Report on Short-Term Power Market in India: 2024-25



Economics Division
Central Electricity Regulatory Commission

Report on
Short-Term Power Market in India
2024-25



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Preface

The Electricity Act 2003 consolidates the laws relating to the generation, transmission, distribution, trading, and use of electricity and generally for taking measures conducive to the development of electricity industry, promoting competition therein, protecting the interest of consumers and supply of electricity to all areas, rationalization of electricity tariff, ensuring transparent policies, etc. This is further strengthened by the regulatory initiatives of the Electricity Regulatory Commissions through various regulations and orders required to enable a framework for a robust and healthy power market in the country.

The Central Electricity Regulatory Commission sets the regulatory process in motion through Trading License Regulations, General Network Access Regulations, Power Market Regulations, REC Regulations, Deviation Settlement Mechanism Regulations, Ancillary Services Regulations, and Cross Border Trade of Electricity Regulations. Under these regulations, the short-term power market covers contracts of less than a year for electricity transacted through Inter-State Trading Licensees, directly between entities, and through Power Exchanges. The short-term power market and Deviation Settlement Mechanism, as an integral part of the power sector, has been beneficial for meeting the short-term needs of consumers, suppliers, and the sector as a whole. In 2024-25, the short-term market constituted about 13.03% per cent of the total electricity generation in India.

The annual report on the short-term power market in India provides a snapshot of short-term transactions of electricity through different instruments used by various market participants. The Central Electricity Regulatory Commission brings out this report with the objective of keeping market participants and other stakeholders aware and updated on the state of the power market in the country. The dissemination of information through the report is one of the key elements to ensure efficiency and competition in the sector and for stakeholders and consumers to maintain faith in the system. This report covers an overview of the power sector, trends in short-term transactions of electricity on annual, monthly, and daily basis, time of the day variation

in volume and price of electricity, trading margin for bilateral transactions, analysis of transactions carried out by various types of participants with emphasis on open access consumers on power exchanges, effect of congestion on volume of electricity traded on power exchanges, and ancillary services operations. The report also covers cross border trade of electricity between India and its neighbouring countries and analysis on transactions of Renewable Energy Certificates.

In order to ensure ease of access, this report is also made available on the CERC website www.cercind.gov.in. We are hopeful that market participants and stakeholders will find the Report on Short-term Power Market in India, 2024-25 useful.

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Abbreviations

Abbreviation	Expanded Version
AC	Alternating Current
ACP	Area Clearing Price
ACS	Average Cost of Supply
ADSS	Any Day Single Sided Contract
AMNSIL	Arcelor Mittal Nippon Steel India Ltd
APCPDCL	Andhra Pradesh Central Power Distribution Company Limited
APDCL	Assam Power Distribution Company Ltd
APL	Above Poverty Line
APTEL	Appellate Tribunal for Electricity
ARR	Average Revenue Realized
AT&C	Aggregate Technical and Commercial
BESS	Battery Energy Storage Systems
BEST	Brihanmumbai Electricity Supply and Transport
Block	15 Minutes Time Block
BSPHCL	Bihar State Power Holding Company Limited
BU	Billion Units (Billion kWh)
CAGR	Compound Annual Growth Rate
CBTE	Cross Border Trade of Electricity
CCPP	Combined Cycle Power Plant
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CGS	Central Generating Station
Ckm	Circuit km
COD	Commercial Operation Date
COP	Conference of the Parties
CPP	Captive Power Producer/Plant
CSPDCL	Chhattisgarh State Power Distribution Company Limited
CTU	Central Transmission Utility
DAC	Day Ahead Contingency
DAM	Day Ahead Market
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
DISCOMs	Distribution Companies
DSM	Deviation Settlement Mechanism
DVC	Damodar Valley Corporation
ER	Eastern Region
FCAS	Frequency Control Ancillary Services
FRAS	Fast Response Ancillary Services

Abbreviation	Expanded Version
G-DAC	Green Day Ahead Contract
G-DAM	Green Day Ahead Market
GNA	General Network Access
GPP	Gas Power Plant
GPS	Gas Power Station
GRIDCO	GRIDCO Limited
G-TAM	Green Term Ahead Market
GUVNL	Gujarat Urja Vikas Nigam Limited
GW	Giga Watts
HHI	Herfindahl-Hirschman Index
HP-DAM	High Price Day Ahead Market
HP-TAM	High Price Term Ahead Market
HPO	Hydro Purchase Obligation
HPP	Hydroelectric Power Plant
HPPC	Haryana Power Purchase Centre
HPS	Hydro Power Station
HPX	Hindustan Power Exchange Ltd.
HVDC	High-Voltage Direct Current
ID	Intra Day
IDAM	Integrated Day Ahead Market
IEA	International Energy Agency
IEGC	Indian Electricity Grid Code
IEX	Indian Energy Exchange
IPDS	Integrated Power Development Scheme
IPP	Independent Power Producers
ISGS	Inter State Generating Station
ISTS	Inter State Transmission System
IT	Information Technology
JBVNL	Jharkhand Bijli Vitran Nigam Limited
JKPCL	Jammu Kashmir Power Corporation Ltd.
KSEB	Kerala State Electricity Board
KSEBL	Kerala State Electricity Board Ltd
kV	Kilovolt
kWh	Kilo Watt Hour
LTA	Long Term Access
Ltd.	Limited
MCP	Market Clearing Price
MMC	Market Monitoring Cell
MNRE	Ministry of New and Renewable Energy

Abbreviation	Expanded Version
MOP	Ministry of Power
MP	Miscellaneous Petition
MPDCL	Meghalaya Power Distribution Corporation Limited
MPP	Merchant Power Plant
MPPMCL	MP Power Management Company Limited
MSEDCL	Maharashtra State Electricity Distribution Co. Ltd.
MU	Million Units
MVA	Mega Volt Ampere
MW	Mega Watts
MWh	Mega Watt Hour
N1	Northern Region 1
N2	Northern Region 2
N3	Northern Region 3
NCAS	Network Control Ancillary Services
NER	North Eastern Region
NEW Grid	North East West Grid
NLDC	National Load Dispatch Centre
NR	Northern Region
NRSS	Northern Region Strengthening Scheme
NSGM	National Smart Grid Mission
NTPC	National Thermal Power Corporation
NTSD	Non Transferable Specific Delivery
OA	Open Access
OAC	Open Access Consumer
OTP	Other than RTC and Peak period
PCKL	Power Company of Karnataka Limited
PDCL	Power Distribution Corporation Limited
PFC	Power Finance Corporation
PGCIL/POWERGRID	Power Grid Corporation of India Limited
POSOCO	Power System Operation Corporation Limited
PPA	Power Purchase Agreement
PRAS	Primary Reserve Ancillary Services
PSPCL	Punjab State Power Corporation Limited
PX	Power Exchange
PXIL	Power Exchange India Limited
RDSS	Revamped Distribution Sector Scheme
RC	Regulatory Compliance
RE	Renewable Energy
REC	Renewable Energy Certificate

Abbreviation	Expanded Version
RES	Renewable Energy Sources
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RLDC	Regional Load Despatch Centre
RLNG	Regasified Liquefied Natural Gas
RPO	Renewable Purchase Obligation
RRAS	Reserves Regulation Ancillary Services
RTC	Round the Clock
RTM	Real-Time Market
RUVNL	Rajasthan Urja Vikas Nigam Limited
RUVSL	Rajasthan Urja Vikas and IT Services Limited
S1	Southern Region 1
S2	Southern Region 2
S3	Southern Region 3
SR	Southern Region
SAARC	South Asian Association for Regional Cooperation
SBPDCL	South Bihar Power Distribution Company Ltd
SEB	State Electricity Board
SEBI	Securities & Exchange Board of India
SHP	Small Hydro Power
SM	Suo-Motu
SPCL	State power Corporation Limited
SRAS	Secondary Reserve Ancillary Services
SR Grid	Southern Region Grid
St	Stage
STPP	Super Thermal Power Plant
STPS	Super Thermal Power Station
TAM	Term Ahead Market
TANGEDCO	Tamil Nadu Generation and Distribution Corporation
T-GNA	Temporary General Network Access
TPP	Thermal Power Plant
TPS	Thermal Power Station
TRAS	Tertiary Reserve Ancillary Services
TSSPDCL	Telangana Southern Power Distribution Company Limited
UDAY	Ujwal DISCOM Assurance Yojana
UPPCL	Uttar Pradesh Power Corporation Limited
UPCL	Uttarakhand Power Corporation Limited
URS	Un-requisitioned Surplus
W1	Western Region 1
W2	Western Region 2

Abbreviation	Expanded Version
W3	Western Region 3
WBSEDCL	West Bengal State Electricity Distribution Company Ltd
WR	Western Region
WRSS	Western Region Strengthening Scheme

Executive Summary

The 'Report on Short-term Power Market in India: 2024-25' provides a snapshot of the developments in the power sector, with a focus on short-term power transactions through different mechanisms by various market participants. The report broadly comprises four sections, viz., an overview of the power sector, trends in the short-term power market in India, cross-border trade of electricity and trading of renewable energy certificates.

The chapter on the Overview of the power sector discusses the year-wise trend in electricity generation, transmission and distribution, including the revenue gap of state electricity distribution companies (DISCOMs)/SEBs and the measures/reforms undertaken by the Ministry of Power in recent years. The salient features of the power sector, as discussed in the report, are as under:

1. Thermal energy (mainly from Coal) is an important source of electricity generation in India, contributing about 52.0% of the total installed generation capacity in 2024-25, followed by Renewable Energy Source (RES) (36.3%), Hydro (10.0%), and Nuclear (1.7%).

2. The Compound Annual Growth Rate (CAGR) of total installed generation capacity was 7.6% during the period from 2008-09 to 2024-25. The CAGR of RES was 17.4%, whereas it was 5.2% for all other sources combined during the period.

3. During the period from 2008-09 to 2024-25, the share of the State sector in the total installed generation capacity declined from 53.6% to 23.5%, and the share of the central sector declined from 30.9% to 22.4%, while the share of the private sector increased from 15.5% to 54.1%.

4. Gross electricity generation in India increased from 747.07 BU in 2008-09 to 1829.69 BU in 2024-25, and it increased at a CAGR of 5.8%.

5. The CAGR of gross electricity generation from 2008-09 to 2024-25 was low (5.8%) as compared to the CAGR of annual installed electricity generation capacity (7.6%).

6. An increase in the installed capacity resulted in a decrease in the shortage of electricity (both energy and peak shortage/deficit). The energy deficit decreased from 11.1% in 2008-09 to about 0.09% in 2024-25, whereas the peak deficit decreased from 11.9% to 0.001% during this period.

7. From 2008-09 to 2024-25, the transmission lines (AC&HVDC) grew at a CAGR of 5.2%, whereas the transformation capacity of substations (220 kV and above) grew at the rate of 10.1%.

8. The annual transmission charges increased at a CAGR of 13.67% during the period from 2011-12 to 2024-25.

9. The total electricity consumption increased from 611.29 BU in 2008-09 to 1543.0 BU in 2023-24 (estimated), registering a CAGR of 6.4%. During the period, per-capita consumption of electricity also increased from 734 kWh to 1395 kWh.

10. All India average cost of supply and average revenue (without subsidy) of state power utilities increased from ₹3.40/kWh and ₹2.63/kWh, respectively, in 2008-09 to ₹7.09/kWh and ₹5.54/kWh, respectively, in 2023-24. During the last five years, the revenue as a percentage of cost was varying between 77% and 80%, indicating that the weighted average tariff for all categories of consumers was about 20-23% lower than the weighted average cost of supply.

'Short-term transactions of electricity and DSM Volume' refers to contracts of less than one-year period for electricity transacted bilaterally through Inter-State Trading Licensees (only inter-state part) and directly between entities; through Power Exchanges {Indian Energy Exchange Ltd. (IEX), Power Exchange India Ltd. (PXIL) and Hindustan Power Exchange (HPX)}; and the volume under Deviation Settlement Mechanism (DSM). The analysis of the short-term power market & DSM volume includes (i) yearly/monthly/daily trends in short-term transactions of electricity and DSM; (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; and (vii) ancillary services operations. Major highlights of the short-term power market during 2024-25 are as under:

1. Of the total electricity generated in India in 2024-25, the short-term power market comprised about 13.03%. The balance 86.97% of generation was procured mainly by distribution companies through long-term contracts and short-term intra-state transactions.

2. During the period from 2009-10 to 2024-25, the volume of short-term transactions of electricity & DSM increased at a higher rate (CAGR of 8.9%) when compared with the gross electricity generation (CAGR of 5.8%).

3. In terms of volume, the size of the short-term market & DSM increased from 218.22 BU in 2023-24 to 238.35 BU in 2024-25, registering an annual growth of about 9.2%.

4. The volume of electricity transacted through short-term (i.e. excluding the volume of electricity transacted through DSM and direct bilateral transactions between the entities) was 170.0 BU in 2024-25. In monetary terms, the size of this short-term market was about ₹89681 crore in the year 2024-25[1].

5. The volume of electricity transacted through power exchanges increased at a CAGR of 22.1%, whereas the volume of electricity transacted through traders declined at a CAGR of -0.1% from 2009-10 to 2024-25.

6. The DSM volume as a percentage of the total volume of short-term transactions of electricity & DSM declined from 39.2% in 2009-10 to 13.49% in 2024-25.

[1] *excluding banking transactions*

7. The volume of electricity transacted through direct bilateral as a percentage of the total volume of short-term transactions of electricity & DSM increased from 9.4% in 2009-10 to 15.19% in 2024-25.

8. The weighted average price of electricity transacted through power exchanges was ₹4.93/kWh and through trading licensees it was ₹7.17/kWh in 2024-25. The corresponding values for the year 2023-24 were ₹5.82/kWh and ₹7.33/kWh, respectively.

9. DSM charge declined from ₹5.73/kWh in 2023-24 to ₹5.00/kWh in 2024-25.

10. During 2024-25, 4% of the volume of electricity transacted through traders was at a price less than ₹5/kWh and 94% of the volume was transacted through traders at less than ₹9/kWh.

11. In Day Ahead Market at IEX, during 2024-25, 79% of the volume of electricity was transacted at a price less than ₹5/kWh, while 88% of the volume was transacted at a price less than ₹9/kWh. In case of PXIL, 1% of the volume of electricity was transacted at a price less than ₹5/kWh and 5% of the volume was transacted at less than ₹9/kWh. In case of HPX, 4% of the volume of electricity was transacted at a price less than both ₹5/kWh and ₹9/kWh.

12. In Green Day Ahead Market at IEX, during 2024-25, 82% of the volume of electricity was transacted at a price less than ₹5/kWh, while about 92% of the volume was transacted at a price less than ₹9/kWh. At PXIL, 100% volume was transacted in G-DAM at a price less than ₹5/kWh. There was no trading of electricity in G-DAM at HPX.

13. In Real-Time Market at IEX, during 2024-25, 82% of the volume of electricity was transacted at a price less than ₹5/kWh while about 90% of the volume was transacted at a price less than ₹9/kWh. At PXIL and HPX, there was no volume transacted at price less than ₹5/kWh, however, about 3% and 1% of the volume was transacted at a price less than ₹9/kWh.

14. In High Price- Day Ahead Market at IEX, during 2024-25, 3% of the volume of electricity was transacted at a price less than ₹10/kWh, while about 82% of the volume was transacted at a price less than ₹15/kWh. In case of PXIL and HPX, there was no trade in HP-DAM segment.

15. During 2024-25, of the total electricity bought under bilateral transactions from traders, 86.4% was on round-the-clock (RTC) basis, followed by 11.7% in periods other than RTC and peak (OTP), and 1.9% was during peak hours. The per unit price of electricity procured during the Peak period was high (₹9.35/kWh) when compared with the price during RTC (₹7.01/kWh) and OTP (₹6.61/kWh).

16. It is observed from the block-wise and region-wise prices of electricity transacted through power exchanges in 2024-25, that the price of electricity in all the regions was almost similar in DAM, G-DAM and RTM at IEX, which is indicative of very few instances of congestion. There was no consistent trend in the price in different regions in DAM and RTM at PXIL and the same was mainly due to low liquidity.

17. From 2008-09 to 2024-25, the number of traders who were undertaking trading increased from 15 to 44. The Herfindahl-Hirschman Index (HHI), based on the volume of electricity transacted in the short-term through traders, increased from 0.1630 in 2008-09 to 0.1760 in 2024-25. The concentration of market power, in terms of the volume of electricity transacted through traders/trading licensees, was moderate in 2024-25.

18. The weighted average trading margin charged by the trading licensees in 2024-25 was ₹0.019/kWh, in line with the CERC Trading License Regulations, 2020.

19. In the power exchanges, Open Access industrial consumers bought 14.30 BU of electricity in collective transactions, which formed 13.2% of the total day ahead, green day ahead, high-price day ahead and real-time market volume transacted in the power exchanges during 2024-25.

20. During 2024-25, the weighted average price of electricity bought by open access consumers at IEX was (₹3.31/kWh and ₹3.17/kWh in DAM and RTM), which was lower as compared to the weighted average price of the total electricity transacted through IEX (₹4.26/kWh and ₹4.05/kWh in DAM and RTM). No open access consumers bought electricity though DAM and RTM at PXIL and HPX during 2024-25.

21. The year witnessed very few constraints on the volume of electricity transacted through power exchanges due to transmission congestion. During 2024-25, the actual transacted volume was about 0.48% less than the unconstrained volume. Due to a few instances of congestion and the splitting of the market, the congestion amount collected during the year was ₹155.51 crore.

22. During 2024-25, the energy scheduled under TRAS-Up through markets was 4.58 MU (including DAM-AS and RTM-AS), whereas energy scheduled under TRAS-Down through Markets was 20.37 MU (including DAM-AS and RTM-AS). Energy scheduled under TRAS-UP in shortfall/emergency was 5130.80 MU, while energy scheduled under TRAS-Down in shortfall/emergency was 10453.70 MU.

Salient features of the cross-border trade of electricity and renewable energy certificates transacted through power exchanges are as under:

1. India has been importing electricity from Bhutan and exporting electricity to Bangladesh, Nepal, and Myanmar. India was net importer of electricity from 2013-14 to 2015-16, and has been a net exporter of electricity from 2016-17 onwards. The Cross Border Electricity Trade in the Day Ahead Market of IEX was commenced in 2021-22. The trade with Nepal was commenced on 17.04.2021, whereas the trade with Bhutan was commenced on 01.01.2022. The Cross Border Trade in Real-Time Market of IEX commenced from October 2023.

2. During 2024-25, a total of 343.10 lakh RECs were transacted on the power exchanges and bilaterally through trading licensees. The categorization of RECs between solar and non-solar has been dispensed with, with the introduction of the concept of multiplier under the CERC (Terms and Conditions for Renewable

Energy Certificates for Renewable Energy Generation) Regulations 2022, w.e.f. 05.12.2022. These Regulations provides for the transactions of RECs through the trading licensees in addition to the transactions through power exchanges. A new contract, namely "REC", has been made available for trading of RECs by the power exchanges w.e.f. December 2022.

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Chapter-I
Overview of Power Sector

India's power sector is well diversified and evolving with changes in market dynamics. The demand for electricity in the country has increased rapidly and is expected to increase further in the years to come. In order to meet the increasing demand for electricity, the electricity supply chain has undergone a phase of transformation to competitiveness. This chapter provides an overview of the developments made in the electricity supply chain over the years and the new policy initiatives undertaken to address some of the key challenges faced by the power sector.

1. Electricity Generation

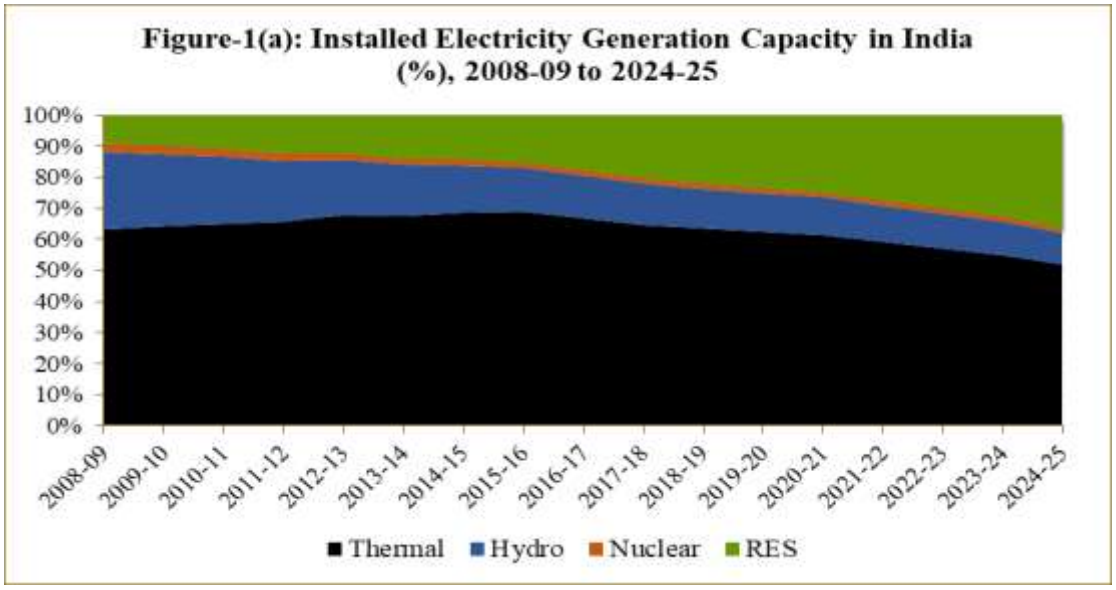
The sources of electricity generation in India can be broadly classified into conventional and non-conventional. The conventional sources of power generation are thermal (coal, lignite, natural gas, and oil), hydro and nuclear power, whereas non-conventional sources of power generation (renewable energy sources) include solar, wind, agricultural and domestic waste, etc. Table-1(a) and Figure-1(a) show the installed electricity generation capacity in India by different sources.

Table-1(a): Installed Electricity Generation Capacity in India (GW), 2008-09 to 2024-25

Year	Thermal	Hydro	Nuclear	RES*	Total
2008-09	93.73	36.88	4.12	13.24	147.97
2009-10	102.45	36.86	4.56	15.52	159.40
2010-11	112.82	37.57	4.78	18.45	173.63
2011-12	131.60	38.99	4.78	24.50	199.88
2012-13	151.53	39.49	4.78	27.54	223.34
2013-14	168.26	40.53	4.78	34.99	248.55
2014-15	188.90	41.27	5.78	38.96	274.90
2015-16	210.68	42.78	5.78	45.92	305.16
2016-17	218.33	44.48	6.78	57.24	326.83
2017-18	222.91	45.29	6.78	69.02	344.00
2018-19	226.28	45.40	6.78	77.64	356.10
2019-20	230.60	45.70	6.78	87.03	370.11
2020-21	234.73	46.21	6.78	94.43	382.15
2021-22	236.11	46.72	6.78	109.89	399.50

2022-23	237.27	46.85	6.78	125.16	416.06
2023-24	243.22	46.93	8.18	143.64	441.97
2024-25	246.94	47.73	8.18	172.37	475.21

Source: CEA, Growth of Electricity Sector in India, various issues.
** RES includes Small Hydro Project (≤ 25 MW)*



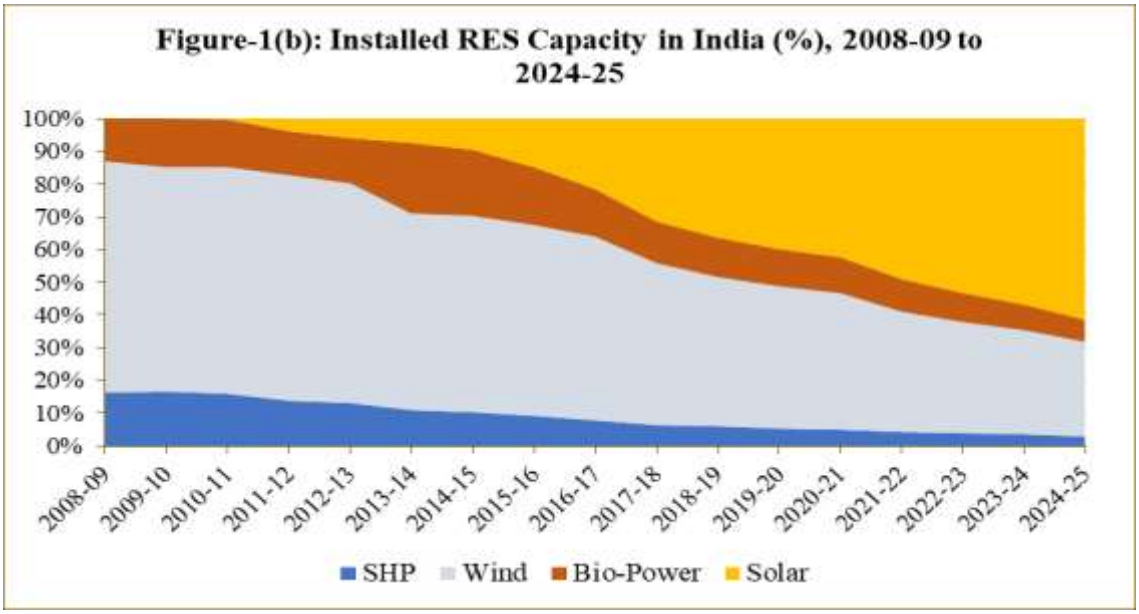
As can be observed from Figure-1(a), thermal is a major source of electricity generation in India, contributing 52.0% of the total capacity of generation in 2024-25, followed by renewable energy sources (RES) with 36.3%, hydro (10.0%) and nuclear (1.7%). While the share of thermal-based generation capacity in the total installed capacity gradually decreased from 63.3% in 2008-09 to 52.0% in 2024-25, the share of renewables-based generation capacity increased about four times, i.e., from 8.9% to 36.3% during this period. The CAGR of total installed electricity generation capacity was about 7.6% during the period, whereas it was 17.4% in RES and 5.2% in all other sources.

Table-1(b) shows the installed RES capacity from various sources, and Figure-1(b) shows the share of different sources in the installed RES capacity. As can be observed from the figure, solar constitutes about 61.3% of total RES capacity in India, followed by wind (29.0%), bio-power (6.7%) and small hydropower (3.0%) in 2024-25. The share of solar in the total RES installed capacity has increased considerably from less than 1% in 2008-09 to 61.3% in 2024-25.

Table-1(b): Installed RES Capacity in India (GW), 2008-09 to 2024-25

Year	SHP	Wind	Bio-Power	Solar	Total RES
2008-09	2.16	9.34	1.74	0.00	13.24
2009-10	2.60	10.65	2.26	0.01	15.52
2010-11	2.91	12.81	2.70	0.03	18.45
2011-12	3.41	16.90	3.26	0.94	24.50
2012-13	3.64	18.49	3.73	1.69	27.54
2013-14	3.80	21.04	7.51	2.63	34.99
2014-15	4.06	23.35	7.81	3.74	38.96
2015-16	4.27	26.78	8.11	6.76	45.92
2016-17	4.38	32.28	8.30	12.29	57.24
2017-18	4.49	34.05	8.84	21.65	69.02
2018-19	4.59	35.63	9.24	28.18	77.64
2019-20	4.68	37.69	10.02	34.63	87.03
2020-21	4.79	39.25	10.31	40.09	94.43
2021-22	4.85	40.36	10.68	54.00	109.89
2022-23	4.94	42.63	10.80	66.78	125.16
2023-24	5.00	45.89	10.94	81.81	143.64
2024-25	5.10	50.04	11.58	105.65	172.37

Source: CEA, Growth of Electricity Sector in India, various issues.



