in the India Electricity Grid Code (IEGC) and for relieving congestion in the transmission network, to ensure smooth operation of the power system and safety and security of the grid.

The Commission has recognised the following types of Ancillary Services:

(a) Primary Reserve Ancillary Service (PRAS);
(b) Secondary Reserve Ancillary Service (SRAS);
(c) Tertiary Reserve Ancillary Service (TRAS); and
(d) Such other Ancillary Services as specified in the Grid Code

The Ancillary Services Regulations, 2022 cover SRAS and TRAS and stipulate that PRAS and other Ancillary Services shall be governed by the Grid Code or as specified separately by the Commission.

The SRAS is proposed to be procured through an administered mechanism to start with. However, there is an enabling provision for market-based procurement of SRAS, the framework for which can be specified separately. The regulations seek to reward fast-ramping resources in the SRAS segment. The TRAS is proposed to be procured through a market-based mechanism. A separate Ancillary Service product is to be introduced in the existing Day Ahead Market and Real Time Market. For TRAS-Up, the principle of uniform market clearing price (MCP) shall be adopted. However, for TRAS-Down, the pay-as-you-bid mechanism has been adopted. TRAS-Up cleared but not despatched would be given commitment charge at 10 percent of the MCP for TRAS-Up subject to the ceiling of 20 paise/kWh.

As per the notification dated 31st October 2022, it was decided that all the provisions of the Central Electricity Regulatory Commission (Ancillary Services) Regulations, 2022, except those mentioned below, shall come into effect from 05.12.2022.

The following provisions shall come into force from the date to be separately notified by the Commission:

i. Provisions pertaining to TRAS under Regulation 6;
ii. Regulations 14 to 19;
iii. Provisions pertaining to TRAS in Regulations 20 to 22
iv. Regulations 26.

Post notification, the CERC (Ancillary Services) Regulations, 2022 were made effective in a phased manner. The provisions regarding the SRAS were made effective from 05.12.2022 and the TRAS become effective from 01.06.2023.

As provided under the new Regulations, NLDC notified the Detailed Procedure for Secondary Reserve Ancillary Services (SRAS) in December, 2022 and the Detailed Procedure for Tertiary Reserve Ancillary Services (TRAS) in April, 2023. The nodal agency estimates the required quantum for SRAS and TRAS for such period as specified in the Grid Code.

With the coming into effect of the provisions relating to TRAS, the RRAS Regulations 2015, along with related Detailed Procedures for RRAS, ceased to be in operation. The Commission, vide Order dated 28.04.2023 in Petition No. 81/RC/2023, 82/MP/2023 and 88/RC/2023, accorded approval for introduction of TRAS market segment on all the three Power Exchanges.

Regulation 17(5) of the AS Regulations 2022 provides that "*The Commission may, if considered necessary, provide for a price cap for TRAS*". The Commission considering it important that price caps in energy and ancillary market be harmonized to avoid the possible arbitrage opportunities, vide the above referred Order directed that the bids placed under TRAS shall be subject to the same price caps as applicable for energy segment. The TRAS providers which are otherwise eligible for participation in HP-DAM shall, for the purposes of their bids in TRAS-DAM or TRAS-RTM or both, be subject to the price cap as applicable for HP-DAM. Other TRAS providers shall be subject to the price cap as applicable to market segments other than HP-DAM.

Regulation 20 of the CERC Ancillary Services Regulation 2022 authorizes NLDC, being the Nodal Agency, for procurement of Ancillary Services in case of shortfall in procurement of SRAS & TRAS and in emergency conditions. Under the shortfall condition, NLDC is enabled to use URS available in the generating stations whose tariffs are determined by the Commission under Section 62 of the Act. During the emergency condition NLDC can use any generating station irrespective of whether it is covered under Section 62 or Section 63 or otherwise.

The generating stations whose URS is despatched for TRAS-Up, in the event of short-fall in procurement of TRAS-Up through the Market, shall be paid at the rate of 110% of their energy charges for the quantum of TRAS-Up despatched. The generating stations despatched for TRAS-Down, in the event of short-fall in procurement of TRAS-Down through the Market, shall pay back at the rate of 90% of their energy charges, corresponding to the quantum of TRAS-Down despatched.