The Electricity Act of 2003 liberalised the process of electricity generation by shifting towards a license-free regime, which has resulted in increased competition in the generation segment with the share of private players witnessed a significant increase in total electricity generation.

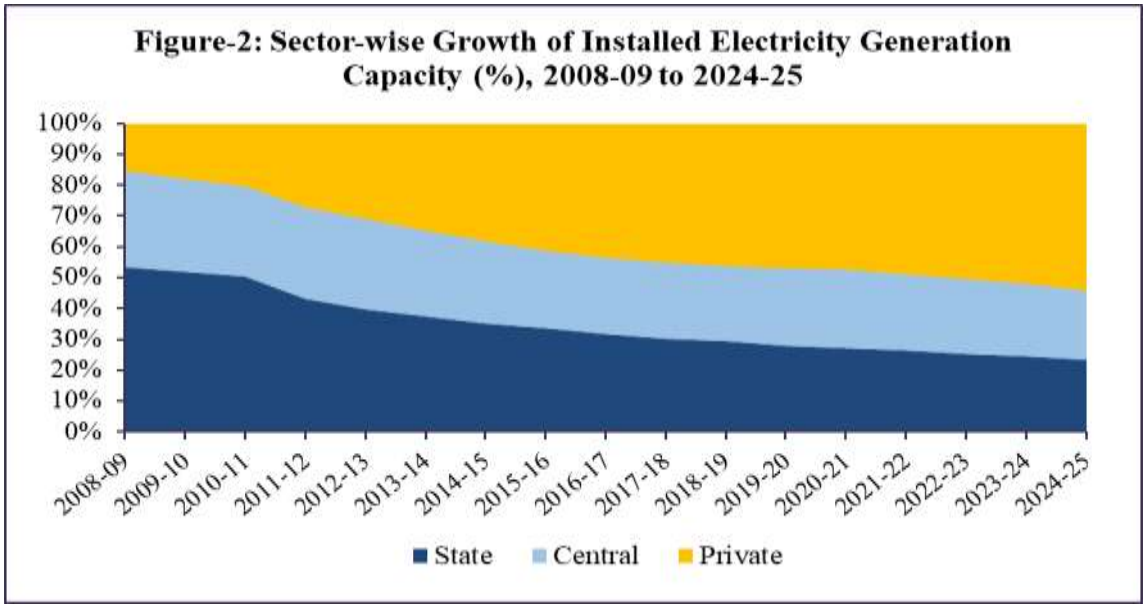
The players in the electricity generation segment can be divided into three types based on ownership and operations, i.e., (i) Central public sector undertakings, (ii) State public sector undertakings/State Electricity Boards, and (iii) Private sector companies.

The sector-wise growth of installed generation capacity is shown in Table-2 and Figure-2. The total installed generation capacity increased at a CAGR of 7.6% from 2008-09 to 2024-25. During this period, the share of the state sector in the total installed generation capacity declined from 53.6% to 23.5%, and the share of the central sector also declined from 30.9% to 22.4%, whereas the share of the private sector increased significantly from 15.5% to 54.1%.

Table-2: Sector-wise Growth of Installed Electricity Generation Capacity, 2008-09 to 2024-25

Year	Installed Generation Capacity (GW)			
	State	Central	Private	Total
2008-09	79.31	45.78	22.88	147.97
2009-10	82.91	47.48	29.01	159.40
2010-11	87.42	50.76	35.45	173.63
2011-12	85.92	59.68	54.28	199.88
2012-13	89.13	65.36	68.86	223.34
2013-14	92.27	68.13	84.87	245.26
2014-15	95.08	72.52	104.12	271.72
2015-16	101.79	76.30	124.00	302.09
2016-17	103.97	80.26	142.62	326.85
2017-18	103.97	84.52	155.51	344.00
2018-19	105.08	86.60	164.43	356.10
2019-20	103.32	93.48	173.31	370.11
2020-21	103.87	97.51	180.77	382.15
2021-22	104.85	99.00	195.64	399.50
2022-23	105.73	100.05	210.28	416.06
2023-24	107.67	104.45	229.85	441.97
2024-25	111.66	106.37	257.18	475.21

Source: CEA, Growth of Electricity Sector in India, various issues.



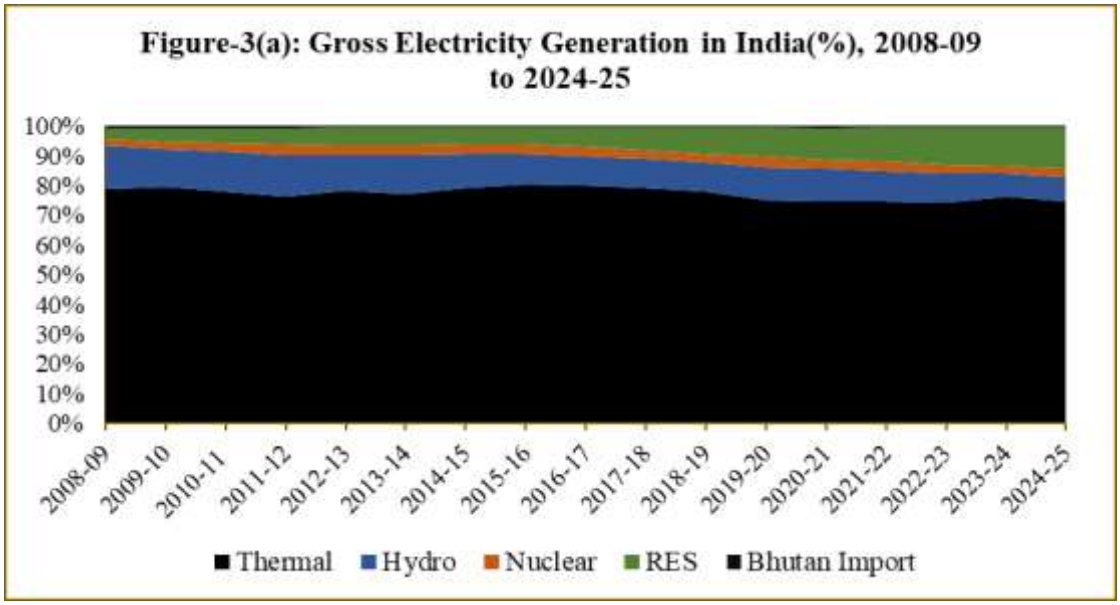
Source-wise gross electricity generation in India is shown in Table-3(a) and Figure-3(a). It can be observed from the table that gross electricity generation in India has increased from 747.07 BU in 2008-09 to 1829.69 BU in 2024-25, at a CAGR of about 5.8%. The growth in gross electricity generation is low when compared with the growth in installed electricity generation capacity (7.6%). This may be primarily due to an increase in capacity from RES with a relatively low utilization factor.

Table 3(a) - Gross Electricity Generation in India (BU), 2008-09 to 2024-25

Year	Thermal	Hydro	Nuclear	RES	Bhutan Import	Total
2008-09	588.28	110.10	14.93	27.86	5.90	747.07
2009-10	640.21	104.06	18.64	36.95	5.40	805.26
2010-11	665.00	114.30	26.30	41.15	5.60	852.35
2011-12	708.43	130.51	32.29	51.23	5.30	927.76
2012-13	760.45	113.72	32.87	57.45	4.80	969.29
2013-14	792.05	134.85	34.23	59.62	5.60	1026.35
2014-15	877.94	129.24	36.10	61.79	5.00	1110.07
2015-16	943.01	121.38	37.41	65.78	5.20	1172.78
2016-17	994.22	122.31	37.66	81.87	5.64	1241.70
2017-18	1037.06	126.12	38.35	101.84	4.78	1308.15
2018-19	1072.00	135.00	37.70	126.76	4.40	1375.86
2019-20	1044.45	155.67	46.38	138.32	5.81	1390.63
2020-21	1032.51	150.30	43.03	147.25	8.77	1381.86
2021-22	1114.71	151.63	47.11	170.90	7.49	1491.85
2022-23	1206.39	162.10	45.86	203.56	6.74	1624.65

2023-24	1326.55	134.05	47.94	225.83	4.72	1739.09
2024-25	1363.89	148.63	56.68	255.01	5.48	1829.69

Source: CEA, Growth of Electricity Sector in India, various issues



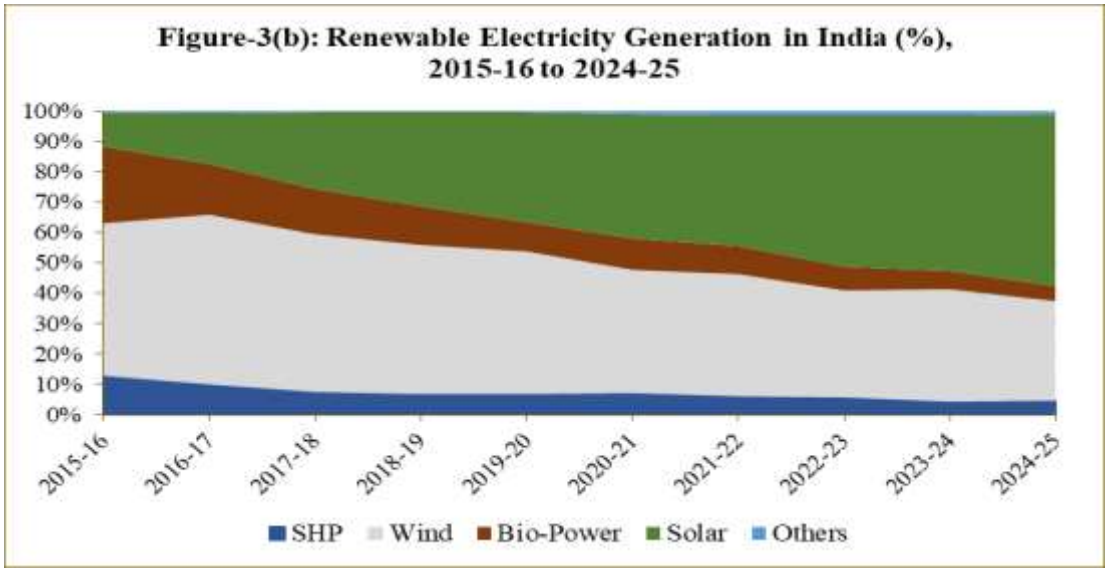
Of all the sources, electricity generation from thermal (mainly coal) continues to play a dominant role in the energy mix of the country, with a share of about 74.5% in 2024-25. Though the relative share of thermal continues to be the highest, it has shown a declining trend over the last few years, mainly because of the increasing emphasis on renewable energy sources. The share of electricity generated from RES in the total generation has increased about four times, i.e., from 3.7% in 2008-09 to 13.9% in 2024-25.

Table-3(b) and Figure-3(b) provide details of renewable electricity generation (Excluding Large Hydro) in India from various sources from 2015-16 onwards. As can be observed from the figure, total renewable electricity generation increased from 65.78 BU in 2015-16 to 255.01 BU in 2024-25 at a CAGR of 16.3%. Solar generation increased significantly from 7.45 BU in 2015-16 to about 144.15 BU in 2024-25 at a CAGR of 39.0%.

Table-3(b): Renewable Electricity Generation* in India (BU), 2015-16 to 2024-25

Year	SHP	Wind	Bio-Power	Solar	Others	Total RES
2015-16	8.36	33.03	16.68	7.45	0.27	65.78
2016-17	8.16	46.01	13.69	13.80	0.57	82.22
2017-18	7.69	52.67	15.25	25.87	0.36	101.84
2018-19	8.70	62.04	16.33	39.27	0.43	126.76
2019-20	9.45	64.65	13.74	50.13	0.37	138.34
2020-21	10.26	60.15	14.82	60.40	1.62	147.25
2021-22	10.46	68.64	16.06	73.48	2.27	170.91
2022-23	11.17	71.81	16.02	102.01	2.53	203.55
2023-24	9.49	83.39	14.24	115.98	2.75	225.83
2024-25	11.57	83.35	13.07	144.15	2.87	255.01

Source: CEA, Report of Renewable Generation
** Excluding Large Hydro*



As per the announcement made by the Hon'ble Prime Minister at the COP26 Summit in Glasgow in November 2021, the Government of India has set an ambitious target for the enhancement of non-fossil fuel energy capacity to 500 GW by 2030. The commitment regarding non-fossil fuel energy capacity is proposed to be met mainly from the installation of solar and wind power capacities. This will enable diversification of India's energy mix with the increasing share of renewable resources.

The Energy Conservation (Amendment) Act, 2022 notified on October 20, 2023 mandates the minimum share of non-fossil energy consumption for designated

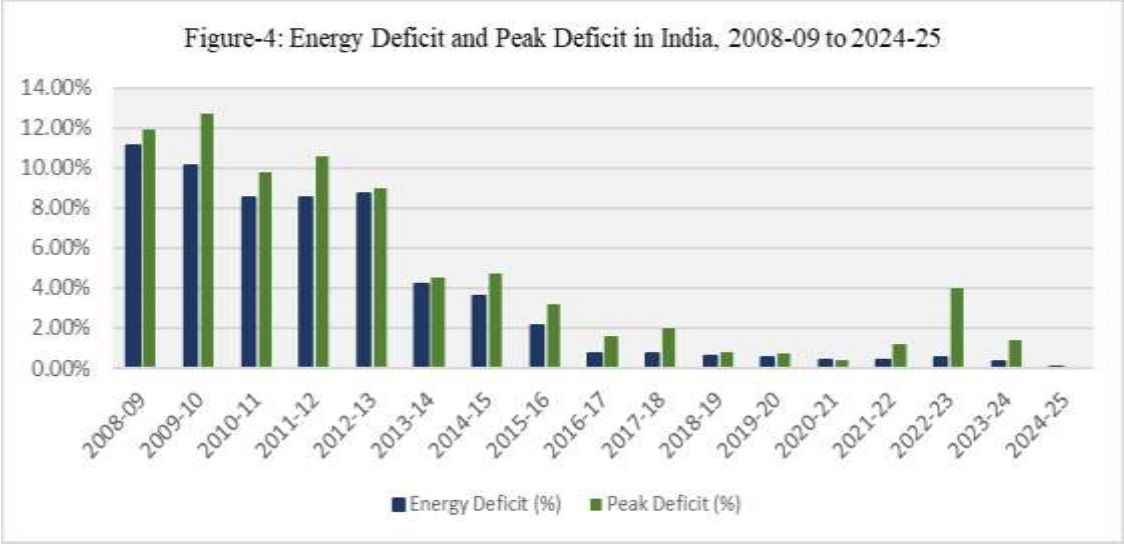
consumers, effective from April 1, 2024. As per the notification, all electricity distribution licensees and all other designated consumers who are open access consumers or captive users to the extent of consumption of electricity from sources other than distribution licensee shall utilize a minimum percentage of energy consumption from different types of non-fossil sources as a percentage of their total share of energy consumption.

The increase in installed electricity generation capacity over the years (as shown in Table-1(a)) has had a positive impact on the power supply position. Both energy requirement and peak demand increased from 777.04 BU and 109.81 GW, respectively, in 2008-09 to 1693.96 BU and 249.86 GW, respectively, in 2024-25 (Table-4). An increase in the installed capacity resulted in a decrease in the energy and peak deficit from 11.1% and 11.9%, respectively, in 2008-09 to about 0.09% and 0.001%, respectively, in 2024-25 (Figure-4).

Table-4: Power Supply Position in India, 2008-09 to 2024-25

Year	Energy (BU)			Peak (GW)		
	Require-ment	Availability	Deficit (%)	Require-ment	Availability	Deficit (%)
2008-09	777.04	691.04	11.10%	109.81	96.79	11.90%
2009-10	830.59	746.64	10.10%	119.17	104.01	12.70%
2010-11	861.59	788.36	8.50%	122.29	110.26	9.80%
2011-12	937.20	857.89	8.50%	130.01	116.19	10.60%
2012-13	995.56	908.65	8.70%	135.45	123.29	9.00%
2013-14	1002.26	959.83	4.20%	135.92	129.82	4.50%
2014-15	1068.92	1030.79	3.60%	148.17	141.16	4.70%
2015-16	1114.41	1090.85	2.10%	153.37	148.46	3.20%
2016-17	1142.93	1135.33	0.70%	159.54	156.93	1.60%
2017-18	1213.33	1204.70	0.70%	164.07	160.75	2.00%
2018-19	1274.60	1267.53	0.60%	177.02	175.53	0.80%
2019-20	1291.01	1284.44	0.50%	183.80	182.53	0.70%
2020-21	1275.53	1270.66	0.40%	190.20	189.40	0.40%
2021-22	1379.81	1374.02	0.40%	203.01	200.54	1.20%
2022-23	1513.50	1505.91	0.50%	215.89	207.23	4.00%
2023-24	1626.13	1622.02	0.30%	243.27	239.93	1.40%
2024-25	1693.96	1692.37	0.09%	249.86	249.85	0.001%

Source: CEA



2. Electricity Transmission

Transmission sector is having a natural monopoly, as it involves high sunk costs in investing in the infrastructure needed to transmit electricity, such as transmission lines. Although the transmission market is largely dominated by the public sector, there are many lines, including High-Voltage Direct Current (HVDC) lines owned by private players. The Ministry of Power has promoted private sector participation through the Tariff Based Competitive Bidding (TBCB) process to develop independent transmission projects and enhance capacity. As on 31.3.2025, CERC granted approval for Inter-state transmission licence to 166 entities (Annexure-I).

CERC notified the Central Electricity Regulatory Commission (Connectivity and General Network Access to the inter-State Transmission System) Regulations, 2022 on 7.6.2022. These regulations simplify the process of connectivity and access to the grid for facilitating open access and competition in the power sector. The Regulations also specify that each State shall have a General Network Access (GNA) to ISTS. The States shall be able to schedule power under long term or medium-term or short-term contracts based on its own assessment of merit order on day ahead basis within GNA quantum. Any drawal beyond GNA shall be with additional charges and the GNA once granted shall remain valid until relinquished. Connectivity grantees shall be deemed to have been granted GNA, equal to the quantum of Connectivity from the start date of

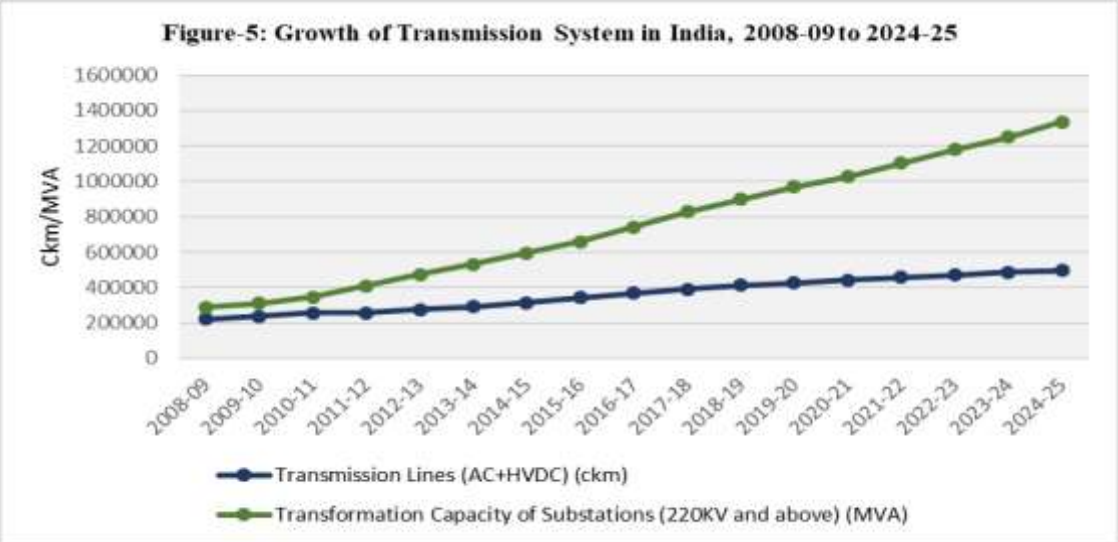
Connectivity. The Regulations also feature the concept of Temporary GNA as open access to ISTS granted to an eligible buyer or an entity on behalf of buyer for a time period of one block up to eleven months.

The growth of transmission system (transmission lines and transformation capacity) in India during 2008-09 to 2024-25 is shown in Table-5 and Figure-5.

Table-5: Growth of Transmission System in India, 2008-09 to 2024-25

Year	Transmission Lines (AC+HVDC) (Ckm)	Transformation Capacity of Substations (220kV and above) (MVA)
2008-09	220794	288615
2009-10	236467	310052
2010-11	254536	345513
2011-12	257481	409551
2012-13	274588	473216
2013-14	291336	530546
2014-15	313437	596100
2015-16	341551	658949
2016-17	367851	740765
2017-18	390970	826958
2018-19	413407	899663
2019-20	425071	967893
2020-21	441821	1025468
2021-22	456716	1104450
2022-23	471341	1180352
2023-24	485544	1251080
2024-25	494374	1337513

Source: CEA, Monthly Reports



It can be observed from Table-5 that bulk transmission (transmission lines 220 kV & above) has increased from 2.21 lakh Ckm in 2008-09 to 4.94 lakh Ckm in 2024-25. During the period, the transformation capacity of sub-stations has also increased from 2.89 lakh MVA to 13.38 lakh MVA. The CAGR in the transmission lines and transformation capacity of sub-stations was 5.2% and 10.1%, respectively.

Table-6 provides the data on annual transmission charges (transmission charges applicable for transmission lines owned by PGCIL and other ISTS licensees) for the period from 2011-12 to 2024-25. The annual transmission charges increased at a CAGR of 13.67% during the period. There are various reasons for increase in annual transmission charges, like the growth of transmission lines (especially at higher voltage levels), waiver of transmission charges for inter-state renewable energy generators, and relinquishment of long-term access (LTA).

Table-6: Annual Transmission Charges, 2011-12 to 2024-25

Year	Transmission Charges as on 31st March (₹ Crore)
2011-12	8743
2012-13	12797
2013-14	15118
2014-15	17680
2015-16	22476
2016-17	27383
2017-18	31405
2018-19	35599
2019-20	39285
2020-21	41051
2021-22	41696
2022-23	46800
2023-24	46203
2024-25	46219

Source: Grid-India

In March 2023, the Ministry of Power brought out a detailed Plan titled "Transmission System for Integration of over 500 GW RE Capacity by 2030" in consultation with States and other stakeholders. The planned transmission system is expected to provide visibility to the RE developers about the potential generation sites and scale of investment opportunities.

3. Electricity Distribution

Distribution is the last leg in the electricity supply chain and assumes significant importance in the overall performance of the sector. State Electricity Distribution Companies (DISCOMs)/State Electricity Boards (SEBs) own the majority of the distribution segment in the electricity supply chain. In order to boost competition and make the sector more efficient, the Government is emphasizing the importance of a well-performing distribution sector and has been focusing on the improvement of the financial health of the distribution utilities. This is necessary to meet the goal of providing people a reliable and good-quality power and universal access to electricity. To meet this goal, it is required to increase rural electrification, reduce aggregate technical and commercial (AT&C) losses incurred while distributing electricity, ensuring financial viability of DISCOMs, and encourage private sector participation.

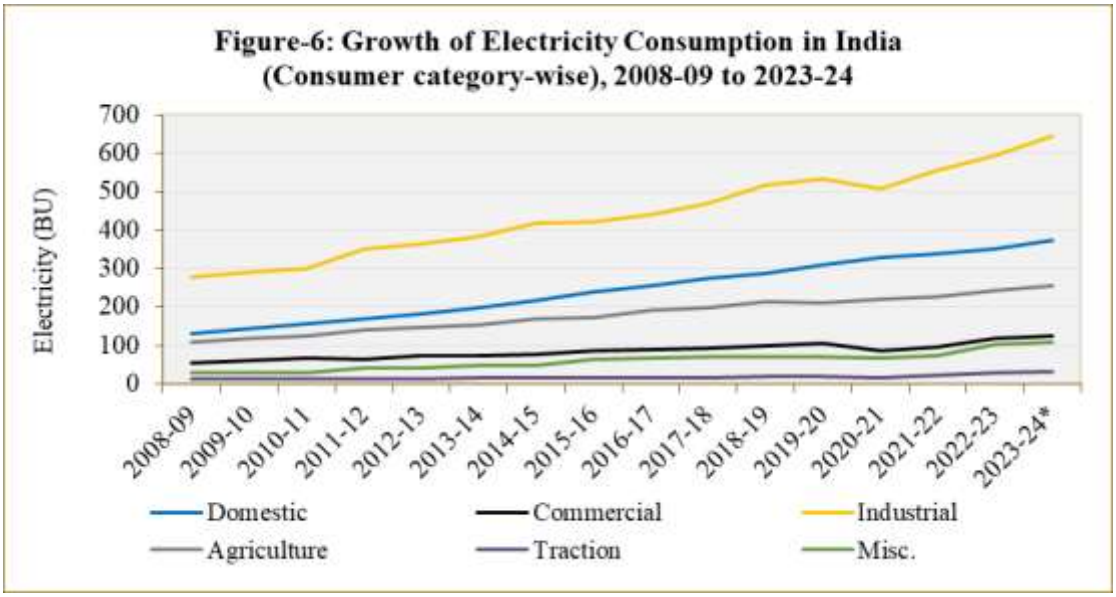
The growth in electricity consumption (consumer category-wise) is provided in Table-7 & Figure-6. The total electricity consumption increased from 611.29 BU in 2008-09 to 1543 BU in 2023-24 at a CAGR of 6.4%. During the period, per capita consumption of electricity in India has increased from 734 kWh to 1395 kWh. Despite this considerable growth, the level of per capita electricity consumption in India is low as compared to the world average of around 3474 kWh for 2023 (as per IEA website).

Table-7: Growth of Electricity Consumption in India (Consumer category-wise) (BU), 2008-09 to 2023-24

Year	Domestic	Commercial	Industrial	Agriculture	Traction	Misc.	Total
2008-09	130.06	53.54	279.66	107.78	11.81	28.45	611.29
2009-10	144.25	59.30	290.26	119.32	12.41	27.71	653.24
2010-11	156.02	68.72	301.26	123.39	13.09	29.93	692.40
2011-12	171.10	65.38	352.29	140.96	14.21	41.25	785.19
2012-13	183.70	72.79	365.99	147.46	14.10	40.26	824.30
2013-14	199.84	74.25	384.42	152.74	15.54	47.42	874.21
2014-15	217.41	78.39	418.35	168.91	16.18	49.29	948.52
2015-16	238.88	86.04	423.52	173.19	16.59	62.98	1001.19
2016-17	255.83	89.83	440.21	191.15	15.68	68.49	1061.18
2017-18	273.55	93.76	468.61	199.25	17.43	70.83	1123.43
2018-19	288.24	98.23	519.20	213.41	18.84	72.06	1209.97
2019-20	308.75	106.05	532.82	211.30	19.15	70.03	1248.09
2020-21	330.81	86.95	508.78	221.30	14.67	67.70	1230.21
2021-22	339.78	97.12	556.48	228.45	21.94	73.00	1316.76
2022-23	353.16	117.23	593.90	243.85	30.03	102.15	1440.31
2023-24*	375.00	125.00	645.00	255.00	33.00	110.00	1543.00

* Estimated

Source: CEA, Growth of Electricity Sector in India, various issues.



** Estimated*

As per the latest available report by Power Finance Corporation Ltd (PFC) namely 'Report on Performance of State Power Utilities- 2023-24', the average all-India AT&C losses for distribution utilities deteriorated from 15.11% in 2022-23 to 16.12% in 2023-24. Billing Efficiency decreased from 86.98% in FY 2022-23 to 86.91% in FY 2023-24. Collection efficiency declined from 97.60% in 2022-23 to 96.51% in 2023-24.

The electricity tariffs charged by the DISCOMs are not cost-reflective for various reasons. The DISCOMs sell electricity below cost or provide for free/subsidized rates for agriculture and domestic consumers. These tariffs for residential and agricultural consumers are subsidized by overcharging industrial and commercial users. Average cost of supply and average revenue of all state power utilities for the period from 2008-09 to 2023-24 is provided in Table-8 and Figure-7.

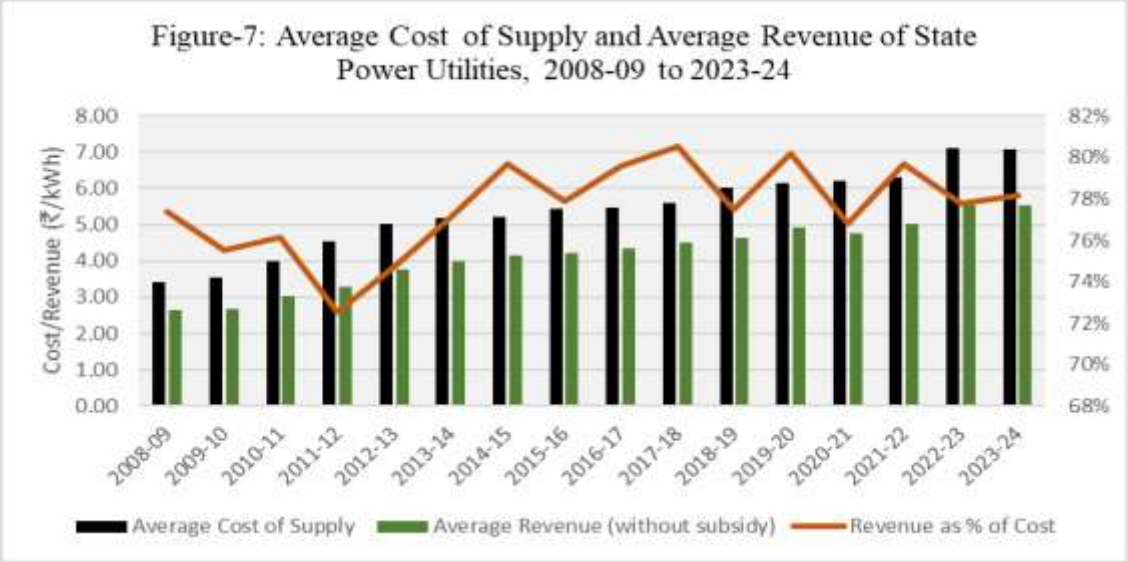
The all-India average cost of supply and average revenue (without subsidy) increased from ₹3.40/kWh and ₹2.63/kWh respectively in 2008-09 to ₹7.09/kWh and ₹5.54/kWh, respectively, in 2023-24. Here the average revenue includes revenue from operations, regulatory income, revenue grants under UDAY and other income. The gap between the cost of supply and revenue has increased from ₹0.77/kWh to ₹1.55/kWh during the period. The revenue as percentage of cost of supply varied between 77% to

80% during the recent five years, which indicates that the average revenue was about 20-23% lower than the average cost of supply and this gap is financed through budgetary support as subsidy by the Government.

Table-8: Average Cost of Supply and Average Revenue of State Power Utilities, 2008-09 to 2023-24

Year	Average Cost of Supply (₹/kWh)	Average Revenue (without subsidy) (₹/kWh)	Revenue Gap (₹/kWh)	Revenue as % of Cost
2008-09	3.40	2.63	0.77	77%
2009-10	3.55	2.68	0.87	75%
2010-11	3.98	3.03	0.95	76%
2011-12	4.55	3.30	1.25	73%
2012-13	5.03	3.76	1.27	75%
2013-14	5.19	4.00	1.19	77%
2014-15	5.21	4.15	1.06	80%
2015-16	5.43	4.23	1.20	78%
2016-17	5.48	4.36	1.12	80%
2017-18	5.60	4.51	1.09	81%
2018-19	6.00	4.65	1.35	78%
2019-20	6.15	4.93	1.22	80%
2020-21	6.21	4.77	1.44	77%
2021-22	6.29	5.01	1.28	80%
2022-23	7.11	5.53	1.58	78%
2023-24	7.09	5.54	1.55	78%

Source: PFC, Report on The Performance of State Power Utilities.



Due to some of the legacy issues, the DISCOMs are financially stressed with huge operational losses and outstanding debt. DISCOMs, therefore, find it difficult to

supply adequate power at affordable rates. To improve their financial health, several policy initiatives have been taken by the Union Government during the last few years, which include implementation of Ujwal DISCOM Assurance Yojana (UDAY, launched in 2015), Integrated Power Development Scheme (IPDS, launched in 2014), National Smart Grid Mission (NSGM launched in 2015), etc. UDAY is being implemented in various States for the financial turnaround and revival of the DISCOMs through four initiatives (i) improving operational efficiencies of DISCOMs; (ii) reduction of cost of power purchase; (iii) reduction in interest cost of DISCOMs; and (iv) enforcing financial discipline on DISCOMs through alignment with State finances.

The IPDS works with the objectives of reducing AT&C losses, establishment of IT enabled energy accounting/auditing system, improvement in billed energy based on metered consumption and improvement in collection efficiency and the scheme is focused on urban areas. The Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY, launched in 2014) is centred on improving distribution and electrification in rural areas. The scheme includes the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) as a key component of the rural electrification initiative. NSGM was launched in 2015 to plan and monitor implementation of policies and programmes related to Smart Grid in India. NSGM scheme was extended till 31st March 2024 with focus on: (i) completing ongoing sanctioned projects, (ii) training and capacity building, (iii) technical assistance to utilities and (iv) handholding of DISCOMs on their Smart Grid Distribution preparedness, etc.

The Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya Scheme) was launched in September 2017, with the objective to provide free electricity connections to all households, for above poverty line (APL) & poor families in rural areas and poor families in urban areas. All DISCOMs, including Private Sector DISCOMs, State Power Departments and Renewable Energy Cooperative Societies shall be eligible for financial assistance under the scheme in line with DDUGJY.

These schemes have helped the DISCOMs in strengthening and augmenting sub-transmission and distribution network, as well as IT enablement. These schemes have supported in achieving the goal of providing universal electricity access to the

households enabling significant improvement in availability of power supply in both rural and urban areas.

The Ministry of Power has launched the Revamped Distribution Sector Scheme (RDSS) dated 20.07.2021, with the aim to provide reform-based result-linked financial assistance to DISCOMs to strengthen the supply infrastructure. Main objectives of the scheme include: (i) Reduction of AT&C losses to pan-India levels of 12-15% by FY 2024-25; (ii) Reduction of ACS-ARR gap to zero by FY 2024-25; (iii) improvement in the quality, reliability and affordability of power supply to consumers through a financially sustainable and operationally efficient distribution sector; and (iv) modernization of the DISCOMs through technology enhancement in the areas of asset management, customer experience and business operations. RDSS assist DISCOMS to improve their operational efficiencies and financial sustainability by providing result-linked financial assistance to DISCOMS to strengthen supply infrastructure based on meeting pre-qualifying criteria and achieving basic minimum benchmarks. As reported in the MOP Annual Report 2024-25, the AT&C losses have come down to 16.73% by the FY 2023-24.

Electricity (Late Payment Surcharge and Related Matters) Rules, 2022 provide relief to the DISCOMS, as well as electricity consumers and at the same time Generating companies also get the benefit from assured monthly payments, which will help the whole power sector to become financially viable. As reported in the MOP Annual report 2024-25, effective implementation of these Electricity Rules, 2022 resulted that the legacy dues of Rs. 1,39,947 Crore as on 03.06.2022, have come down to Rs. 24,684 Crore as in December, 2024 and is anticipated to further come down to Rs 19,288 Cr by March, 2025.

The amendment to the Electricity Rules, 2005 notified on 26.07.2023 put in place additional measures to improve financial health of DISCOMs by streamlining the process of accounting, reporting, billing and payment of subsidy by States to the Distribution Companies.

The National Conference of Power Ministers of States and UTs was held on 12th November, 2024 at Delhi. During the Conference, detailed deliberations were held with focus on Operational Performance & Financial Viability of DISCOMs, Review of RDSS and Smart Meters implementation Strategy, Rights of Electricity Consumers, Resource Adequacy, Storage Capacity Addition through PSPs and BESS, National Transmission Plan, Green Energy Corridor, Pending clearances by States, EV Charging Infrastructure, Indian Carbon Market and overall development of Power Sector.

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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. In exercise of powers conferred under Section 66 of the Electricity Act, 2003 and paragraph 5.7.1 (f) of the National Electricity Policy, and all other powers enabling it in this behalf, the Commission had notified the CERC (Power Market) Regulations, 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 and the CERC (Power Market) Regulations, 2021 in February 2021, repealing the earlier regulations.

The trading licensees started their operations in year 2004, whereas the power exchanges started their operation in year 2008. Various bilateral contracts including banking contracts were offered by the trading licensees. Initially only Day Ahead Contracts were offered on the platforms of power exchanges i.e. The Indian Energy Exchange (IEX) and Power Exchange India Ltd. (PXIL). Vide CERC Orders dated 31.08.2009, the Commission approved the introduction of additional contracts on power exchanges, i.e., Day-ahead Contingency contracts, Intra-day contracts, Daily contracts and 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 and 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 Contracts (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 and 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 were 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 (GTAM) on IEX on 24th February 2022. These contracts are aimed to provide an additional avenue for the existing and prospective hydropower generators to sell their 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 the 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 (TAM) and GTAM. 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 contracts 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 the trading of these contracts 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 DAM 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 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 approved the introduction of High Price Term Ahead Market (HP-TAM) and High Price Contingency contracts on HPX, PXIL and IEX, respectively.

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 these new regulations, all entities are required 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 DAM segments of all the Power Exchanges or the weighted average ACP of the RTM 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 DAM segments of all the Power Exchanges and the weighted average ACP of the RTM 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 DAM segments of all the Power Exchanges; or the weighted average ACP of the RTM 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 2024-25)

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 DAM, GDAM, HP-DAM, TAM, GTAM, HP-TAM and RTM;
- 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 2025, there were a total of 66[2] inter-state trading licensees (See 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 238.35 BU in 2024-25. During this period, the volume of short-term transactions of electricity increased at a CAGR of 8.9%, whereas total electricity generation increased at a CAGR of 5.8%[3]. The volume of short-term transactions of electricity as a percentage of total electricity generation varied from 8.9% to 13.03% during the period (Table-9).

Table-9: Volume of Short-term Transactions of Electricity & DSM with respect to Total Electricity Generation, 2009-10 to 2024-25

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	9.60%
2010-11	81.56	852.35	9.60%
2011-12	94.51	927.75	10.20%
2012-13	98.94	969.29	10.20%
2013-14	104.64	1026.34	10.20%
2014-15	98.99	1110.07	8.90%

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

2015-16	115.23	1172.78	9.80%
2016-17	119.23	1241.70	9.60%
2017-18	127.62	1308.15	9.80%
2018-19	145.20	1375.86	10.60%
2019-20	137.16	1390.93	9.90%
2020-21	146.01	1380.06	10.60%
2021-22	186.75	1491.85	12.50%
2022-23	194.35	1624.47	12.00%
2023-24	218.22	1739.09	12.50%
2024-25	238.35	1829.70	13.03%

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 on the volume of electricity transacted through traders (bilateral transactions) and power exchanges (collective transactions (DAM, G-DAM, HP-DAM, RTM), Contingency contracts and TAM contracts).

The volume of electricity transacted through traders declined from 26.72 BU in 2009-10 to 26.25 BU in 2024-25 (Table-10(a)) at a CAGR of -0.1%. The share of electricity transacted through traders as a percentage of total volume of short-term transactions & DSM varied from 11.01% to 40.5% during this period.

Table-10(a): Volume of Electricity transacted through Traders (BU), 2009-10 to 2024-25

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	40.50%
2010-11	27.70	81.56	34.00%
2011-12	35.84	94.51	37.90%
2012-13	36.12	98.94	36.50%
2013-14	35.11	104.64	33.60%
2014-15	34.56	98.99	34.90%

2015-16	35.43	115.23	30.70%
2016-17	33.51	119.23	28.10%
2017-18	38.94	127.62	30.50%
2018-19	47.32	145.20	32.60%
2019-20	29.95	137.16	21.80%
2020-21	26.67	146.01	18.30%
2021-22	39.47	186.75	21.10%
2022-23	33.80	194.35	17.40%
2023-24	41.02	218.22	18.80%
2024-25	26.25	238.35	11.01%

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 143.75 BU in 2024-25 (Table-10(b)). The CAGR in volume of this segment during 2009-10 to 2024-25 was 22.1%. 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 60.3% in 2024-25 (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. It can be observed from the table that in 2024-25, Daily contracts recorded the maximum volume in the TAM segment, followed by the ADSS contracts, day-ahead Contingency, monthly contracts, intra-day contracts and weekly contracts.

Table-10(b): Volume of Electricity transacted through Power Exchanges (BU), 2009-10 to 2024-25

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	Electricity Transacted through PXs as % to Total Volume of Short-term & DSM
	DAM	G-DAM	HP-DAM	TAM	G-TAM	HP-TAM	RTM	DAM	G-DAM	HP-DAM	TAM	G-TAM	HP-TAM	RTM	DAM	G-DAM	HP-DAM	TAM	G-TAM	HP-TAM	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%
2024-25	61.23	8.32	0.00	11.76	0.41	0.01	38.90	0.06	0.00	0.00	13.46	0.29	0.40	0.06	0.00	0.00	0.00	7.84	0.92	0.03	0.05	143.75	238.35	60.3%

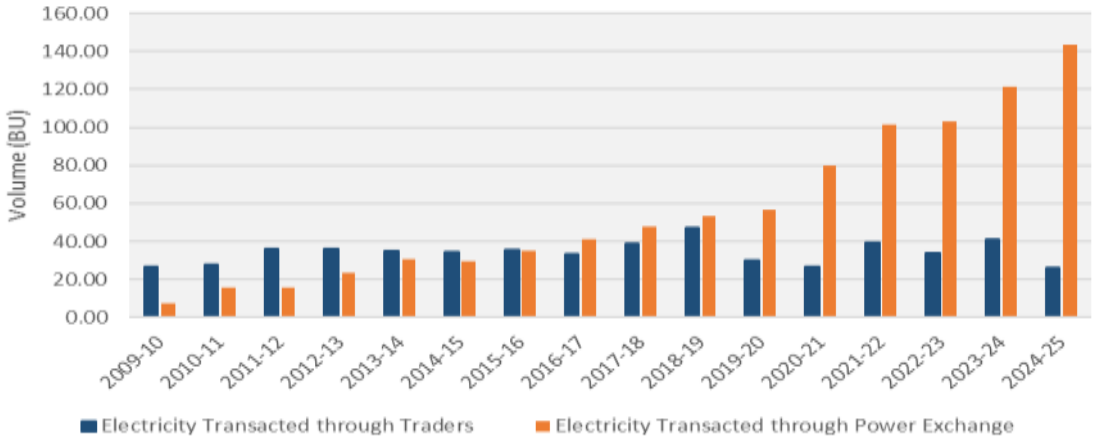
Note: TAM includes Contingency and TAM contracts

Table-10(c): Volume of Electricity transacted through Term Ahead Market at Power Exchanges (BU), 2009-10 to 2024-25

Year	Electricity Transacted through IEX						Electricity Transacted through PXIL						Electricity Transacted through HPX					
	ID Con-tracts	DAC Con-tracts	Daily Con-tracts	Weekly Con-tracts	Monthly Con-tracts	ADSS Con-tracts	ID Con-tracts	DAC Con-tracts	Daily Con-tracts	Weekly Con-tracts	Monthly Con-tracts	ADSS Con-tracts	ID Con-tracts	DAC Con-tracts	Daily Con-tracts	Weekly Con-tracts	Monthly Con-tracts	ADSS Con-tracts
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
2024-25	0.14	1.98	5.36	0.02	1.33	3.34	0.36	3.51	4.60	0.09	2.18	3.41	0.18	2.47	2.80	0.00	1.32	2.03

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 2024-25



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 2024-25

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
2024-25	7.17

Source: Traders data

Table-11(b): Price of Electricity Transacted through Power Exchanges, 2009-10 to 2024-25

Year	Electricity Transacted through IEX							Electricity Transacted through PXIL							Electricity Transacted through HPX						
	DAM	G-DAM	HP-DAM	TAM	G-TAM	HP-TAM	RTM	DAM	G-DAM	HP-DAM	TAM	G-TAM	HP-TAM	RTM	DAM	G-DAM	HP-DAM	TAM	G-TAM	HP-TAM	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
2024-25	4.25	3.97	12.80	7.11	6.21	15.00	4.02	9.81	3.40	-	7.20	5.16	14.60	9.65	9.78	-	-	7.87	4.37	14.90	9.96

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 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 ₹89681 crores in 2024-25, at a CAGR of 11.5% (Table-12). The variation in volume and price affected the size of the bilateral and power exchange market.

Table-12: Size of Electricity Market: Bilateral through Traders and Power Exchanges (₹ Crore), 2009-10 to 2024-25

Year	Size of Bilateral Trader market	Size of Power Exchange market	Total
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
2024-25*	18822	70860	89681

** 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.*

2.1.2 Direct Bilateral Transactions of Electricity

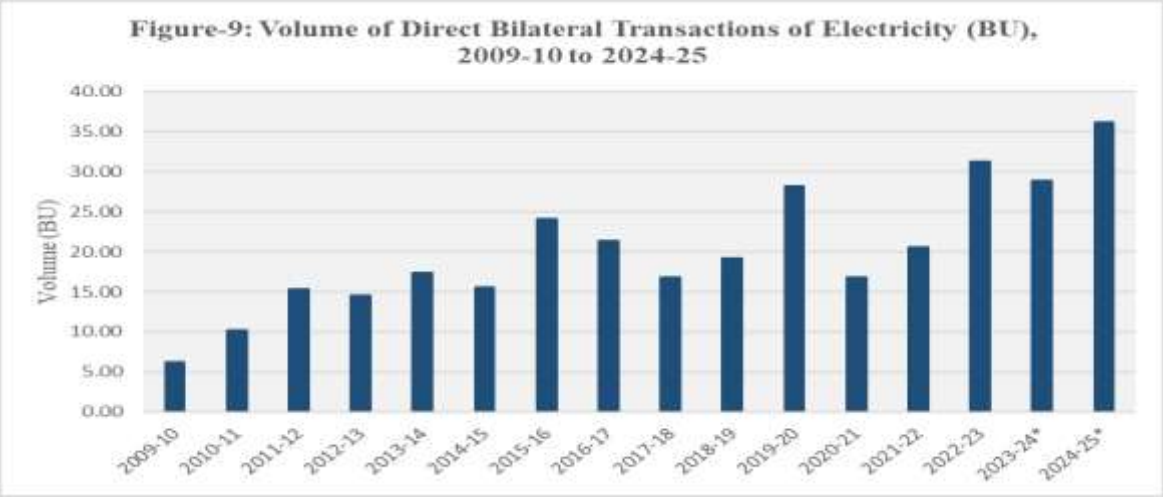
The volume of direct bilateral transactions of electricity between entities is shown in Table-13 and Figure-9. As may be seen from the Table, the volume of direct bilateral transactions increased from 6.19 BU in 2009-10 to 36.21 BU in 2024-25. The volume of direct bilateral transactions as a percentage 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 transaction of Electricity, 2009-10 to 2024-25

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	9.40%
2010-11	10.25	81.56	12.60%
2011-12	15.37	94.51	16.30%
2012-13	14.52	98.94	14.70%
2013-14	17.38	104.64	16.60%
2014-15	15.58	98.99	15.70%
2015-16	24.04	115.23	20.90%
2016-17	21.38	119.23	17.90%
2017-18	16.77	127.62	13.10%
2018-19	19.23	145.20	13.20%
2019-20	28.17	137.16	20.50%
2020-21	16.84	146.01	11.50%
2021-22	20.56	186.75	11.00%
2022-23	31.30	194.35	16.10%
2023-24*	28.92	218.22	13.30%
2024-25*	36.21	238.35	15.19%

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 Charges

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 13.49% in 2024-25. 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 ₹5.0/kWh in 2024-25 (Table-14).

Table-14: DSM Volume and Charges, 2009-10 to 2024-25

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	39.20%	4.62
2010-11	28.08	81.56	34.40%	3.91
2011-12	27.76	94.51	29.40%	4.09
2012-13	24.76	98.94	25.00%	3.86
2013-14	21.47	104.64	20.50%	2.05
2014-15	19.45	98.99	19.60%	2.26
2015-16	20.75	115.23	18.00%	1.93
2016-17	23.22	119.23	19.50%	1.76
2017-18	24.21	127.62	19.00%	2.03
2018-19	25.13	145.20	17.30%	2.68
2019-20	22.59	137.16	16.50%	2.85
2020-21	22.91	146.01	15.70%	2.82
2021-22	25.27	186.75	13.50%	3.73
2022-23	26.30	194.35	13.50%	5.39
2023-24	26.78	218.22	12.30%	5.73
2024-25	32.14	238.35	13.49%	5.00

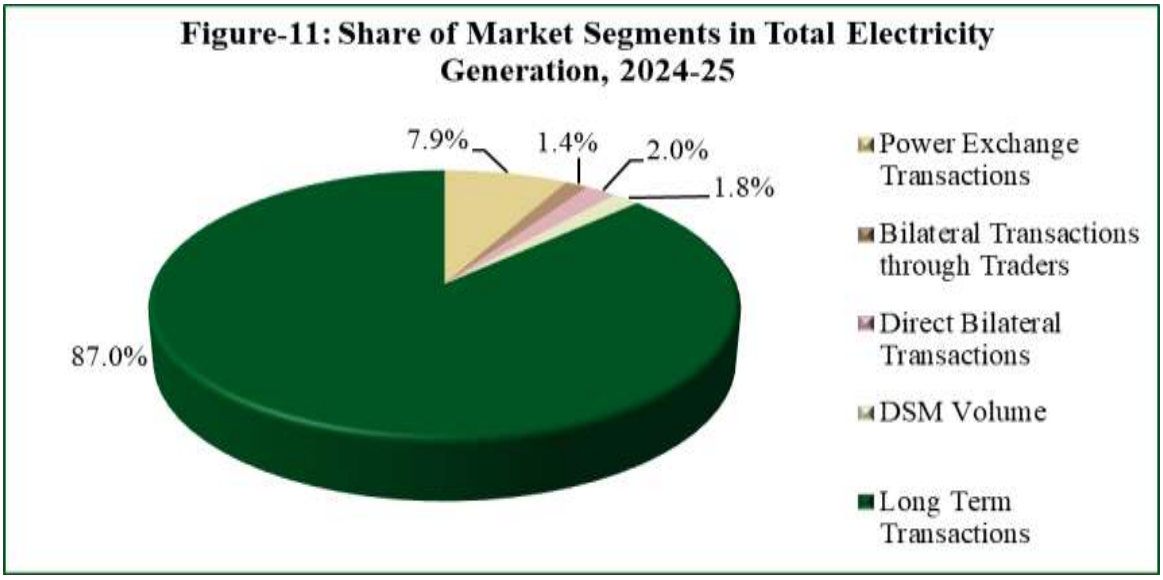
Source: NLDC



3. Monthly Trends in Short-term Transactions of Electricity & DSM Volume (April 2024-March 2025)

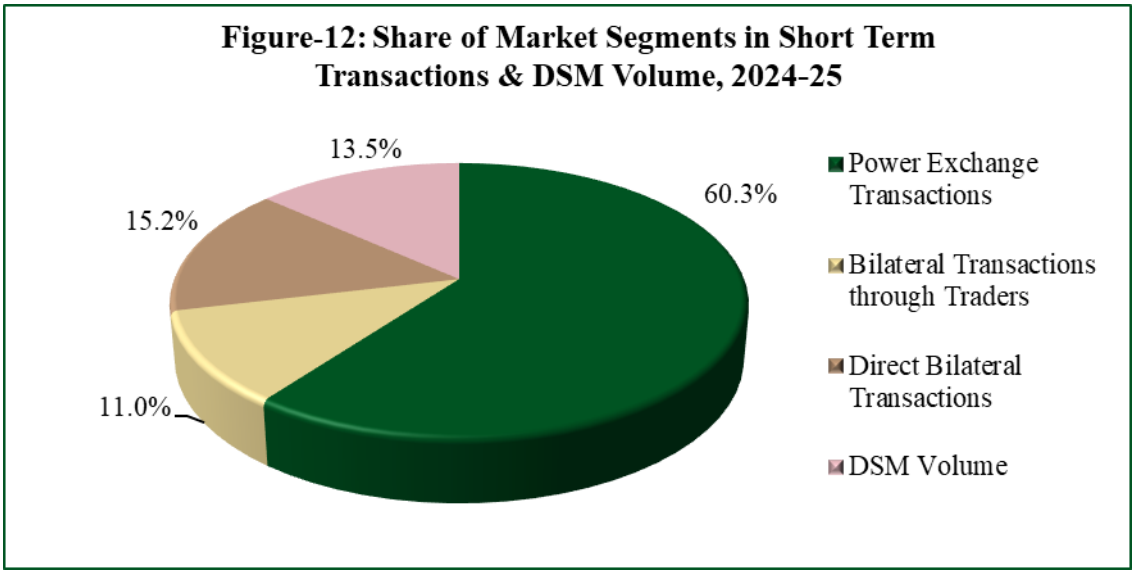
During 2024-25, the share of total short-term volume & DSM volume, as a percentage of total electricity generation in the country, was 13.0% (Figure-11).

Figure-11: Share of Market Segments in Total Electricity Generation, 2024-25



The share of different market segments within the total short-term transactions & DSM volume in 2024-25 is shown in Figure-12 below.

Figure-12: Share of Market Segments in Short Term Transactions & DSM Volume, 2024-25



Of the total short-term transactions & DSM volume in 2024-25, the volume of electricity transacted through power exchanges was maximum (60.3%), followed by direct

bilateral transactions between entities (15.2%), DSM volume (13.5%) and bilateral transactions through traders (11.0%).

3.1 Volume of Short-term Transactions of Electricity & DSM

The month-wise volume of short-term transactions of electricity & DSM in 2024-25 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) that the volume of short-term transactions of electricity as percentage of total electricity generation varied from 10.7% and 15.4% during April 2024 to March 2025.