The Commission in view of the prevailing power supply situation in the country and considering it necessary to facilitate the availability of adequate reserves with the

system operator during the shortfall conditions, issued Order dated 31.05.2023 in Petition No. 7/SM/2023 to expand the scope of operation. Following directions were given, which came into effect from 01.06.2023 and shall remain in force until further orders of the Commission or until appropriate provisions are made in the Ancillary Services Regulations, 2022, whichever is earlier:

a. In case of shortfall conditions, in addition to the generating stations whose tariffs are determined by the Commission under Section 62 of the Act, (i) the regional generating stations other than those whose tariffs are determined by the Commission under Section 62 of the Act, (ii) the state generating stations whose tariffs are determined or adopted by the State Commission and (iii) the generating stations mandated by the Central Government whose tariffs are discovered through a competitive bidding process, shall be eligible to make themselves available for use by the Nodal Agency by declaring their compensation charge in advance to the Nodal Agency.

b. The Nodal Agency shall prepare the merit order stack of all generating stations available under shortfall conditions for economic dispatch of Ancillary Services.

c. Such generating stations shall pay or be paid, as the case may be, for the corresponding quantum of dispatch under shortfall conditions on similar lines as applicable for the generating stations whose tariffs are determined by the Commission under Section 62 of the Act, as specified in Regulation 20 by considering their compensation charge as energy charge.

10.3 RRAS/ TRAS Instructions issued by Nodal Agency

Table-32 provides month-wise details on maximum power despatched and maximum power regulated in a time block based on the instructions issued. The provisions regarding the TRAS become effective from 01.06.2023. It can be observed from the table that during the year 2023-24 in a time block, maximum power despatched was 4076 MW in May 2023, while the maximum power regulated was 9000 MW in November 2023.

Table 32: Maximum Ancillary (RRAS/ TRAS) despatched in a Time Block (MW), 2023-34

Month	Max regulation "UP"	Max regulation "DOWN"
RRAS		
Apr-23	3011	6500
May-23	4076	8174
TRAS		
Jun-23	3000	8000
Jul-23	3842	7000
Aug-23	4075	6147
Sep-23	3238	6500
Oct-23	3073	5342
Nov-23	4007	9000
Dec-23	4000	6500
Jan-24	2817	3500
Feb-24	2817	3500
Mar-24	2017	6759

Source: Grid-India Monthly Ancillary Services Reports

10.4 Accounting and Settlement

As per Regulation 21 of the CERC (Ancillary Services Operations) Regulations 2022, accounting of TRAS shall be done by the Regional Power Committee on a weekly basis, based on interface meter data and schedules. Regulation 21(4)(c) provides that the Deviation and Ancillary Service Pool Account shall be charged for the full cost towards TRAS-Up including the charges for the quantum cleared and despatched and the commitment charge for the quantum cleared but not despatched. Further, Regulation 21(5)(b) provides that the Deviation and Ancillary Service Pool Account shall receive credits for payments made by TRAS Provider for the TRAS-Down despatched.

Details of energy scheduled and payment for RRAS (up to May 2023) are given in Table-33. Table-34(a) and 34(b) provides details of energy scheduled and payments for TRAS under market and under shortfall/emergency, respectively in 2023-24 (June onwards).

Table 33: Energy Scheduled and Payments made for RRAS, 2016-17 to 2023-24

Year	Energy scheduled (MU)		Payments for RRAS (₹ Crore)	
RRAS	**Regulation UP**	**Regulation DOWN**	**To RRAS provider(s) from DSM pool for Regulation UP**	**By RRAS provider(s) to DSM pool for Regulation DOWN**
2016-17	2212.28	286.00	939.78	42.39
2017-18	4149.25	243.72	2011.47	43.60

2018-19	4811.69	685.42	2810.73	140.83
2019-20	2435.01	1941.31	1333.36	398.40
2020-21	1649.50	2940.01	713.15	610.69
2021-22	2778.22	5353.44	1952.23	1230.65
2022-23	4153.26	4532.77	5378.59	1344.81
2023-24 (Apr-23 & May-23)	522.56	2132.41	628.03	655.63

Source: Grid-India Monthly Ancillary Services Reports

Table 34(a): Energy Scheduled and Payments for TRAS under Market, 2023-24

Year	TRAS-Up Cleared (MU)		TRAS-Up Scheduled (MU)		TRAS-Down Scheduled (MU)		Net Charges (₹ Crore)
	Day Ahead AS Market	Real Time AS Market	Day Ahead AS Market	Real Time AS Market	Day Ahead AS Market	Real Time AS Market	
2023-24 (Jun-23 onwards)	35.05	45.55	30.87	16.27	2.97	0.06	85.45

Source: Grid-India Monthly Ancillary Services Reports

Table 34(b): Energy Scheduled and Payments for TRAS under Shortfall/ Emergency, 2023-24

Year	Energy scheduled (MU)		Payments made for Ancillary Services (₹ Crore)	
TRAS	Shortfall/ Emergency TRAS-UP	Shortfall/ Emergency TRAS-DOWN	Total Charges/ Compensation Charges for Shortfall/ Emergency TRAS-UP	Total Charges/ Compensation Charges for Shortfall/ Emergency TRAS-DOWN
2023-24 (Jun-23 onwards)	5132.43	8302.36	5055.43	2537.27

Source: Grid-India Monthly Ancillary Services Reports

***