Table-15(a): Volume of Short-term Transaction of Electricity & DSM (BU), 2024-25

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-24	4.39	2.72	7.12	11.7	2.48	21.29	154.96	13.70%
May-24	3.77	2.83	6.60	12.63	2.73	21.95	167.58	13.10%
Jun-24	3.55	4.08	7.63	11.95	2.84	22.43	162.88	13.80%
Jul-24	4.49	4.53	9.02	11.38	2.97	23.37	160.9	14.50%
Aug-24	4.50	4.85	9.35	11.24	3.35	23.94	155.14	15.40%
Sep-24	1.12	1.82	2.95	11.66	2.76	17.37	151.23	11.50%
Oct-24	1.36	0.90	2.26	11.41	2.59	16.26	151.90	10.70%
Nov-24	0.81	1.52	2.32	10.74	2.16	15.22	134.56	11.30%
Dec-24	0.84	2.57	3.41	12.63	2.44	18.48	140.92	13.10%
Jan-25	0.41	3.38	3.79	12.57	2.63	18.99	147.43	12.90%
Feb-25	0.45	3.36	3.8	11.89	2.39	18.08	141.79	12.80%
Mar-25	0.56	3.63	4.19	13.96	2.81	20.95	160.4	13.10%
Total	26.25	36.21	62.45	143.75	32.14	238.35	1829.7	13.00%

** 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 Transactions of Electricity (BU), 2024-25

Month	DAM	GDAM	HP-DAM	TAM	GTAM	HP-TAM	RTM	Total
Apr-24	4.14	0.36	0.0001	4.16	0.14	0.27	2.63	11.70
May-24	4.32	0.56	0.003	4.07	0.16	0.12	3.39	12.63
Jun-24	4.84	0.68	0.0002	3.02	0.19	0.01	3.22	11.95
Jul-24	5.07	0.97	0.0002	1.84	0.14	0.02	3.34	11.38

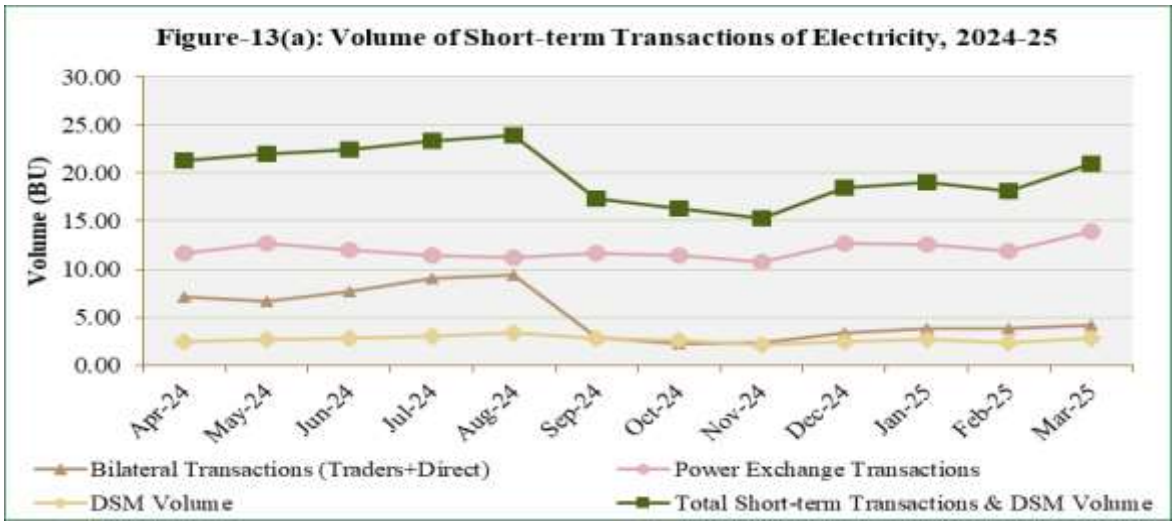
Aug-24	4.71	0.85	0.00	2.01	0.16	0.01	3.49	11.24
Sep-24	4.56	0.72	0.00	2.34	0.11	0.001	3.93	11.66
Oct-24	4.42	0.82	0.00	2.90	0.13	0.01	3.13	11.41
Nov-24	5.62	0.79	0.00	1.23	0.08	0.00	3.02	10.74
Dec-24	6.65	0.77	0.00	1.95	0.08	0.002	3.18	12.63
Jan-25	6.02	0.69	0.00	2.62	0.20	0.002	3.04	12.57
Feb-25	5.43	0.53	0.00	2.92	0.12	0.00	2.89	11.89
Mar-25	5.52	0.58	0.00	4.00	0.13	0.00	3.73	13.96
Total	**61.29**	**8.32**	**0.003**	**33.06**	**1.63**	**0.44**	**39.01**	**143.75**

Source: NLDC & Power Exchanges

Table-15(c): Volume of Electricity transacted through Term Ahead & Contingency Market Segments (BU), 2024-25

Month	Term Ahead Market						Green Term Ahead Market						High Price Term Ahead Market					
	ID Con-tracts	DAC Con-tracts	Daily Con-tracts	Weekly Con-tracts	Monthly Con-tracts	ADSS Con-tracts	ID Con-tracts	DAC Con-tracts	Daily Con-tracts	Weekly Con-tracts	Monthly Con-tracts	ADSS Con-tracts	ID Con-tracts	DAC Con-tracts	Daily Con-tracts	Weekly Con-tracts	Monthly Con-tracts	ADSS Con-tracts
Apr-24	0.05	0.55	1.59	0.11	1.07	0.79	0.00	0.10	0.01	0.00	0.02	0.02	0.02	0.01	0.11	0.00	0.13	0.00
May-24	0.14	1.05	1.63	0.00	1.09	0.16	0.00	0.11	0.004	0.00	0.04	0.01	0.01	0.004	0.07	0.00	0.04	0.00
Jun-24	0.08	0.93	0.90	0.00	0.63	0.49	0.00	0.14	0.02	0.00	0.02	0.02	0.01	0.001	0.00	0.00	0.00	0.00
Jul-24	0.10	0.97	0.34	0.00	0.12	0.31	0.00	0.12	0.02	0.00	0.00	0.00	0.02	0.002	0.00	0.00	0.00	0.00
Aug-24	0.04	0.74	0.76	0.01	0.15	0.31	0.00	0.10	0.04	0.00	0.00	0.01	0.01	0.002	0.00	0.00	0.00	0.00
Sep-24	0.07	0.57	0.47	0.00	0.19	1.05	0.00	0.06	0.02	0.00	0.004	0.02	0.001	0.00	0.00	0.00	0.00	0.00
Oct-24	0.04	0.58	0.83	0.00	0.00	1.45	0.0001	0.08	0.05	0.00	0.00	0.002	0.01	0.00	0.00	0.00	0.00	0.00
Nov-24	0.021	0.22	0.60	0.00	0.02	0.37	0.00	0.04	0.04	0.00	0.00	0.001	0.00	0.00	0.00	0.00	0.00	0.00
Dec-24	0.02	0.38	0.65	0.00	0.10	0.81	0.00	0.03	0.05	0.00	0.00	0.00	0.002	0.00	0.00	0.00	0.00	0.00
Jan-25	0.012	0.50	0.96	0.00	0.17	0.97	0.00	0.05	0.03	0.00	0.01	0.11	0.002	0.00	0.00	0.00	0.00	0.00
Feb-25	0.01	0.31	1.30	0.00	0.39	0.90	0.00	0.04	0.02	0.00	0.005	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Mar-25	0.02	0.24	2.23	0.00	0.63	0.88	0.0000	0.05	0.04	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.60**	**7.04**	**12.25**	**0.12**	**4.57**	**8.49**	**0.000**	**0.90**	**0.33**	**0.00**	**0.10**	**0.30**	**0.08**	**0.02**	**0.18**	**0.00**	**0.17**	**0.00**

As may be observed from Figure-13(a) that the volume of short-term transactions & DSM followed a cyclical pattern with an increasing trend in the initial months of the year 2024-25. 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.



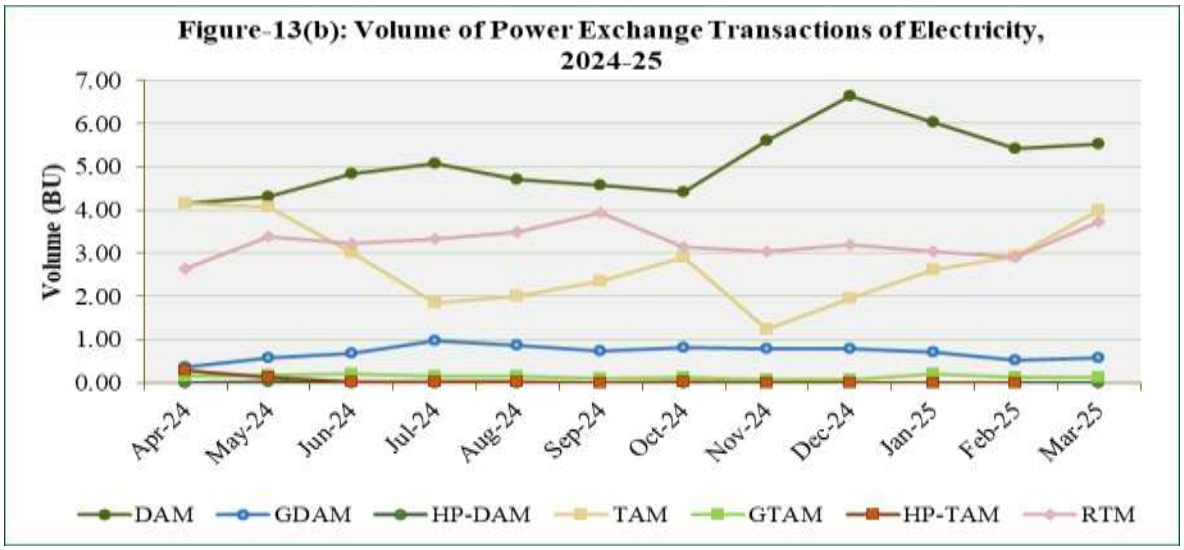


Figure 13(b) depicts the month-wise variation in volume under different market segments of the power exchanges. The volume in DAM and TAM witnessed a cyclical trend with significant variations in opposite direction during 2024-25. No significant

variations observed in the volume of RTM and other market segments such as G-DAM, G-TAM, HP-DAM and HP-TAM.

As on 31.3.2025, there were a total of 66[4] inter-state trading licensees; of which, 44 have undertaken either short-term or both short & long-term trading of electricity during 2024-25 (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 2024-25 was 0.1760, which indicates moderate concentration of market power among the traders. As compared to 2023-24 with HHI value of 0.1721, the level of market concentration has increased in 2024-25.

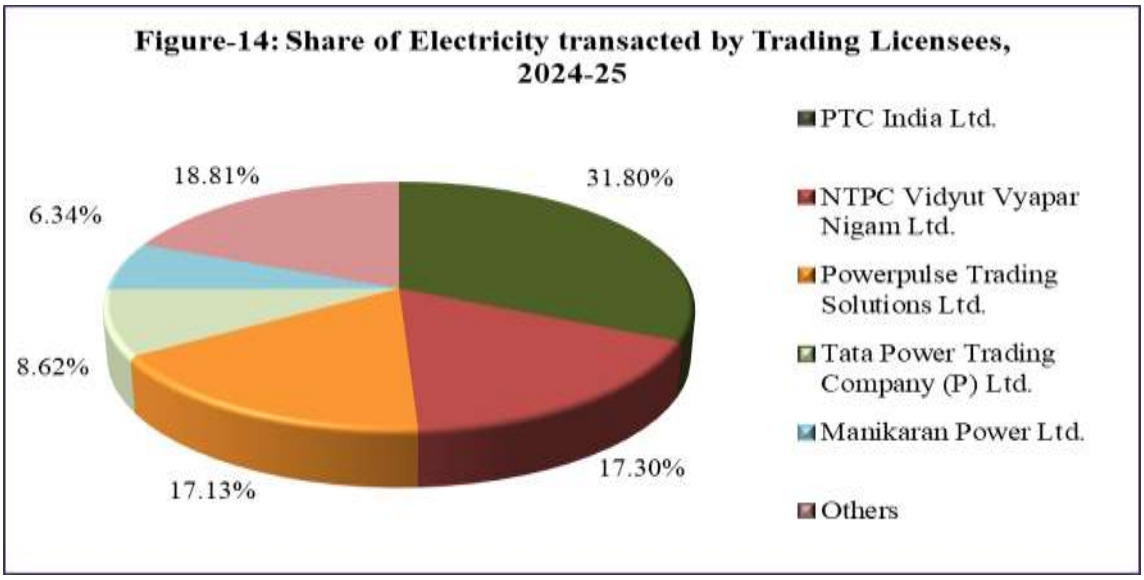
Table-16: Share of Electricity Transacted by Trading Licensees and HHI, 2024-25

S.No.	Name of the Trading Licensee	Share of Electricity transacted by Trading Licensees
1	PTC India Ltd.	31.80%
2	NTPC Vidyut Vyapar Nigam Ltd.	17.30%
3	Powerpulse Trading Solutions Ltd.	17.13%
4	Tata Power Trading Company (P) Ltd.	8.62%
5	Manikaran Power Ltd.	6.34%
6	Arunachal Pradesh Power Corporation (P) Ltd	4.60%
7	GMR Energy Trading Ltd.	2.83%
8	JSW Power Trading Company Ltd	2.73%
9	Instinct Infra & Power Ltd.	1.01%
10	Kreate Energy (I) (P) Ltd.	0.87%
11	Ambitious Power Trading Company Ltd.	0.83%
12	Kundan International Pvt. Ltd.	0.76%
13	Greenko Energies Pvt Ltd	0.60%

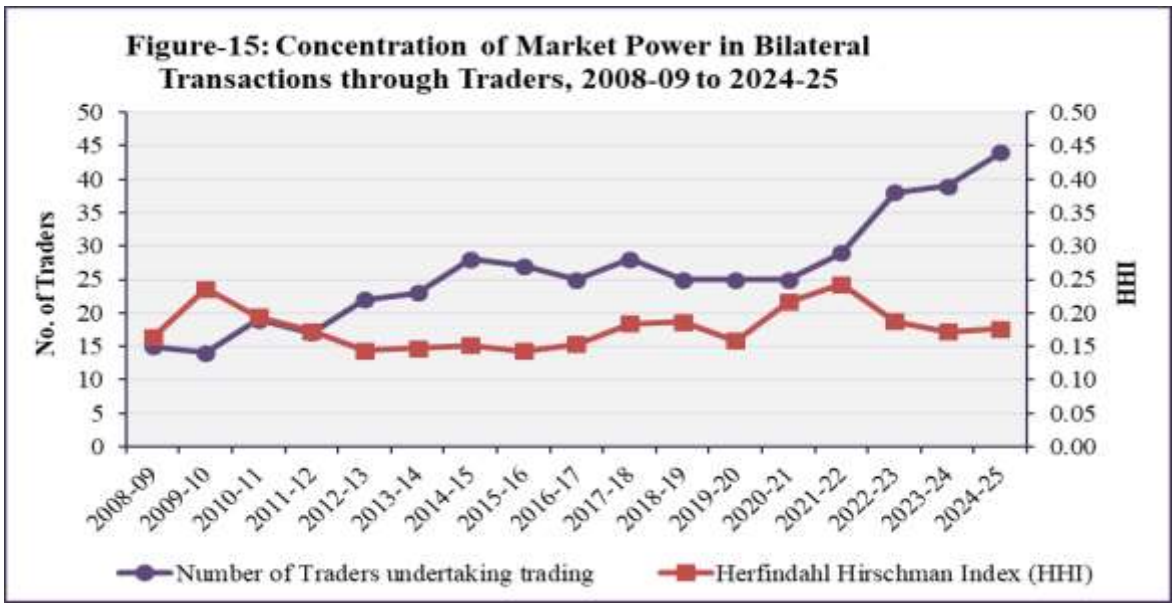
[4] *This does not include Global Energy Pvt. Ltd.*

14	RPG Power Trading Company Ltd.	0.55%
15	Shree Cement Ltd.	0.52%
16	Statkraft Markets Pvt. Ltd.	0.44%
17	Energyedge Power Trading Pvt. Ltd.	0.38%
18	Ideal Energy Solution Pvt. Ltd.	0.36%
19	Gita Power & Infrastructure Private Limited	0.32%
20	Abja Power Private Limited	0.29%
21	Adarsh Stainless Pvt. Ltd.	0.27%
22	Saranyu Power Trading Private Limited	0.23%
23	NLC India Ltd.	0.17%
24	NEFA Power Trading Pvt. Ltd.	0.16%
25	Instant Ventures Pvt. Ltd.	0.12%
26	NHPC Limited	0.12%
27	Refex Industries Ltd.	0.11%
28	SJVN Ltd.	0.09%
29	Refex Energy Limited	0.09%
30	Powerfull Energy Trading Pvt. Ltd.	0.08%
31	Altilium Energie Private Limited	0.08%
32	Elsa Consultancy	0.05%
33	Customized Energy Solutions India (P) Ltd.	0.03%
34	Shubheksha Advisors Pvt. Ltd.	0.03%
35	Renesys Solar Pvt. Ltd.	0.03%
36	Phillip Commodities India (P) Ltd.	0.03%
37	Saini Power Transactor	0.03%
38	REL Power Trading LLP	0.02%
39	Avaada Power Trading Private Limited	0.00%
40	Shell Energy Marketing and Trading India (P) Ltd.	0.00%
41	EKI Power Trading Pvt. Ltd.	0.00%
42	AMP Energy Markets India (P) Ltd	0.00%
43	Reneurja Power LLP	0.00%
44	Serentica Renewables India 2 Pvt. Ltd.	0.00%
Total		100.00%
Share of Top 5 Tradeing Licensees		**81.19%**
Herfindahl-Hirschman Index (HHI)		**0.1760**
Note: Percentage share in total volume of electricity transacted by Trading Licensees in 2024-25 is based on the volume of electricity transacted by the inter-state trading licensees through bilateral and power exchanges.		
Source: MMC, CERC.		

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.



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 44 in 2024-25.



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

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 weighted average price

of short-term transactions of electricity and the average charges for deviation during the year 2024-25. The price of bilateral trader transactions represents the price of electricity transacted through traders. The trend in price of electricity transacted through traders (bilateral 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 Electricity transacted through Trading Licensees (₹/kWh), 2024-25

Month	RTC	Peak	Off-peak	Weighted Average
Apr-24	8.20	9.93	8.78	8.24
May-24	8.21	9.93	8.68	8.27
Jun-24	7.58	9.63	8.70	7.67
Jul-24	6.49	9.08	7.93	6.60
Aug-24	6.69	9.06	5.86	6.70
Sep-24	6.79	9.50	5.85	6.70
Oct-24	6.27	-	6.13	6.22
Nov-24	5.45	-	6.50	5.88
Dec-24	5.41	-	6.23	5.72
Jan-25	5.36	5.54	6.35	5.75
Feb-25	5.44	8.59	6.36	5.85
Mar-25	5.76	9.17	6.65	5.99

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

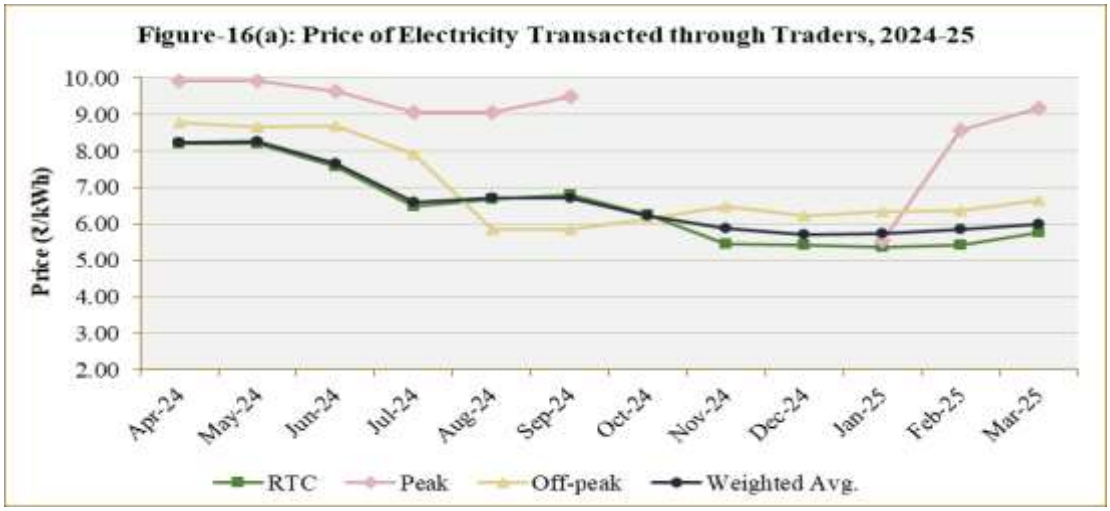
Table-17(b): Price of Electricity transacted through Power Exchanges (₹/kWh), 2024-25

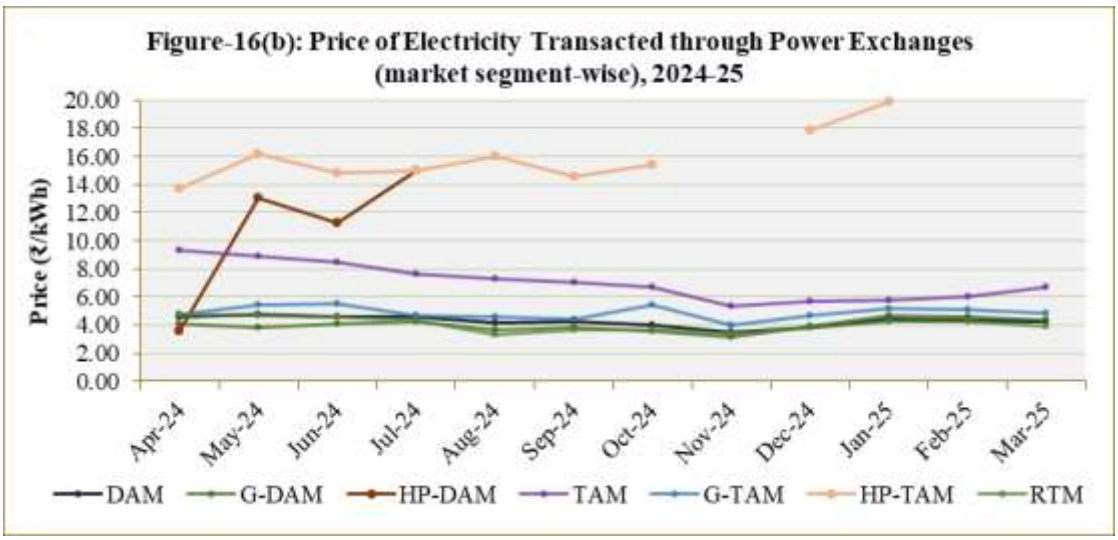
Month	DAM	G-DAM	HP-DAM	TAM	G-TAM	HP-TAM	RTM
Apr-24	4.63	4.08	3.56	9.36	4.79	13.74	4.79
May-24	4.79	3.86	13.08	8.88	5.46	16.18	4.66
Jun-24	4.63	4.06	11.26	8.49	5.55	14.84	4.63
Jul-24	4.55	4.29	15.00	7.67	4.68	15.00	4.30
Aug-24	4.13	3.69	-	7.29	4.63	15.99	3.33
Sep-24	4.28	3.81	-	7.01	4.39	14.57	3.70
Oct-24	4.03	3.60	-	6.73	5.43	15.39	3.66
Nov-24	3.52	3.19	-	5.36	3.97	-	3.43
Dec-24	3.87	3.92	-	5.65	4.72	17.85	3.81
Jan-25	4.40	4.64	-	5.75	5.19	19.91	4.24
Feb-25	4.35	4.59	-	6.00	5.10	-	4.22
Mar-25	4.22	4.31	-	6.67	4.82	-	3.94

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

Table-17(c): Charges for Deviation (₹/kWh), 2024-25

Month	Average Charges for Deviation
Apr-24	5.55
May-24	5.58
Jun-24	5.61
Jul-24	5.42
Aug-24	4.56
Sep-24	4.85
Oct-24	4.68
Nov-24	4.01
Dec-24	4.79
Jan-25	5.03
Feb-25	4.95
Mar-25	4.82





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 there is a downward trend in the price of electricity transacted bilaterally through traders. It can also be observed from the figure that there is no price for electricity transacted during peak for the months from October to December in 2024 because there was no volume of electricity transacted exclusively during the peak period in these months.

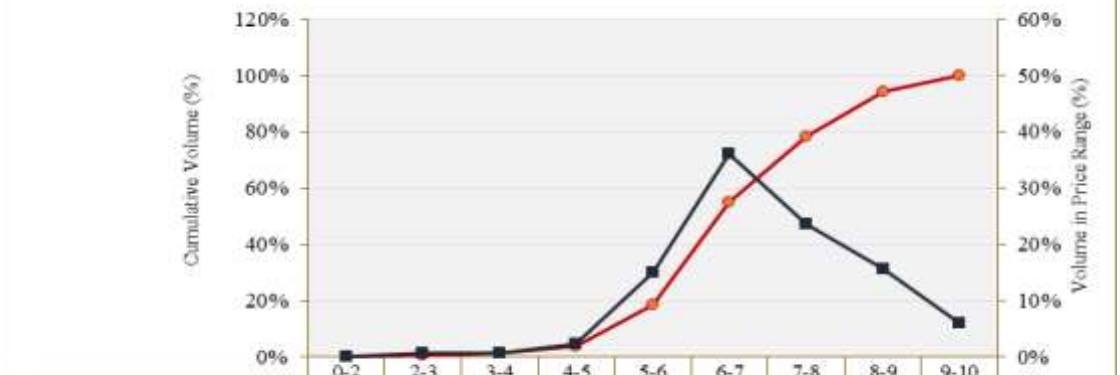
The trend in the price of electricity transacted through Power Exchanges in the various market segments is shown in Table-17(b) and Figure-16(b). The price of electricity transacted in RTM was lowest in most of the months. The price of electricity transacted in TAM was relatively high when compared with 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 weighted average price in the high price market segments (HP-DAM and HP-TAM) was relatively high when compared with other market segments of the power exchanges during 2024-25. It can be observed from the figure that there was no price for some of the months in HP-DAM and HP-TAM and the same due to no trading in those months.

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 HP-DAM segment at PXIL and in the G-DAM & HP-DAM segments at HPX, the same is not discussed.

The volume of bilateral transactions at different price slabs in 2024-25 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 94% of the volume of electricity was transacted through traders at less than ₹9/kWh.

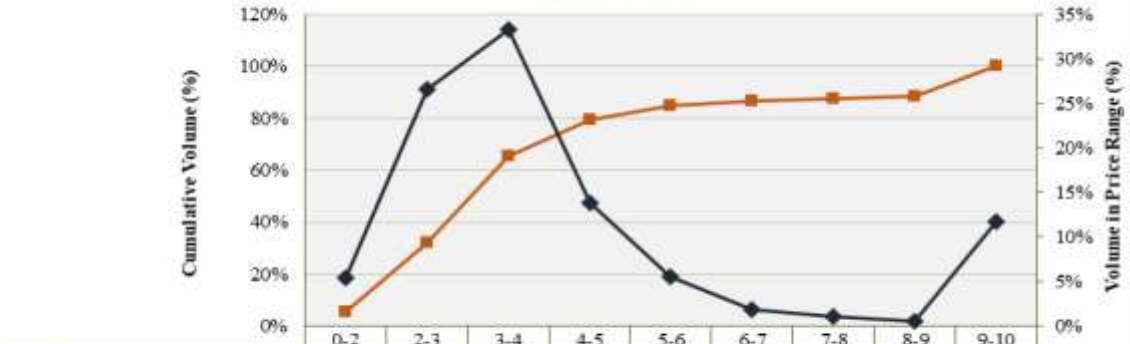
Figure-17: Volume of Bilateral Transaction through Traders at different Price Slabs, 2024-25



	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0.1%	1%	1%	4%	19%	55%	78%	94%	100%
Volume in Price Range (%)	0.1%	1%	1%	2%	15%	36%	24%	16%	5.9%

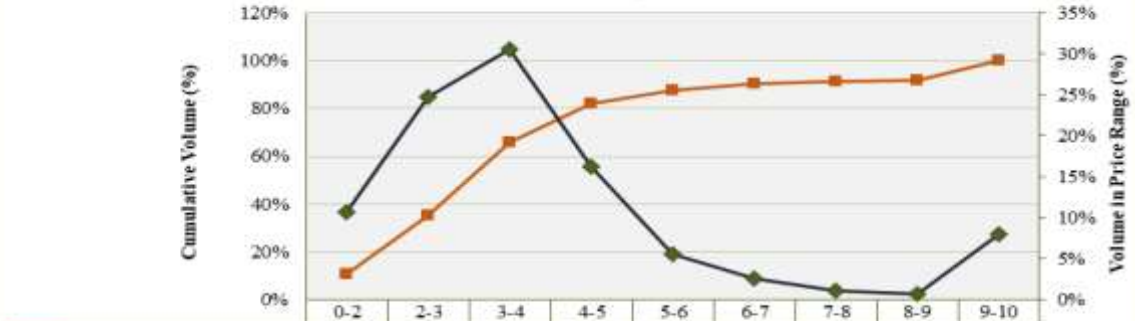
The volume of electricity transacted in IEX at different price slabs in DAM, G-DAM, RTM and HP-DAM segments during 2024-25 are depicted in Figure-18(a), 18(b), 18(c) and 18(d) respectively. The Figures show that 79% of the volume of electricity in DAM was transacted at less than ₹5/kWh and 88% of the volume of electricity was transacted at less than ₹9/kWh. In case of G-DAM, about 82% of the volume of electricity was transacted at less than ₹5/kWh and 92% of the volume of electricity was transacted at less than ₹9/kWh. Similarly, under RTM segment, 82% of the volume of electricity was transacted at less than ₹5/kWh and 90% of the volume of electricity was transacted at less than ₹9/kWh. In case of High-Price DAM, only 3% of the volume of electricity was transacted at less than ₹10/kWh and 82% 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, 2024-25



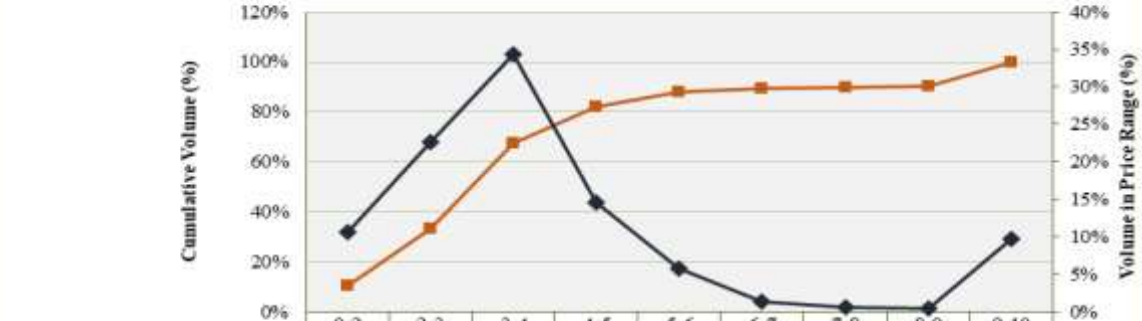
	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	5%	32%	65%	79%	85%	87%	88%	88%	100%
Volume in Price Range (%)	5%	27%	33%	14%	6%	2%	1%	1%	12%

Figure-18(b): Volume of IEX Transactions in Green Day Ahead Market at different Price Slabs, 2024-25



	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	11%	35%	66%	82%	88%	90%	91%	92%	100%
Volume in Price Range (%)	11%	25%	31%	16%	5%	3%	1%	1%	8%

Figure-18(c): Volume of IEX Transactions in Real Time Market at different Price Slabs, 2024-25



	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	11%	33%	68%	82%	88%	89%	90%	90%	100%
Volume in Price Range (%)	11%	23%	34%	15%	6%	1%	1%	0%	10%

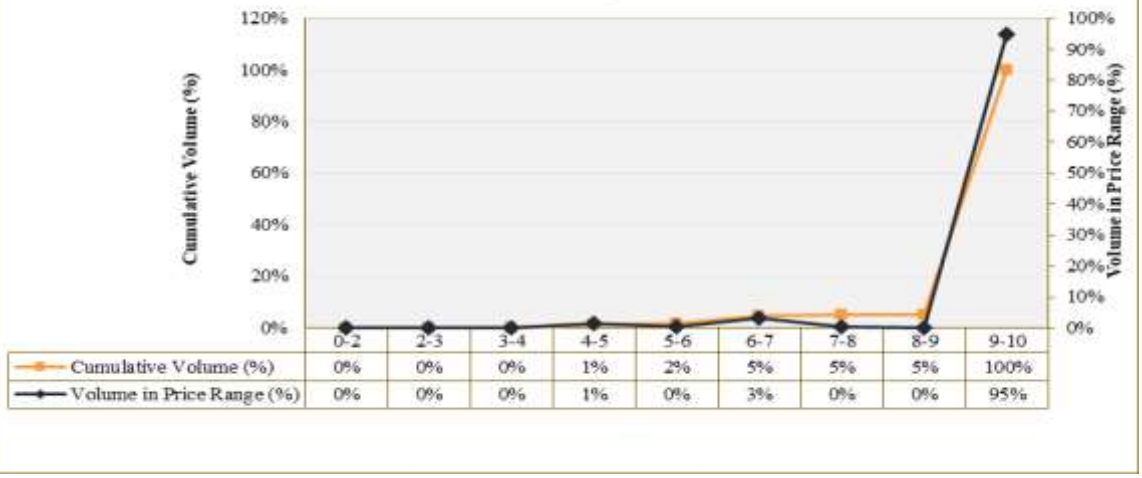
Figure-18(d): Volume of IEX Transactions in High Price Day Ahead Market at different Price Slabs, 2024-25



	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 (%)	1%	1%	2%	2%	2%	3%	3%	3%	3%	3%	9%	82%	82%	82%	100%
Volume in Price Range (%)	1%	0%	1%	0%	0%	1%	0%	0%	0%	0%	6%	73%	0%	0%	18%

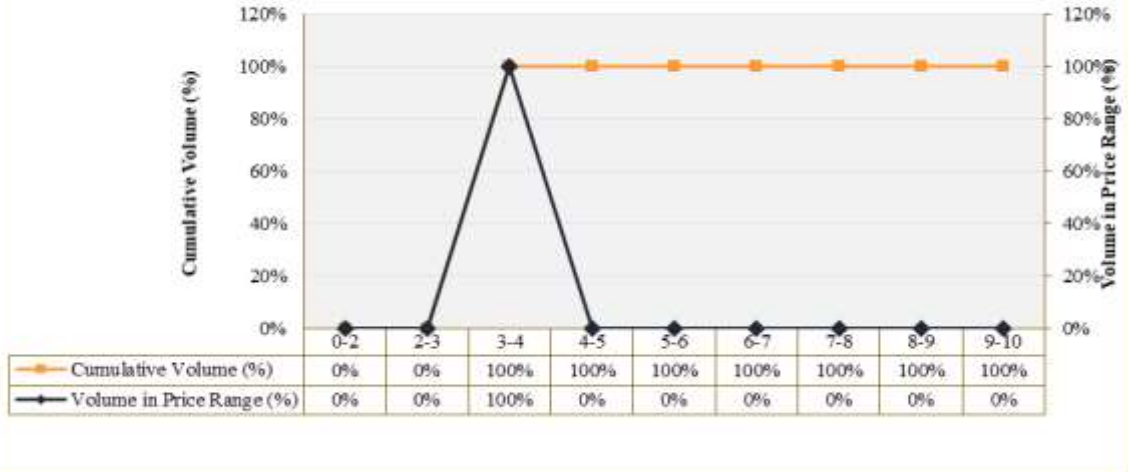
The volume of electricity transacted in PXIL at different price slabs in DAM, G-DAM and RTM is depicted in Figure-19 (a), 19(b) and 19(c) respectively. The figures show that only 1% of the volume of electricity in DAM was transacted at less than ₹5/kWh, and about 5% of the volume of electricity was transacted at less than ₹9/kWh. There were very few transactions through PXIL in G-DAM and RTM during 2024-25. In case of G-DAM, 100% volume was transacted at less than ₹5/kWh. In case of RTM, only 3% of the volume of electricity was transacted at less than ₹9/kWh. There was no trade in HP-DAM at PXIL.

Figure-19(a): Volume of PXIL Transactions in Day Ahead Market at different Price Slabs, 2024-25



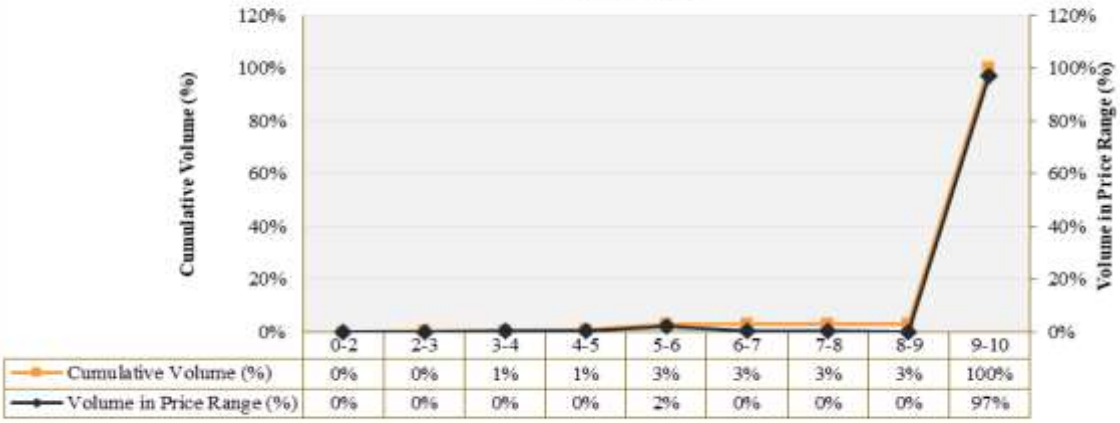
	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0%	0%	0%	1%	2%	5%	5%	5%	100%
Volume in Price Range (%)	0%	0%	0%	1%	0%	3%	0%	0%	95%

Figure-19(b): Volume of PXIL Transactions in Green Day Ahead Market at different Price Slabs, 2024-25



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

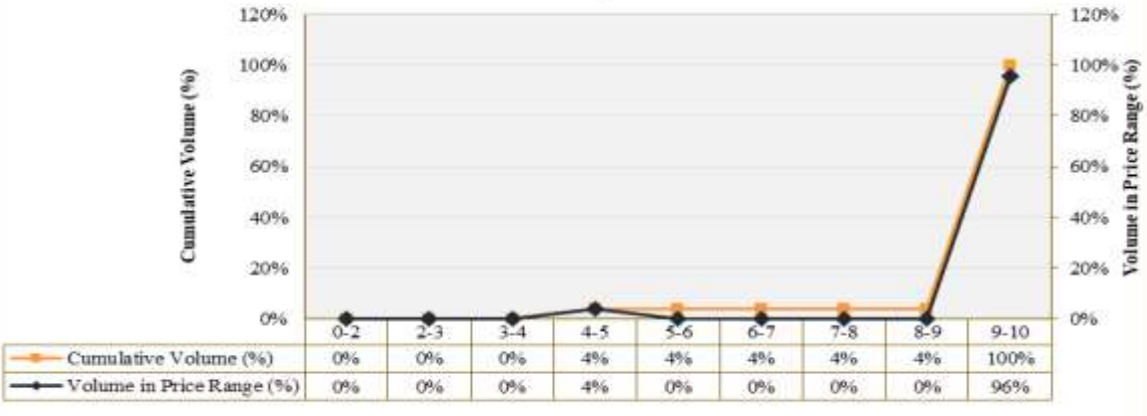
Figure-19(c): Volume of PXIL Transactions in Real Time Market at different Price Slabs, 2024-25



	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0%	0%	1%	1%	3%	3%	3%	3%	100%
Volume in Price Range (%)	0%	0%	0%	0%	2%	0%	0%	0%	97%

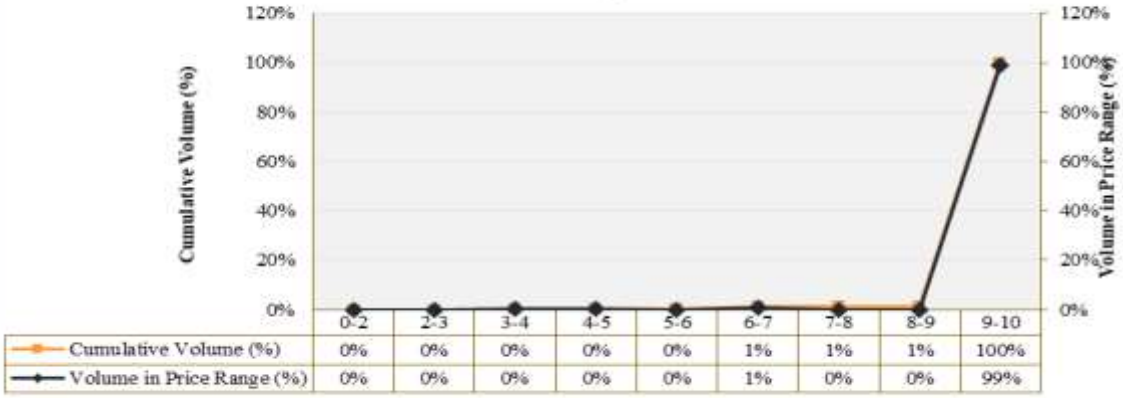
The volume of electricity transacted at HPX at different price slabs in DAM and RTM is depicted in Figure-20(a) and 20(b), respectively. There were very few transactions in DAM and RTM at HPX during 2024-25. Only 4% of volume of electricity transacted in DAM at less than ₹5/kWh and ₹9/kWh. There was no volume of electricity transacted 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, 2024-25



	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0%	0%	0%	4%	4%	4%	4%	4%	100%
Volume in Price Range (%)	0%	0%	0%	4%	0%	0%	0%	0%	96%

Figure-20(b): Volume of HPX Transactions in Real Time Market at different Price Slabs, 2024-25



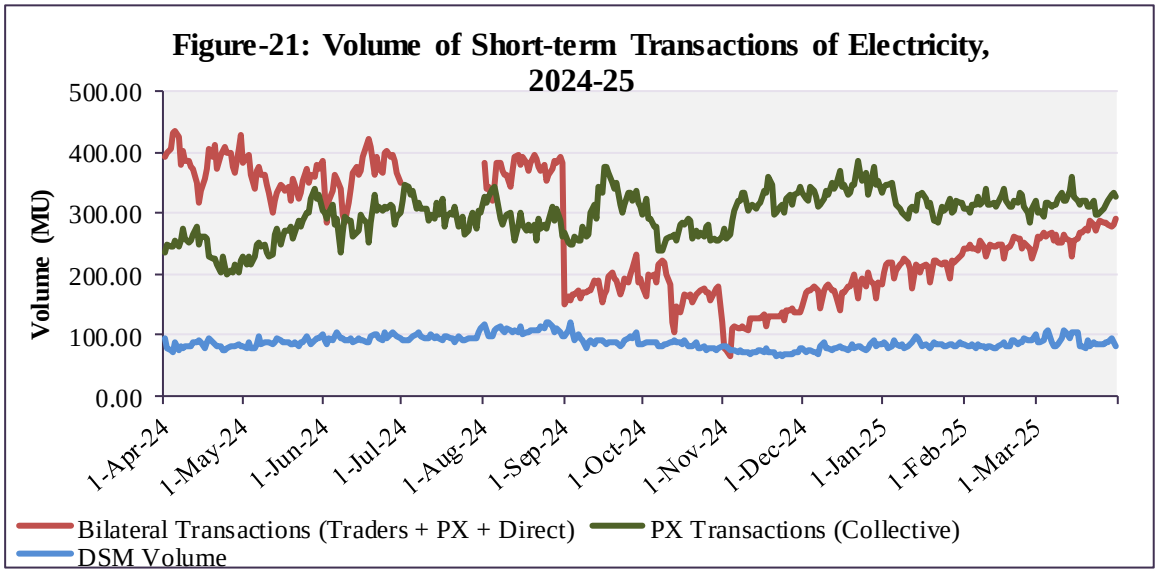
	0-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Cumulative Volume (%)	0%	0%	0%	0%	0%	1%	1%	1%	100%
Volume in Price Range (%)	0%	0%	0%	0%	0%	1%	0%	0%	99%

4. Daily Trends in Short-term Transactions of Electricity & DSM Volume (1st April 2024 to 31st March 2025)

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 August 2024. The volume of bilateral transactions witnessed an increase from November 2024 to March 2025.

Figure-21: Volume of Short-term Transactions of Electricity, 2024-25



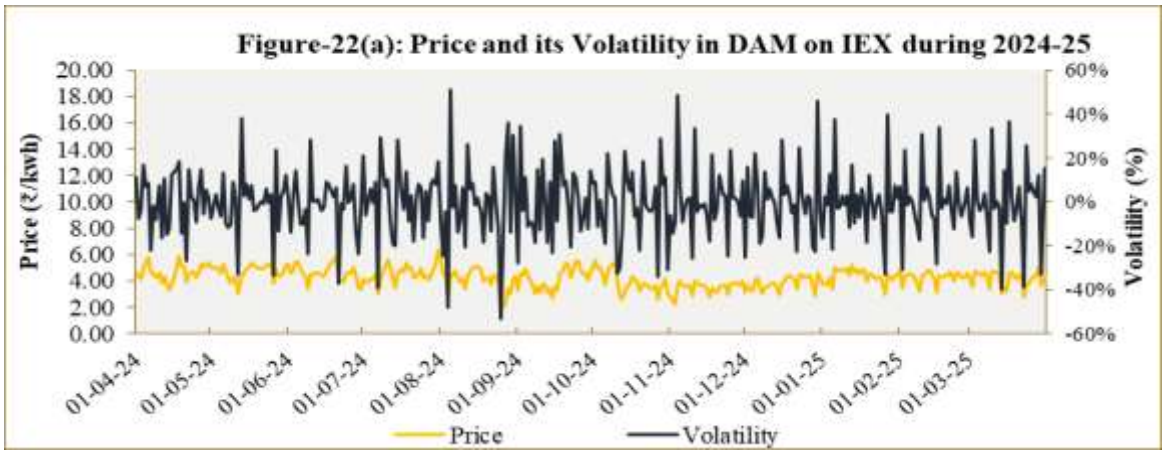
Note: With change in the regime on implementation of GNA Regulations from 1st October 2023, the volume reported here is not strictly comparable. The data on volume of bilateral transactions is not available for the month of July 2024.

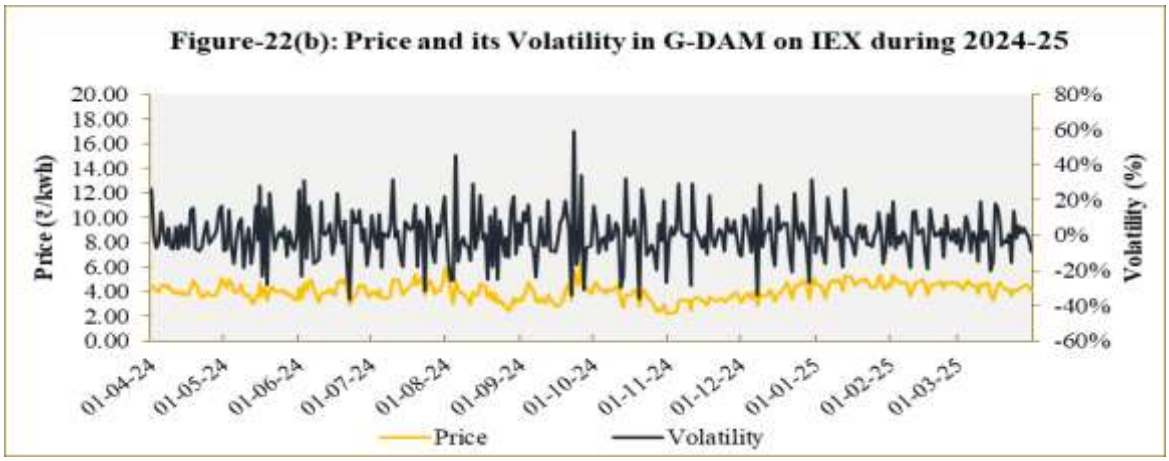
4.2 Price of Short-term Transactions of Electricity

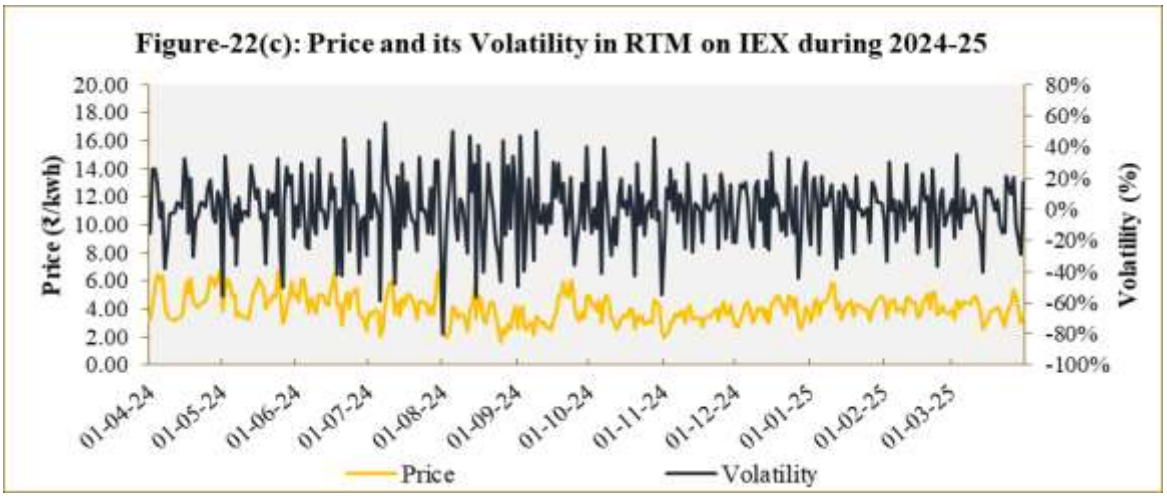
Price and its volatility in the daily price of short-term transactions of electricity through power exchanges (collective transactions) have been analysed in this section. Volatility has been computed using the historical volatility formula (see Annexure-III for the formula).

4.2.1 Price and its Volatility in Power Exchanges

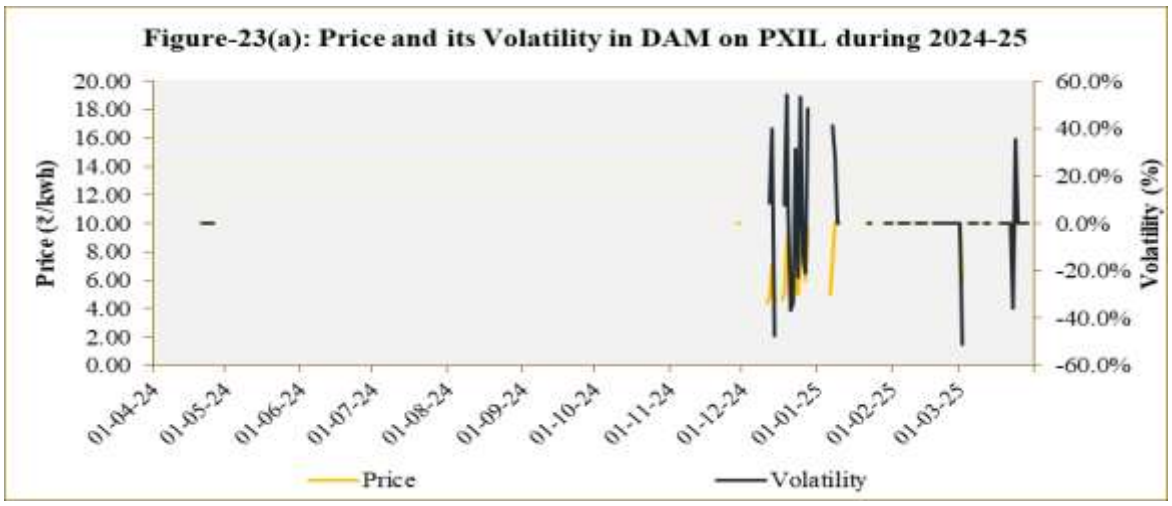
The weighted average price of electricity transacted through IEX in DAM, G-DAM and RTM segments with their respective volatility levels are shown in Figure-22(a), 22(b) and 22(c), respectively during 2024-25. Volatility in the price of electricity transacted through IEX has been computed using daily data for 2024-25, and it works out to be 15.51% in the case of DAM, 13.31% in G-DAM and 21.14% in RTM. The trading in HP-DAM took place on limited number of days during the year, therefore, the volatility in this market segment has not been depicted.

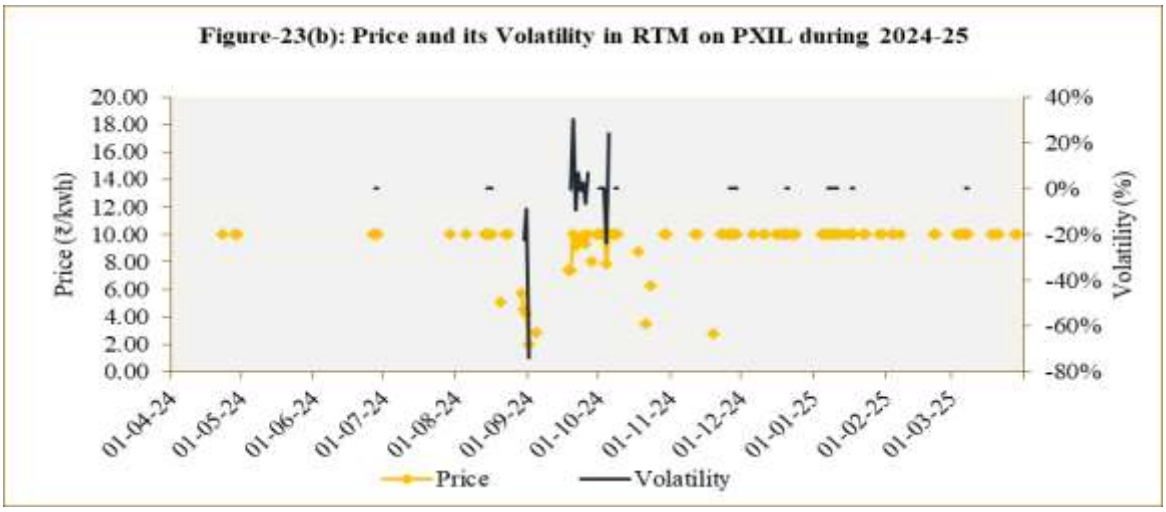




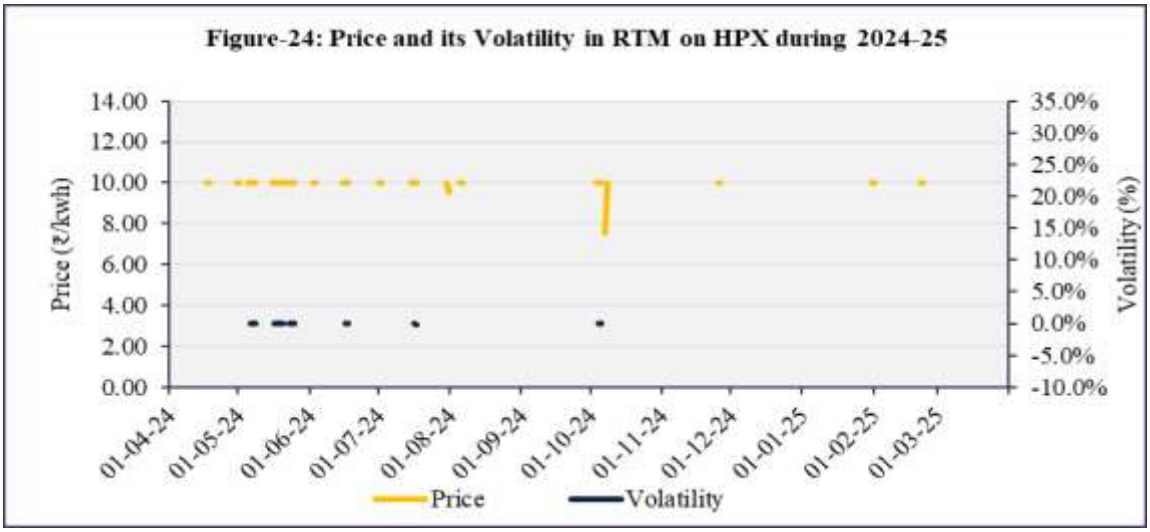


The weighted average price of electricity transacted through PXIL in DAM and RTM segments with their respective volatility levels are shown in Figure-23(a) & Figure-23(b). The price and its volatility for the electricity transacted through PXIL in GDAM and HP-DAM are not depicted here due to low liquidity and transactions took place on limited number of days in 2024-25. Volatility in the price of electricity transacted through PXIL in DAM and RTM has been computed using daily data for 2024-25, and it works out to be 18.36% and 12.58% respectively.





The weighted average price of electricity transacted through HPX in RTM and its volatility has been depicted in Figure-24. The volatility in the price of electricity transacted in RTM was about 5.65% during 2024-25. Very limited number of transactions took place in DAM whereas no transactions took place in G-DAM and HP-DAM at HPX during 2024-25.



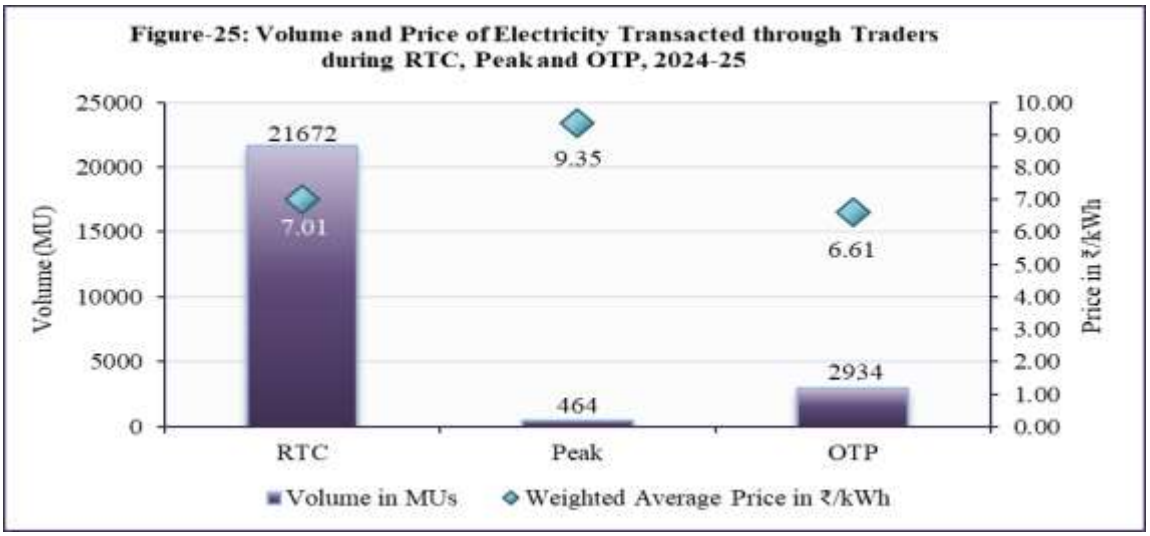
5. Time of the Day Variation in Volume and Price of Electricity Transacted through Traders and Power Exchanges

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

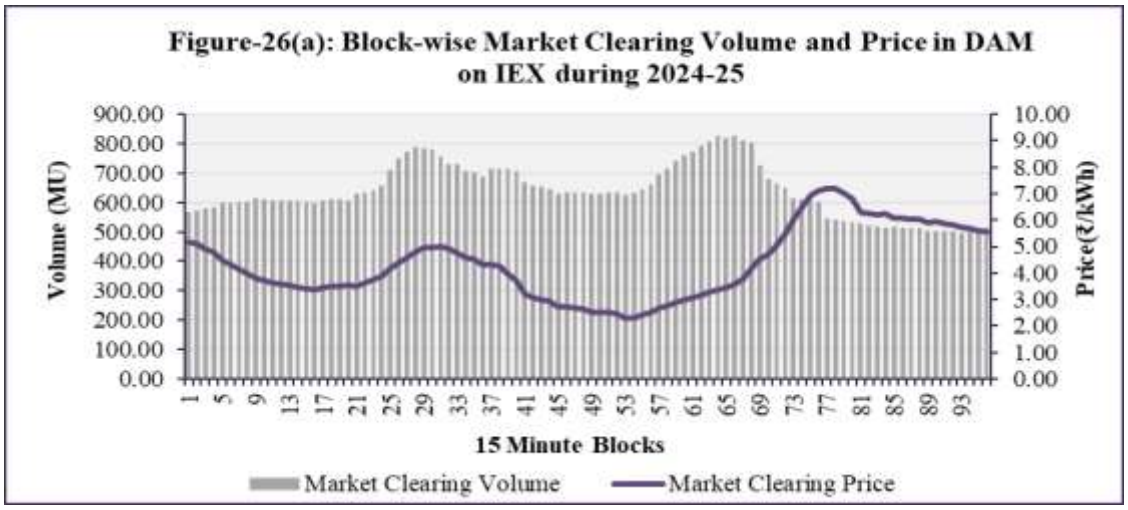
Time of the day variation in volume and price of electricity transacted bilaterally through traders during 2024-25 is shown in Figure-25. The volume of electricity transacted through traders represent inter-state transactions, i.e., excluding banking transactions. Time of the day variation in volume is shown during RTC (Round the Clock), Peak period and OTP (other than RTC & Peak period). Of the total volume, 86.4% was transacted during RTC, followed by 11.7% during OTP and 1.9% during peak period. It can be observed from the figure that the share of electricity transacted during peak period is much lower with less than 2% of the total transactions. It can also be observed that the weighted average price during Peak period was relatively high (₹9.35/kWh), as compared to price of electricity transacted during RTC (₹7.01/kWh) and OTP (₹6.61/kWh).

Figure-25: Volume and Price of Electricity Transacted through Traders during RTC, Peak and OTP, 2024-25

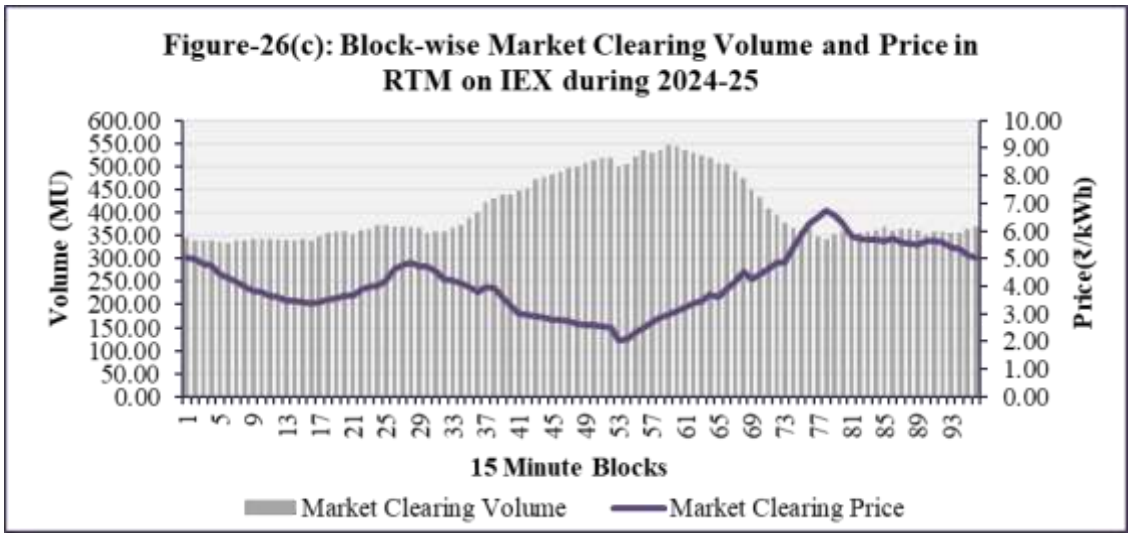


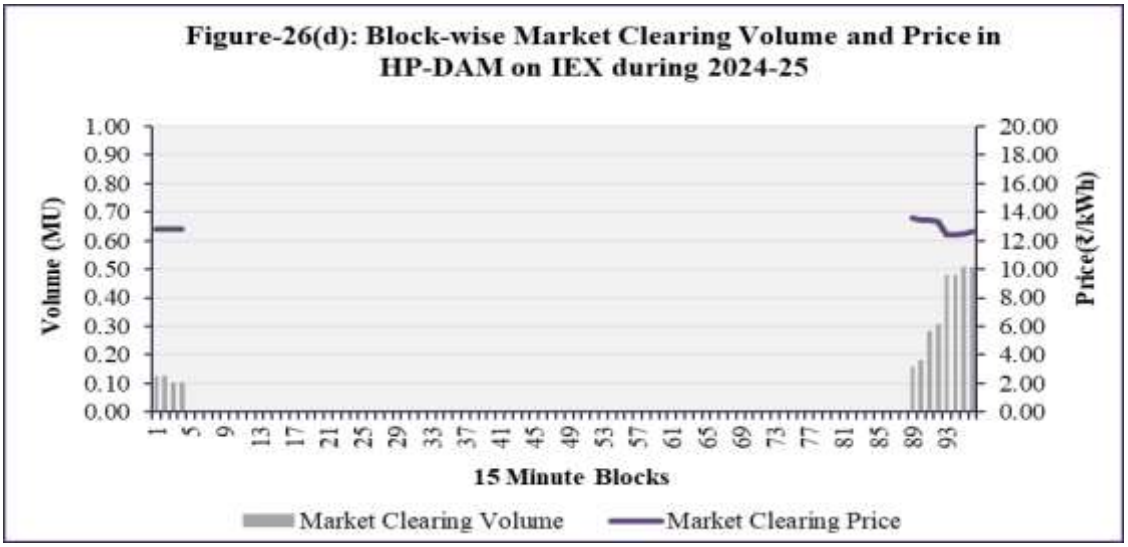
5.2 Time of the Day Variation in Volume and Price of Electricity Transacted through Power Exchanges

Time of the day variation in volume and price of electricity transacted under DAM, G-DAM, RTM and HP-DAM at IEX during 2024-25 are shown block-wise in Figure-26(a), 26(b), 26(c) and 26(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. In HP-DAM, the volume of electricity transacted only during first 4 blocks and last 8 blocks during 2024-25.

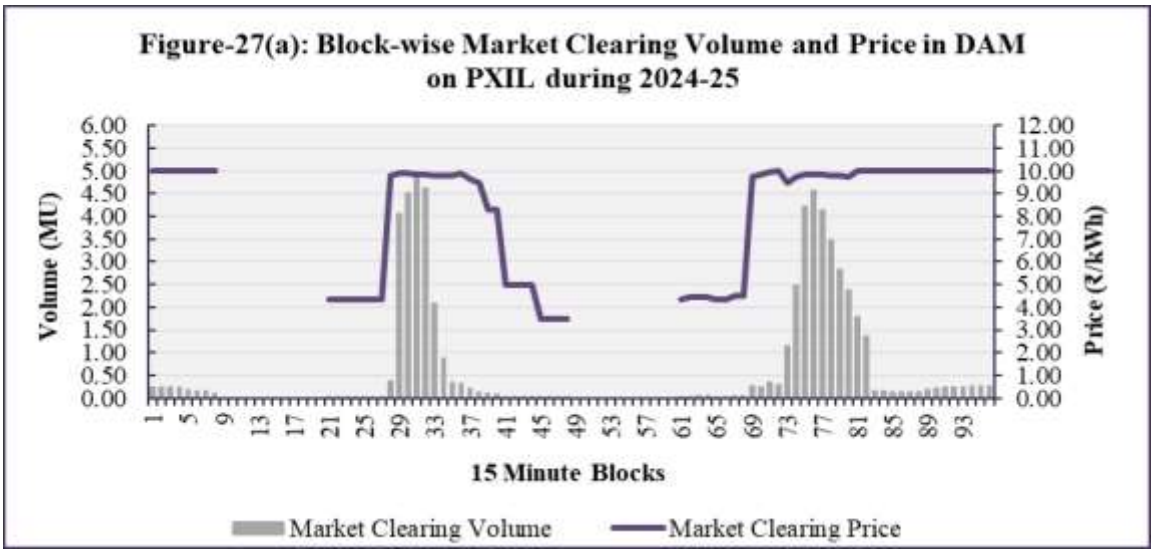


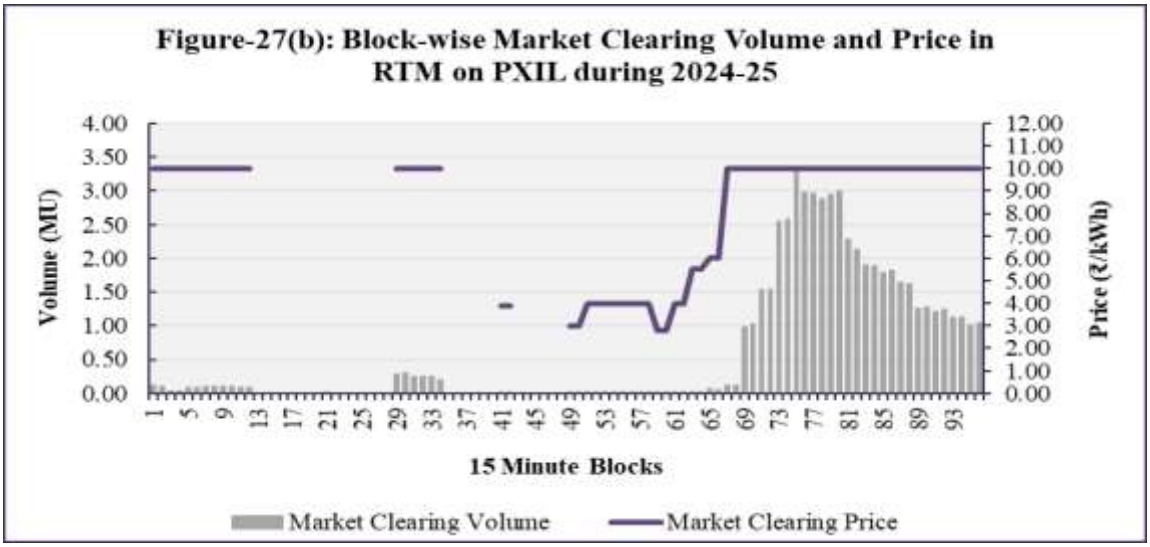




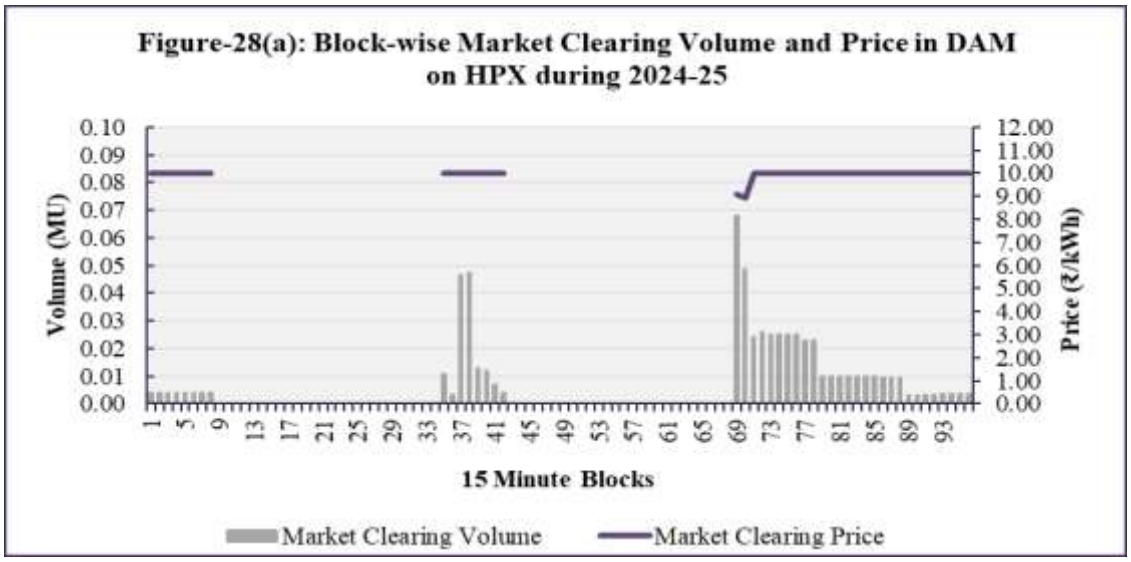


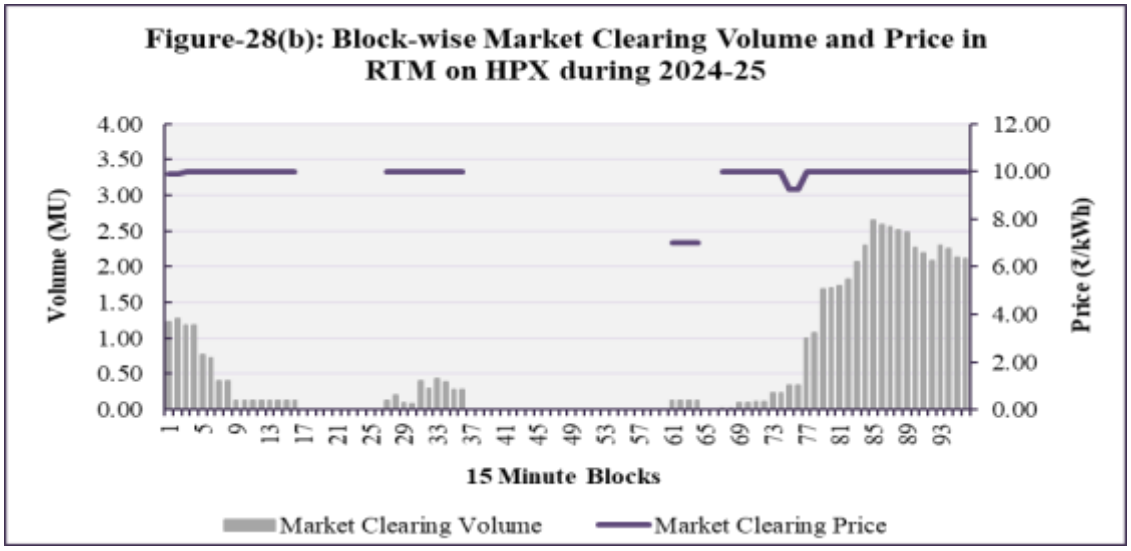
Time of the day variation in volume and price of electricity transacted through DAM and RTM on PXIL during 2024-25 is shown block-wise in Figure-27(a) and Figure-27(b), respectively. It may be observed from the figures that the volume of electricity transacted in limited number of blocks i.e. during morning and evening peak periods in DAM and the price of the electricity remained high at ceiling price, except for a few blocks during off-peak solar hours. In RTM, most of the volume of electricity transacted during evening peak and the price of electricity remained at ceiling. Very limited transactions took place in GDAM and No transactions took place in HP-DAM at PXIL.





Time of the day variation in volume of electricity transacted through DAM and RTM at HPX during 2024-25 is shown block-wise in Figure-28(a) and Figure-28(b). The electricity was transacted during very limited number of blocks in DAM and RTM and the price of electricity remained at ceiling. No time of day variation observed in price, as the transactions took place only at the ceiling price of Rs.10/kWh. No transactions took place in GDAM and HP-DAM at HPX during 2024-25.





Region-wise and block-wise average price (simple average) of electricity transacted through IEX in DAM, G-DAM, RTM and HP-DAM are shown in Figure-29(a), 29(b), 29(c) and 29(d), respectively. It can be observed that during 2024-25, the price of electricity in all the regions was almost similar, which is indicative of very few instances of congestion. In case of DAM and GDAM, in the initial blocks, the price of electricity was slightly lower in the NR and WR region when compared with the MCP (Figure 29(a)). In case of RTM, in half of the blocks, the price of electricity was marginally higher in NR region, when compared with the MCP (Figure 29(c)). In HP-DAM, the volume of electricity transacted only during first 4 blocks and last 8 blocks during 2024-25.

Figure-29(a): Region-wise and Block-wise Price of Electricity Transacted in DAM through IEX, 2024-25

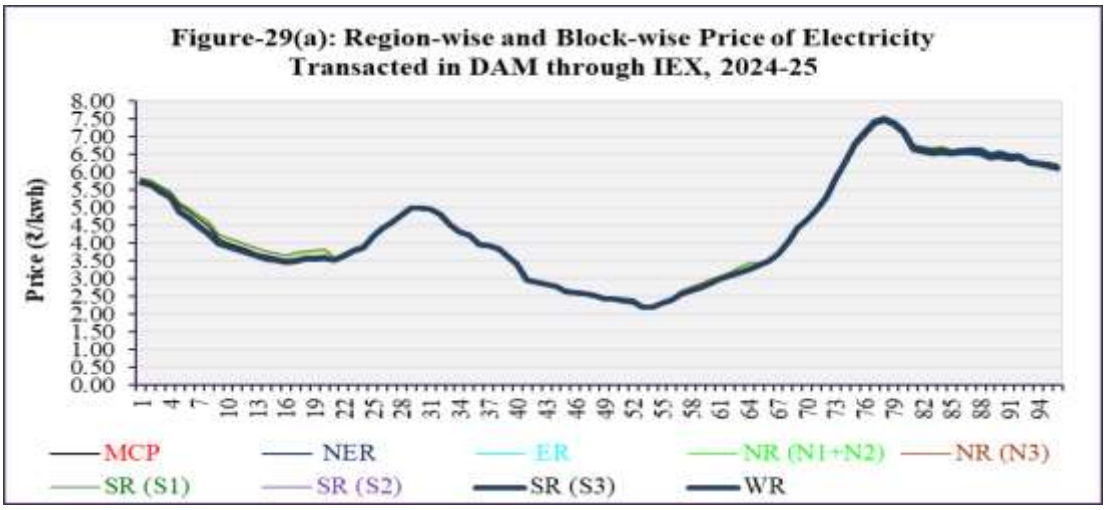


Figure-29(b): Region-wise and Block-wise Price of Electricity Transacted in G-DAM through IEX, 2024-25

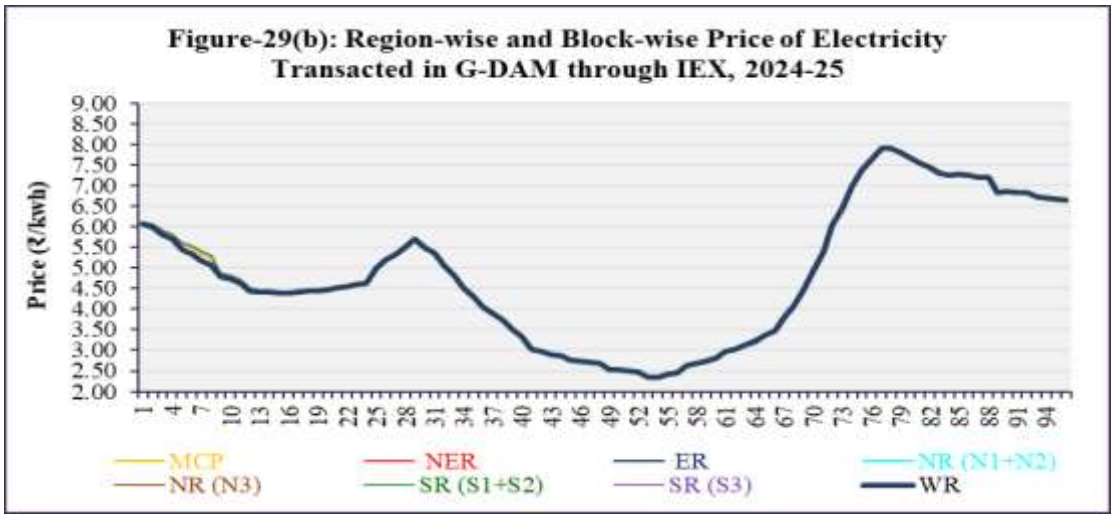
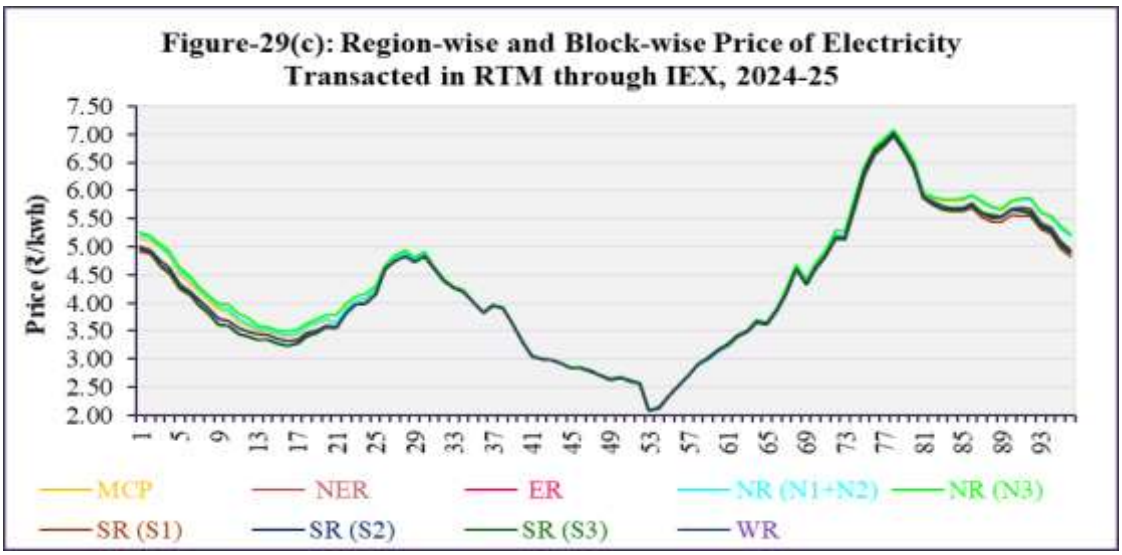
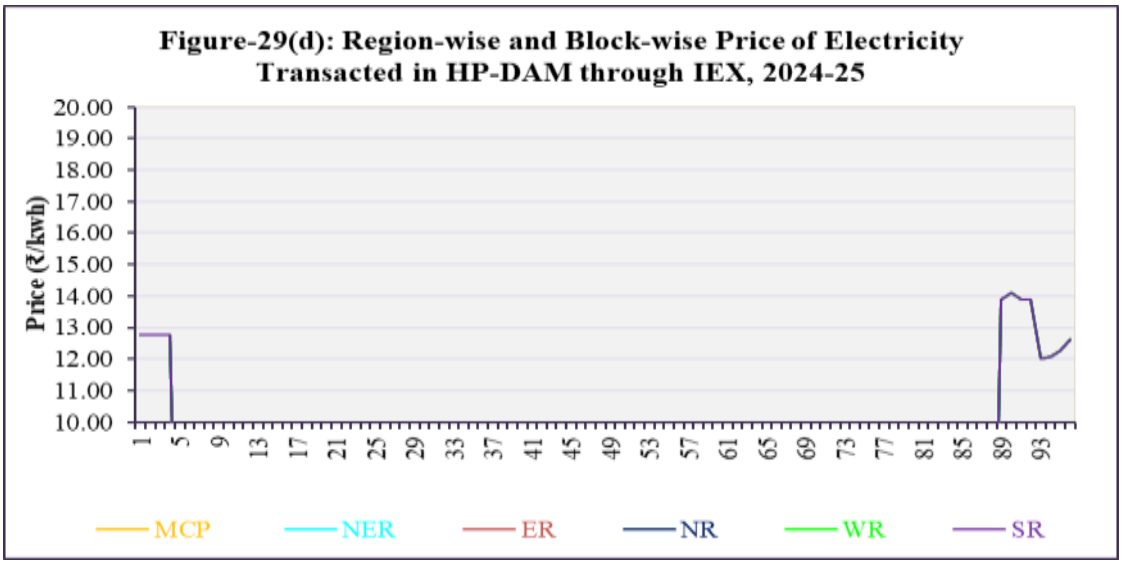
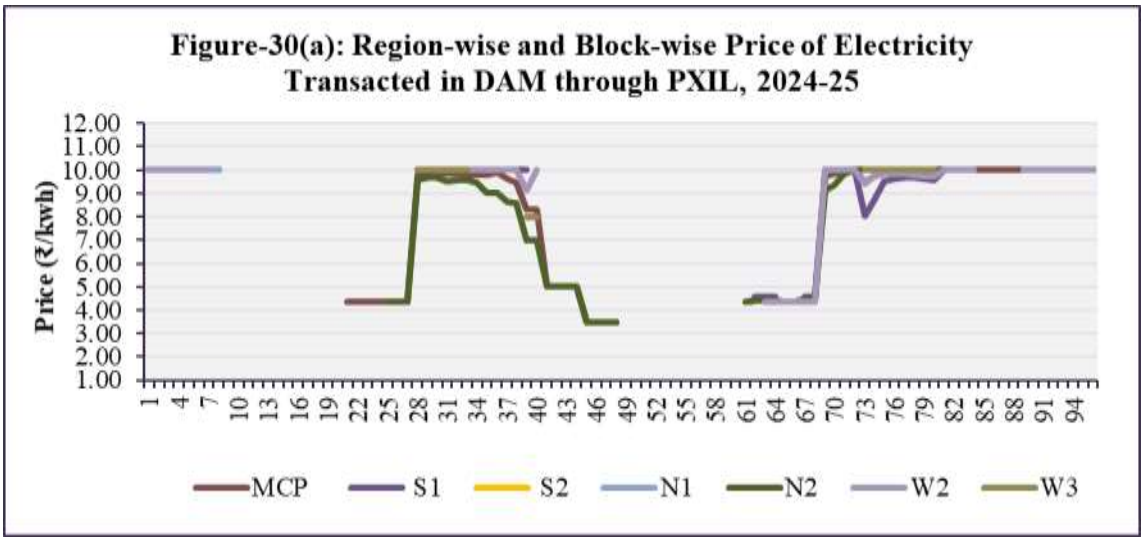


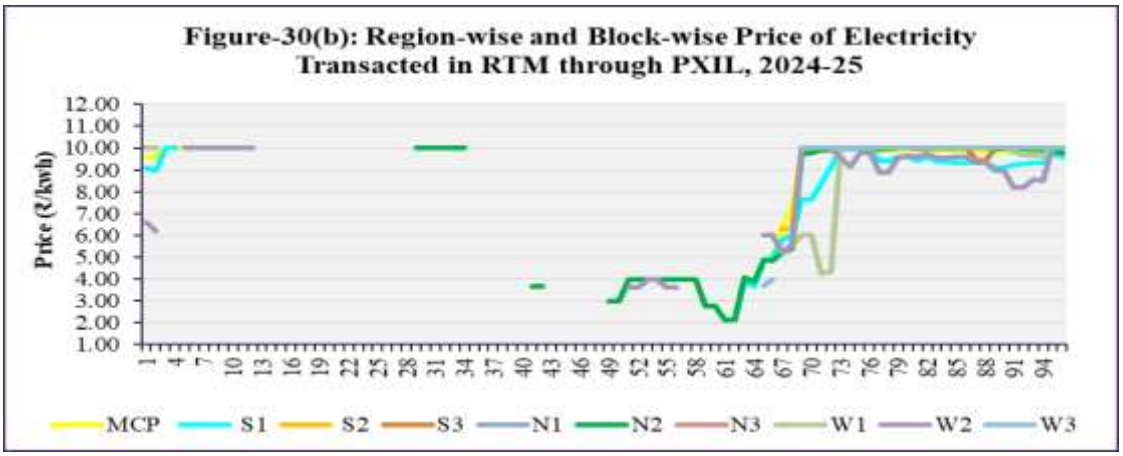
Figure-29(c): Region-wise and Block-wise Price of Electricity Transacted in RTM through IEX, 2024-25



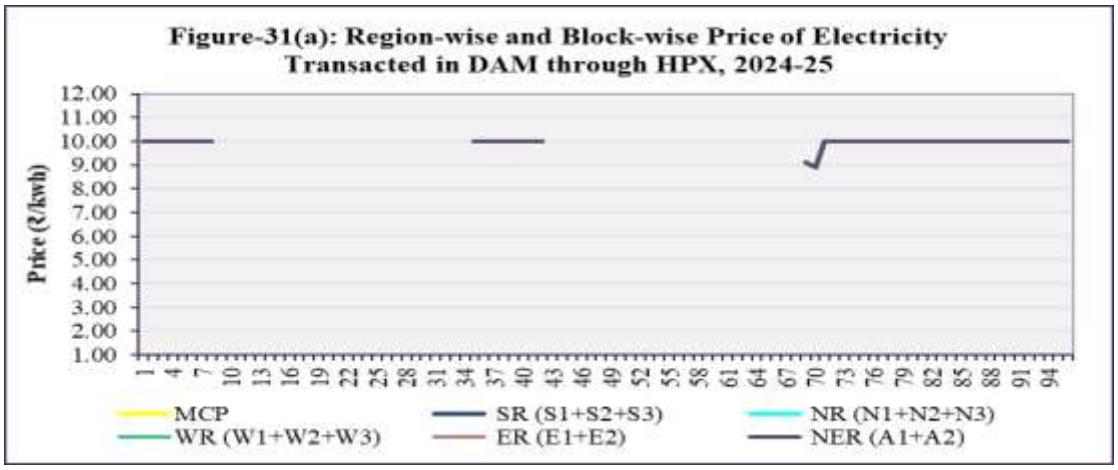


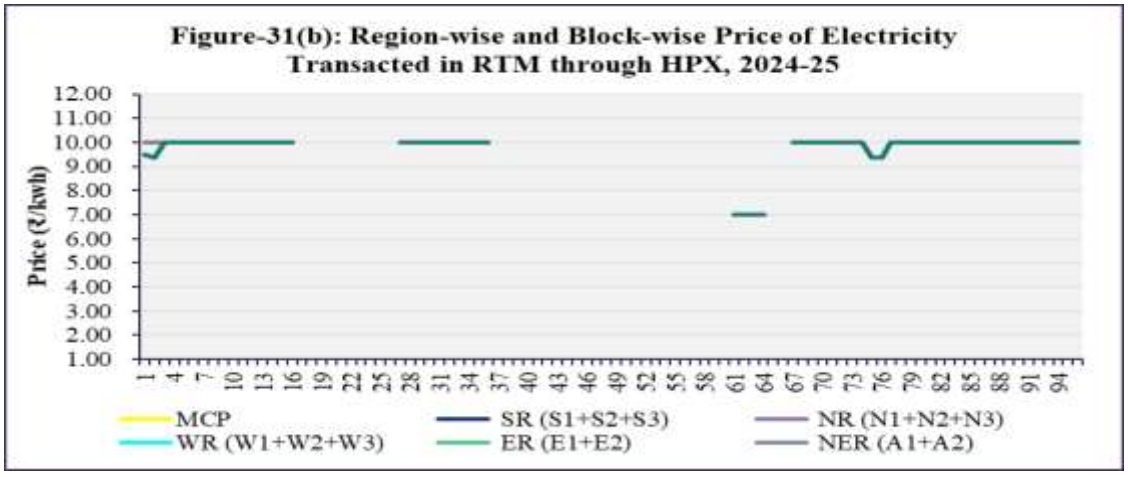
Region-wise and block-wise price of electricity transacted through PXIL in DAM and RTM are shown in Figure-30(a) and Figure-30(b), respectively. It can be observed from the figures that the electricity transactions took place in limited blocks in DAM and RTM of PXIL. Very limited transactions took place in GDAM and No transactions took place in HP-DAM at PXIL.





Region-wise and block-wise price of electricity transacted through HPX in DAM and RTM in 2024-25 are shown in Figure-31(a) and Figure-31(b). It can be observed from the figures that the electricity transactions took place in limited blocks in DAM and RTM of HPX. No transactions took place in G-DAM and HP-DAM in HPX during 2024-25.





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-32).

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 2024-25 is provided in Table-18 and Figure-32.

Table-18: Trading Margin Charged by Trading Licensees, 2009-10 to 2024-25

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
2024-25	0.019

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



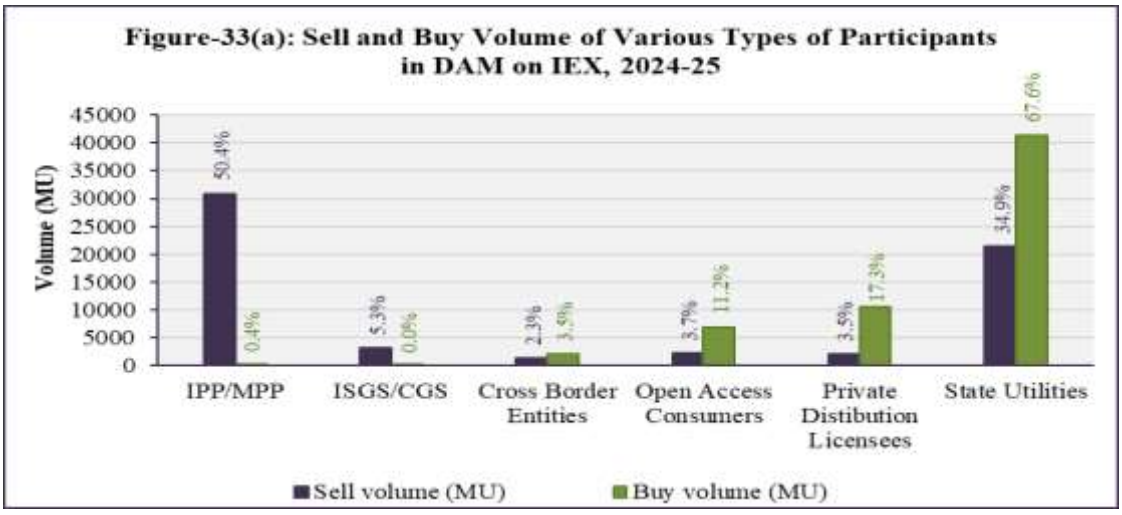
It can be observed from the above figure that the trading margin charged by the trading licensees witnessed a downward trend over the years, except for a few years. This may be attributed to the increasing competition among the trading licensees.

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-33(a), 33(b), 33(c) and 33(d) during the year 2024-25, 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-33(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 state utilities, open access consumers and private distribution licensees {Figure-33(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 and private distribution licensees {Figure-33(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 {Figure-33(d)}.


Figure-33(a): Sell and Buy Volume of Various Types of Participants in DAM on IEX, 2024-25
Volume (MU)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
50.4%
0.4%
5.3%
0.0%
2.3%
3.4%
3.7%
11.2%
3.5%
17.3%
34.9%
67.6%
IPP/MPP
ISGS/CGS
Cross Border Entities
Open Access Consumers
Private Distibution Licensees
State Utilities
Sell volume (MU)
Buy volume (MU)

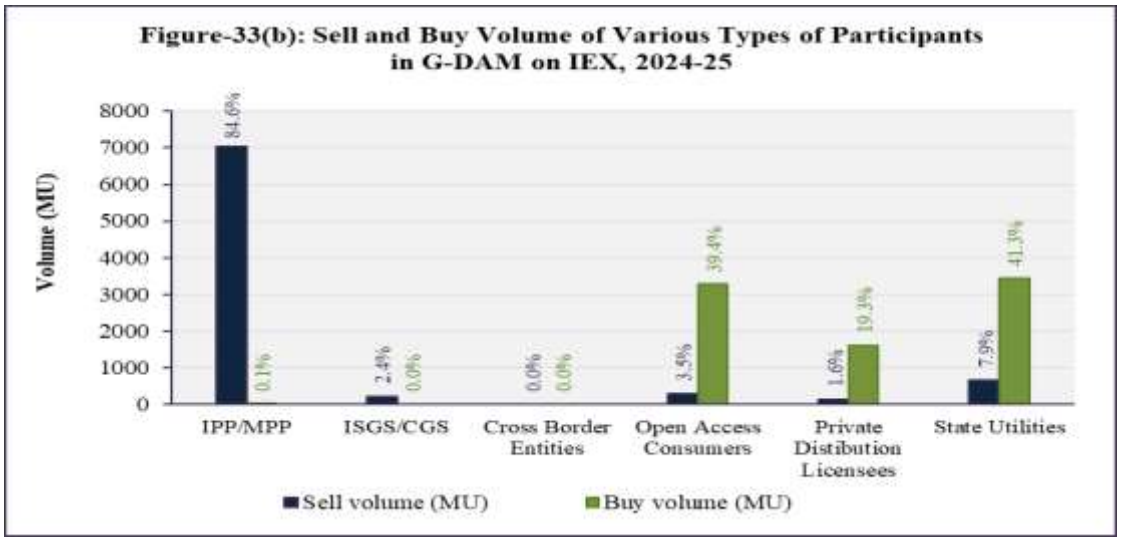
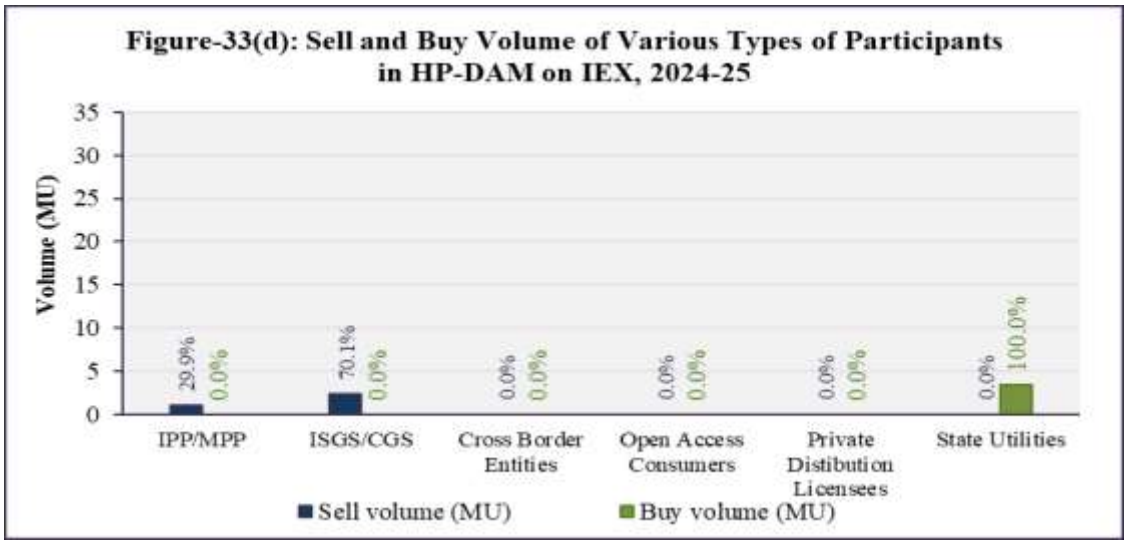
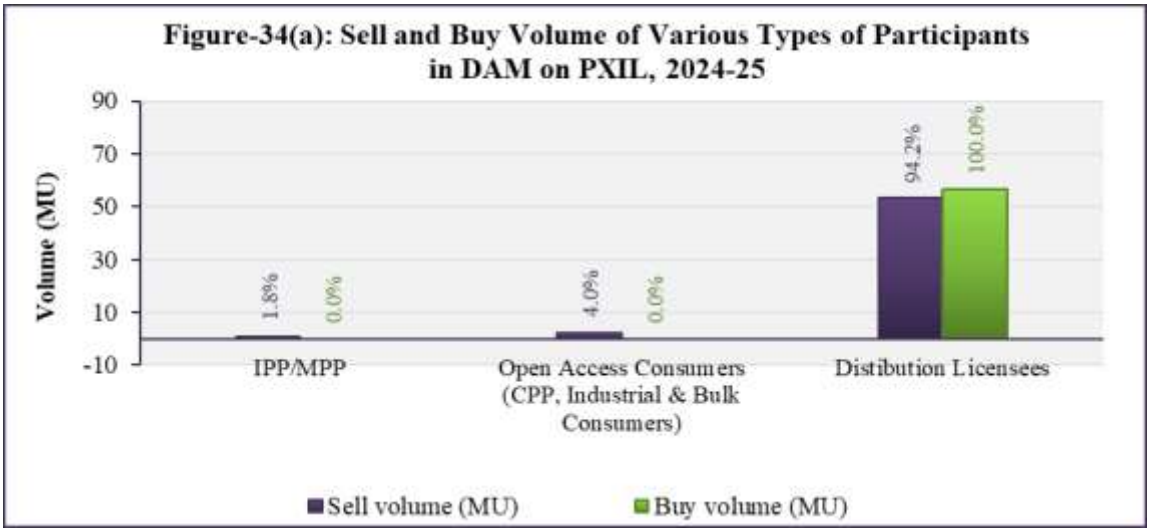
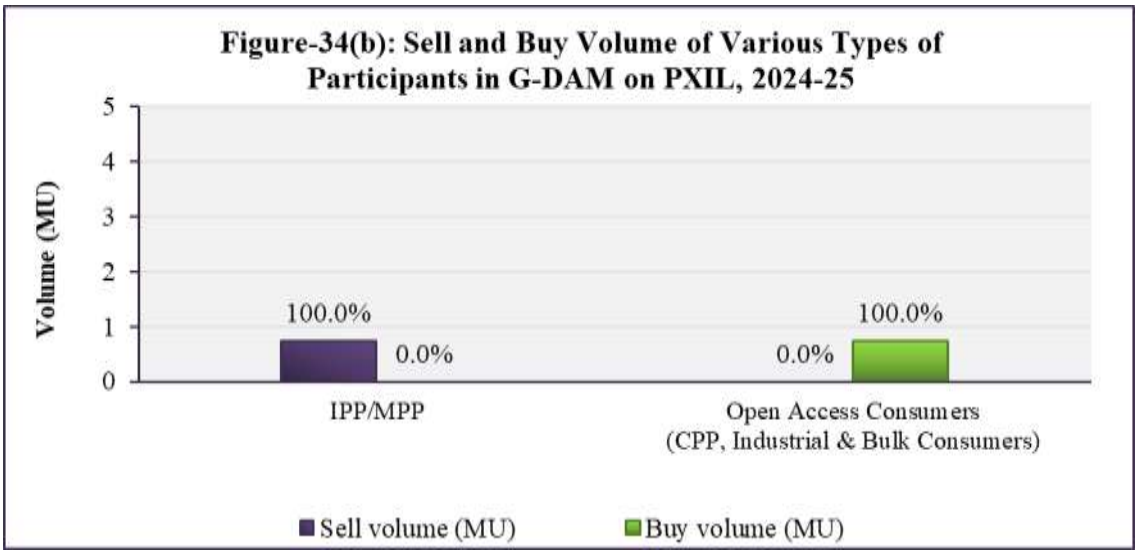

Figure-33(b): Sell and Buy Volume of Various Types of Participants in G-DAM on IEX, 2024-25
Volume (MU)
8000
7000
6000
5000
4000
3000
2000
1000
0
84.6%
0.1%
2.4%
0.0%
0.0%
0.0%
3.5%
39.4%
1.6%
19.3%
7.9%
41.3%
IPP/MPP
ISGS/CGS
Cross Border Entities
Open Access Consumers
Private Distibution Licensees
State Utilities
Sell volume (MU)
Buy volume (MU)

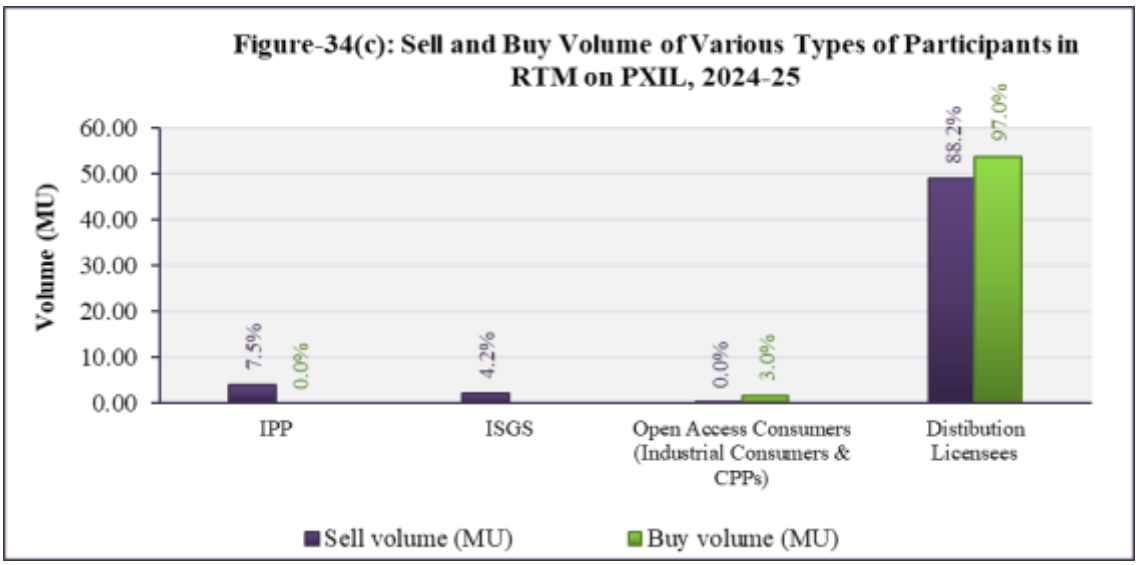

Figure-33(c): Sell and Buy Volume of Various Types of Participants in RTM on IEX, 2024-25
Volume (MU)
30000
25000
20000
15000
10000
5000
0
16.6%
1.8%
10.8%
0.1%
1.1%
0.9%
3.6%
10.7%
4.0%
10.1%
63.9%
76.3%
IPP/MPP
ISGS/CGS
Cross Border Entities
Open Access Consumers
Private Distibution Licensees
State Utilities
Sell volume (MU)
Buy volume (MU)



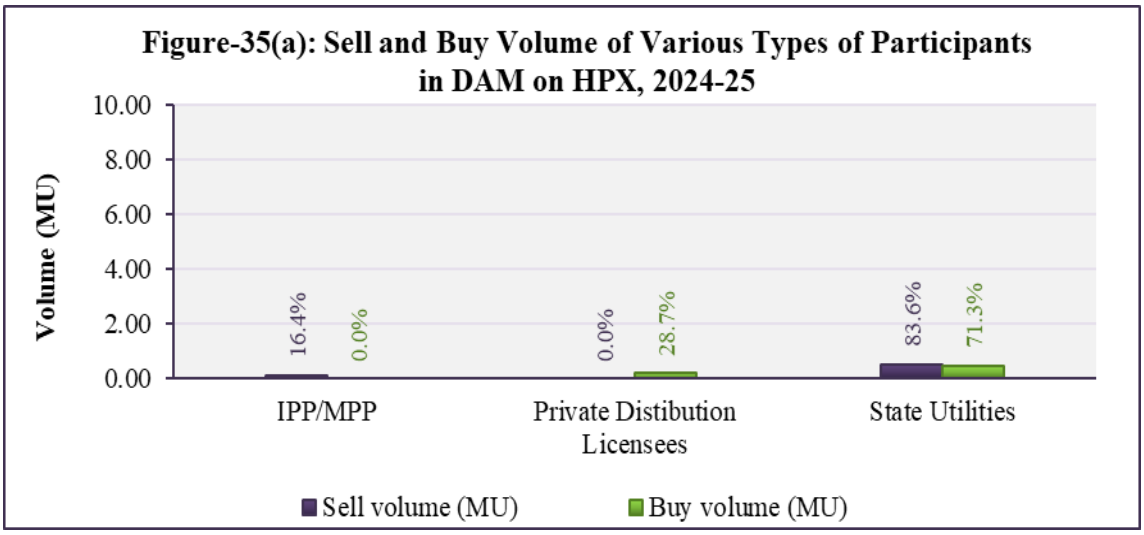
There were four types of participants (IPPs/MPPs, ISGS, Open Access Consumers, and Distribution Licensees) at PXIL during 2024-25. Details of share of various participants in DAM, G-DAM and RTM segments are shown in Figure-34(a), 34(b) and 34(c), respectively. It can be observed from the figure that major sellers and buyers of electricity at PXIL in DAM and RTM were distribution licensees. In case of G-DAM, the major sellers were IPP/MPP whereas the major buyers were open access consumers. No transactions took place in HP-DAM at PXIL during 2024-25.

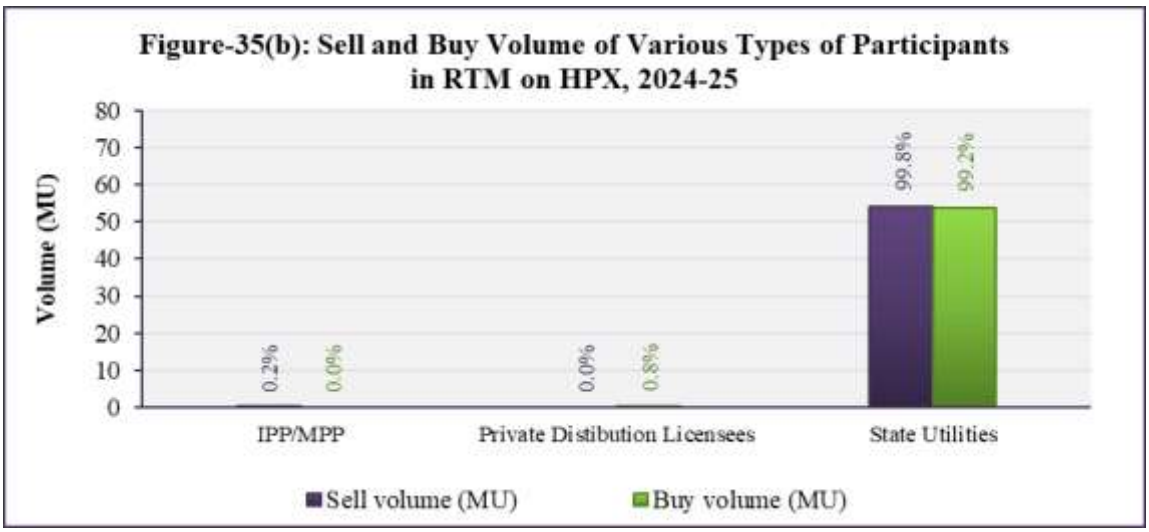






Details of share of various participants in DAM and RTM segments at HPX are shown for the year 2024-25 in Figure-35(a) and 35(b) respectively. It can be observed from the figures that the major sellers and major buyers in DAM and RTM were State Utilities. No transactions took place at HPX in G-DAM and HP-DAM during 2024-25.





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 5383 and 936, respectively in 2024-25 (Table-19). The number of OA consumers at IEX and PXIL increased at a CAGR of 16%, and 14%, respectively. In case of HPX, which commenced its operations in July 2022, the number of OA consumers increased from 239 in 2022-23 to 297 in 2024-25 (Table-19). During the period, the percentage of open access consumers in total portfolios at IEX varied between 87.6% to 96.2%. In PXIL, the percentage of open access consumers

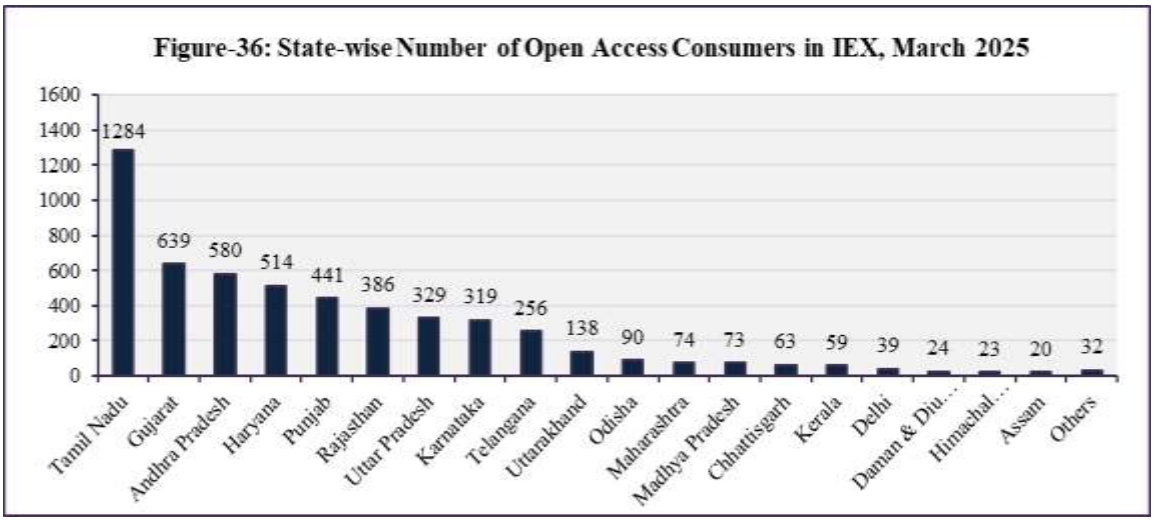
in total portfolio declined significantly from about 90% in 2010-11 to about 16% in 2018-19 and then increased from 16% in 2018-19 to about 22% in 2024-25. In case of HPX, the percentage of open access consumers in total portfolio declined from about 50% in 2022-23 to about 37% in 2024-25.

Table-19: Number of Open Access Consumers in Power Exchanges, 2010-11 to 2024-25

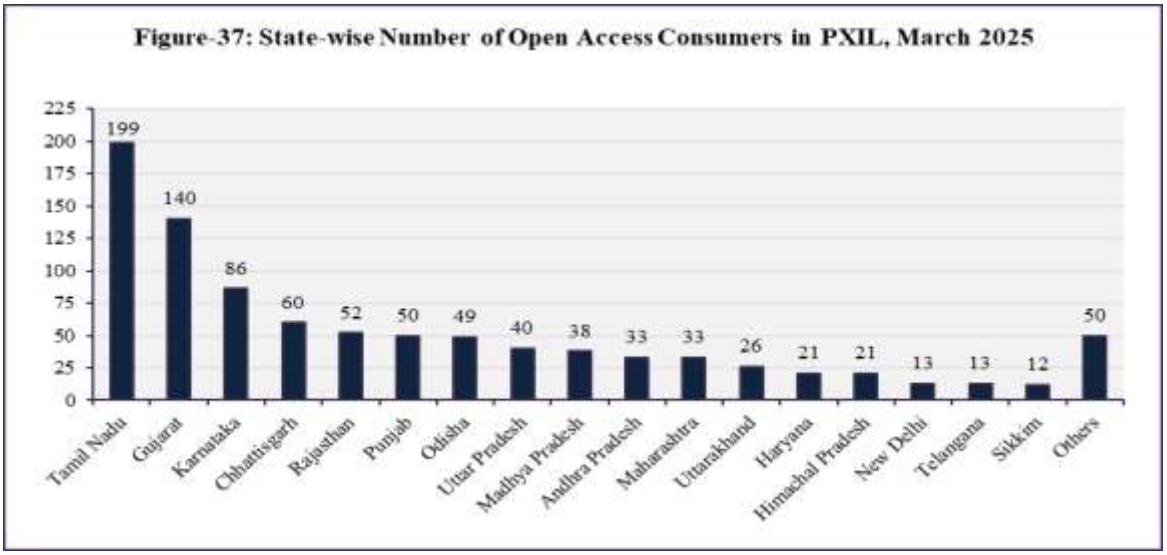
Year	IEX			PXIL			HPX		
	No. of Open Access Consumers	Total No. of Portfolios	% of Open Access Consumers	No. of Open Access Consumers	Total No. of Portfolios	% of Open Access Consumers	No. of Open Access Consumers	Total No. of Portfolios	% of Open Access Consumers
2010-11	825	863	95.6%	170	190	89.5%	-	-	-
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%
2024-25	5383	6147	87.6%	936	4342	21.6%	297	799	37.2%

Note: Status as on 31st March of respective year

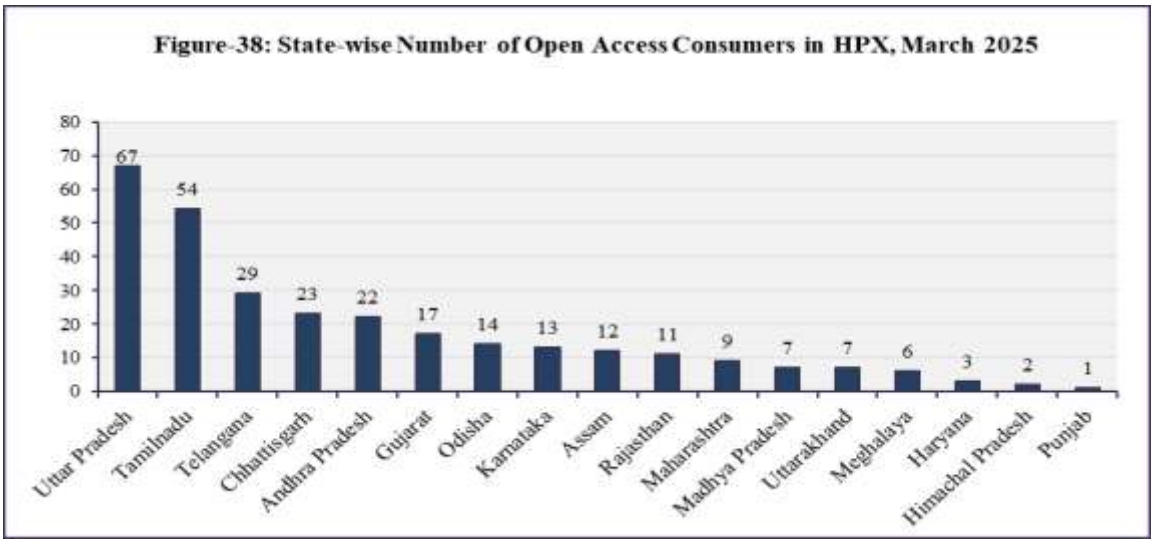
State-wise number of open access consumers participated in IEX, PXIL and HPX has been provided in Figure-36, Figure-37 and Figure-38, respectively. As on March 2025, there were 5383 OA consumers at IEX. These consumers were mostly located in Tamil Nadu, Gujarat, Andhra Pradesh, Haryana and Punjab (Figure-36). The weighted average price of electricity bought by OA consumers through DAM and RTM at IEX (₹3.31/kWh and ₹3.17/kWh in DAM and RTM respectively) was lower when compared to the weighted average price of electricity transacted through DAM and RTM at IEX (₹4.26/kWh and ₹4.05/kWh in DAM and RTM respectively).



As on March 2025, there were 936 OA consumers at PXIL. These consumers were mostly located in Tamil Nadu, Gujarat, Karnataka, Chhattisgarh and Rajasthan (Figure-37). No open access consumers bought electricity through DAM and RTM at PXIL during 2024-25.



In case of HPX, there were 297 OA consumers as on March 2025. These consumers were mostly located in Uttar Pradesh, Tamil Nadu, Telangana, Chhattisgarh and Andhra Pradesh (Figure-38). No open access consumers bought electricity through DAM and RTM at HPX during 2024-25.



Annual comparison between purchase volume of OA consumers and total volume in DAM of IEX, PXIL and HPX during 2010-11 to 2024-25 is shown in Table-20(a). As may be seen in the Table below, in case of IEX, during 2010-11 to 2024-25 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 varying between 0.0% 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 varying between 0.0% to 6.5% during the period from 2022-23 to 2024-25.

Table-20(a): Volume of Purchase by Open Access Consumers in Day Ahead Market of Power Exchanges, 2010-11 to 2024-25

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%
2024-25	6873.59	61231.34	11.2%	0.00	56.46	0.0%	0.00	0.61	0.0%

Source: MMC, CERC

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 varying between 11.4% to 44.9% during 2021-22 to 2024-25. The volume of electricity procured by OA consumers as a percentage of total volume transacted in PXIL was 100% in 2022-23. No transactions took place in GDAM at HPX.

Table-20(b): Volume of Purchase by Open Access Consumers in Green Day Ahead Market of Power Exchanges, 2021-22 to 2024-25

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
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%	-	-	-	-	-	-
2024-25	3276.59	8320.65	39.4%	0.00	0.74	0.0%	-	-	-

Source: MMC, CERC

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 at RTM of IEX was varying between 8.2% to 10.9% during the period from 2020-21 to 2024-25 whereas at RTM of PXIL the same was varying between 0.0% to 2.3%. 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 2024-25

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%	-	-	-
2023-24	3282.83	30124.78	10.9%	0.63	27.64	2.3%	0.00	25.52	0.0%
2024-25	4151.16	38896.09	10.7%	0.00	55.46	0.0%	0.00	54.31	0.0%

Source: MMC, CERC

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 at IEX was 4.9% in 2023-24. There was no procurement of electricity by OA consumers in HP-DAM of PXIL and HPX during 2023-24 and 2024-25.

Table-20(d): Volume of Purchase by Open Access Consumers in High Price Day Ahead Market of Power Exchanges, 2023-24 to 2024-25

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	-
2024-25	0.00	3.34	0.0%	0.00	0.00	-	0.00	0.00	-

Source: MMC, CERC

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 2024-25 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, 2024-25

Sr.No.	Seller	State	Volume (MU)	Approximate Percentage of total volume transacted through Traders	Weighted Average Price (`/kWh)
1	Adani Power Limited Raipur TPP	Chhattisgarh	3530.83	14.08%	6.88
2	IL&FS Tamil Nadu Power Company Ltd	Tamil Nadu	2069.58	8.26%	6.87
3	Jaypee Nigrie STPP	Madhya Pradesh	2043.93	8.15%	6.65
4	Jindal Power Ltd	Chhattisgarh	1966.33	7.84%	7.39
5	Mahan Energen Ltd	Madhya Pradesh	1560.33	6.22%	7.36
6	Simhapuri Energy (P) Ltd	Andhra Pradesh	1241.87	4.95%	7.50
7	Sembcorp Energy India Ltd	Andhra Pradesh	1013.67	4.04%	7.52
8	SKS Power Generation Ltd.	Chhattisgarh	809.67	3.23%	6.98

9	M B Power (Madhya Pradesh) Ltd.	Madhya Pradesh	733.48	2.93%	6.59
10	Shree Cement Ltd TPS	Rajasthan	730.41	2.91%	8.68

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

Table-22: Major Buyers of Electricity through Traders, 2024-25

Sr.No.	Buyer	State	Volume (MU)	Approximate Percentage of total volume transacted through Traders	Weighted Average Price (`/kWh)
1	WBSEDCL	West Bengal	5437.49	22%	7.46
2	Haryana Power Purchase Centre	Haryana	3858.90	15%	6.85
3	TANGEDCO	Tamil Nadu	2854.32	11%	7.80
4	Gujarat Urja Vikas Nigam Limited	Gujarat	1650.76	7%	6.80
5	Kerala State Electricity Board	Kerala	1624.61	6%	6.28
6	BSES Rajdhani Power Limited	Delhi	1274.52	5%	6.89
7	Uttarakhand Power Corporation Ltd	Uttarakhand	965.47	4%	5.30
8	South Bihar Power Distribution Company Ltd	Bihar	886.27	4%	7.41
9	UPPCL	Uttar Pradesh	522.05	2%	9.58
10	Rajasthan Urja Vikas Nigam Ltd	Rajasthan	514.11	2%	6.80

Note: Volume purchased by major buyers and total volume transacted through traders does not include the volume through banking arrangement

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 WBSEDCL, TANGEDCO, SBPDCL and UPPCL were higher than the weighted average price for the bilateral trader segment (₹7.17/kWh).

The details of the top 10 sellers in DAM, G-DAM, RTM and HP-DAM segments of IEX in 2024-25 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-23(a): Major Sellers of Electricity in the Day Ahead Market of IEX, 2024-25

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the total volume transacted through DAM in IEX	Weighted Average Sell Price (₹/kWh)
1	UPPCL	Uttar Pradesh	4044.81	6.61%	3.64
2	Jindal Power Ltd Stage-2	Chhattisgarh	3712.05	6.06%	4.11
3	Adani Power Ltd Raipur TPP	Chhattisgarh	2865.12	4.68%	4.23
4	CSPDCL	Chhattisgarh	2693.69	4.40%	3.17
5	GRIDCO	Odisha	2366.22	3.86%	3.26
6	HPPC	Haryana	2343.82	3.83%	4.61
7	Jaypee Nigrie STPP	Madhya Pradesh	1655.30	2.70%	4.58
8	BSPHCL	Bihar	1625.91	2.66%	3.42
9	Adani Power Ltd Raigarh TPP	Chhattisgarh	1611.17	2.63%	4.13
10	PCKL	Karnataka	1588.67	2.59%	3.65
Note: Total Volume transacted through Day Ahead Market in IEX was about 61231.34 MU.					

Table-23(b): Major Sellers of Electricity in the Green Day Ahead Market of IEX, 2024-25

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the total volume transacted through G-DAM in IEX	Weighted Average Sell Price (₹/kWh)
1	Adani Renewable Energy Holding Limited	Gujarat	788.10	9.47%	2.72
2	Adani Green Energy Limited	Gujarat	400.67	4.82%	2.71
3	PCKL	Karnataka	316.18	3.80%	4.19
4	Adani Wind Energy Kutchh Ltd	Gujarat	274.02	3.29%	4.39
5	Renew Surya Ojas Private Limited	Karnataka	261.21	3.14%	5.00
6	Adani Solar Energy Private Limited	Rajasthan	227.85	2.74%	2.85
7	TPSL Banderwala	Rajasthan	219.36	2.64%	3.00
8	MPDCL	Meghalaya	179.05	2.15%	5.15
9	Naitwar Mori HPS	Himachal Pradesh	170.51	2.05%	4.95
10	APCPDCL	Andhra Pradesh	155.68	1.87%	5.82
Note: Total Volume transacted through Green Day Ahead Market in IEX was about 8320.65 MU.					

Table-23(c): Major Sellers of Electricity in the Real Time Market of IEX, 2024-25

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	BSPHCL	Bihar	4251.15	10.93%	3.39
2	MPPMCL	Madhya Pradesh	2915.48	7.50%	4.36
3	TANGEDCO	TamilNadu	2224.71	5.72%	2.88
4	HPPC	Haryana	1946.22	5.00%	4.14
5	UPPCL	Uttar Pradesh	1545.04	3.97%	3.79
6	GRIDCO	Odisha	1254.61	3.23%	3.88
7	CSPDCL	Chhattisgarh	1165.24	3.00%	4.39
8	WBSEDCL	West Bengal	1085.82	2.79%	5.01
9	APDCL	Assam	1051.69	2.70%	4.84
10	PCKL	Karnataka	975.59	2.51%	3.97
Note: Total Volume transacted through Real Time Market in IEX was about 38896.09 MU.					

Table-23(d): Major Sellers of Electricity in the High Price Day Ahead Market of IEX, 2024-25

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the total volume transacted through HP-DAM in IEX	Weighted Average Sell Price (₹/kWh)
1	NTPC Kawas GPP	Gujarat	1.2648	37.83%	12.64
2	NTPC Jhanor Gandhar GPP	Gujarat	1.0205	30.52%	12.56
3	Torrent Power Sugen CCPP Kamrej	Gujarat	0.4884	14.61%	14.44
4	DGEN Mega Power Project	Gujarat	0.2000	5.98%	11.26
5	Coastal Energen Private Limited	TamilNadu	0.1600	4.79%	13.90
6	Adani Power Ltd Stage-3	Gujarat	0.1500	4.49%	15.00
7	NTPC Auraiya GPS	Uttar Pradesh	0.0275	0.82%	3.63
8	NTPC Anta GPS	Rajasthan	0.0162	0.48%	3.65
9	NTPC Dadri GPS	Uttar Pradesh	0.0160	0.48%	3.42
10	Torrent Power Ltd Unosugen Kamrej	Gujarat	0.0002	0.01%	15.00
Note: Total Volume transacted through High Price Day Ahead Market in IEX was about 3.34 MU.					

Table-24(a): Major Buyers of Electricity in the Day Ahead Market of IEX, 2024-25

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through DAM in IEX	Weighted Average Buy Price (₹/kWh)
1	TSSPDCL	Telangana	15010.90	24.52%	3.83
2	GUVNL	Gujarat	3989.35	6.52%	5.44
3	MSEDCL	Maharashtra	3154.10	5.15%	4.39
4	RUVNL	Rajasthan	3040.18	4.97%	4.64
5	Torrent Power Ahmedabad	Gujarat	2809.66	4.59%	4.39
6	PSPCL	Punjab	2484.30	4.06%	4.02
7	UPCL	Uttarakhand	1657.10	2.71%	4.02
8	APCPDCL	Andhra Pradesh	1569.32	2.56%	5.25
9	Dadra & Nagar Haveli and Daman & Diu PDCL	Daman & Diu - Dadra & Nagar Haveli	1543.01	2.52%	4.40
10	WBSEDCL	West Bengal	1426.53	2.33%	4.95
Note: Total Volume transacted through Day Ahead Market in IEX was about 61231.34 MU.					

Table-24(b): Major Buyers of Electricity in the Green Day Ahead Market of IEX, 2024-25

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through G-DAM in IEX	Weighted Average Buy Price (₹/kWh)
1	PSPCL	Punjab	1104.87	13.28%	4.07
2	DVC	DVC	915.29	11.00%	4.07
3	AMNSIL	Gujarat	915.00	11.00%	4.10
4	Vedanta Limited Jharsuguda	Odisha	627.09	7.54%	2.75
5	BEST	Maharashtra	575.29	6.91%	3.07
6	JBVNL	Jharkhand	329.07	3.95%	6.21
7	Central Railway	Maharashtra	296.25	3.56%	4.09
8	Tata Steel Ltd	DVC	267.94	3.22%	2.87
9	Jindal Stainless Limited Hisar	Haryana	234.38	2.82%	2.98
10	Indian Railways	Gujarat	218.64	2.63%	4.04
Note: Total Volume transacted through Green Day Ahead Market in IEX was about 8320.65 MU.					

Table-24(c): Major Buyers of Electricity in the Real Time Market of IEX, 2024-25

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through RTM in IEX	Weighted Average Buy Price (₹/kWh)
1	PSPCL	Punjab	6818.61	17.53%	3.87
2	TSSPDCL	Telangana	4978.05	12.80%	3.69
3	RUVNL	Rajasthan	3076.66	7.91%	4.48
4	MSEDCL	Maharashtra	1617.48	4.16%	3.82
5	WBSEDCL	West Bengal	1381.65	3.55%	3.47
6	KSEB	Kerala	1172.84	3.02%	3.96
7	APCPDCL	Andhra Pradesh	1156.80	2.97%	5.00
8	JKPCL	Jammu & Kashmir	1142.96	2.94%	4.07
9	TANGEDCO	TamilNadu	1021.49	2.63%	5.74
10	UPPCL	Uttar Pradesh	724.86	1.86%	6.93
Note: Total Volume transacted through Real Time Market in IEX was about 38896.09 MU.					

Table-24(d): Major Buyers of Electricity in the High Price Day Ahead Market of IEX, 2024-25

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through HP-DAM in IEX	Weighted Average Buy Price (₹/kWh)
1	WBSEDCL	West Bengal	3.34	100.00%	12.80
Note: Total Volume transacted through High Price Day Ahead Market in IEX was about 3.34 MU.					

From Table-24(a), it can be seen that the weighted average price of electricity for major buyers such as TSSPDCL, PSPCL, and UPCL in the DAM of IEX were lower than the weighted average price of the electricity transacted through the entire DAM of IEX (₹4.25/kWh). In case of the G-DAM segment (Table-24(b)), the weighted average prices of electricity for major buyers like Vedanta Ltd, BEST, Tata Steel Ltd and Jindal Stainless Ltd were lower than the weighted average price of the electricity transacted through the entire G-DAM of IEX (₹3.97/kWh). Similarly, in case of RTM of IEX, the weighted average prices of electricity for major buyers such as PSPCL, TSSPDCL, MSEDCL, WBSEDCL and KSEB were lower than the weighted average price of the electricity transacted through the entire RTM of IEX (₹4.02/kWh) as may be seen in Table-24(c). It can be seen from the Table-24(d) that there was only one buyer in HP-DAM of IEX i.e. WBSEDCL, who bought the electricity at ₹12.80/kWh.

Table-25 (a), 25(b) and 25 (c) provides details of the top 10 sellers of electricity in DAM, G-DAM and RTM of PXIL and Table-26(a), 26(b), 26(c) provides details of the top 10 buyers of electricity in DAM, G-DAM and RTM of PXIL. There was no trade of electricity in HP-DAM at PXIL in 2024-25.

Table-25(a): Major Sellers of Electricity in the Day Ahead Market of PXIL, 2024-25

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the total volume transacted through DAM of PXIL	Weighted Average Sell Price (₹/kWh)
1	HPPC	Haryana	30.77	54.50%	10.00
2	DVC	West Bengal	8.30	14.69%	10.00
3	PCKL	Karnataka	6.79	12.02%	9.56
4	GRIDCO	Odisha	4.26	7.54%	9.49
5	UPPCL	Uttar Pradesh	1.99	3.53%	7.24
6	OPG Power Generation Private Limited -Unit 4	Tamil Nadu	1.59	2.82%	10.00
7	Udupi Power Corporation Limited	Karnataka	0.75	1.33%	10.00
8	RUVSL	Rajasthan	0.52	0.92%	10.00
9	Vedanta Ltd CPP	Odisha	0.46	0.81%	10.00
10	UPCL	Uttarakhand	0.30	0.53%	10.00
Note: Total Volume transacted through Day Ahead Market in PXIL was about 56.46 MU.					

Table-25(b): Major Sellers of Electricity in the Green Day Ahead Market of PXIL, 2024-25

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the total volume transacted through G-DAM of PXIL	Weighted Average Sell Price (₹/kWh)
1	Jamkhandi Sugars Limited	Karnataka	0.30	40.32%	3.20
2	EID Parry Sugar, Haliyal	Karnataka	0.28	37.10%	3.44
3	Vijaynagar Sugar Private Ltd	Karnataka	0.17	22.58%	3.70
Note: Total Volume transacted through Green Day Ahead Market in PXIL was about 0.74 MU.					

Table-25(c): Major Sellers of Electricity in the Real Time Market of PXIL, 2024-25

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the total volume transacted through RTM of PXIL	Weighted Average Sell Price (₹/kWh)
1	HPPC	Haryana	20.80	37.50%	10.00
2	GRIDCO	Odisha	6.15	11.08%	10.00

3	WBSEDCL	West Bengal	4.34	7.82%	10.00
4	PCKL	Karnataka	3.26	5.87%	10.00
5	GUVNL	Gujarat	3.20	5.77%	10.00
6	RUVSL	Rajsathan	2.65	4.78%	10.00
7	MPPMCL	Madhya Pradesh	2.42	4.36%	10.00
8	Meenakshi Energy Limited	Andhara Pradesh	2.37	4.27%	9.85
9	UPPCL	Uttar Pradesh	1.88	3.38%	10.00
10	BSPHCL	Bihar	1.72	3.10%	10.00
Note: Total Volume transacted through Real Time Market in PXIL was about 55.46 MU.					

Table-26(a): Major Buyers of Electricity in Day Ahead Market of PXIL, 2024-25

Sr. No	Name of the Buyer	State/Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through DAM of PXIL	Weighted Average Buy Price (₹/kWh)
1	GUVNL	Gujarat	29.53	52.30%	9.81
2	RUVSL	Rajasthan	11.63	20.59%	9.99
3	PCKL	Karnataka	7.12	12.60%	9.94
4	WBSEDCL	West Bengal	1.98	3.51%	10.00
5	CSPDCL	Chattisgarh	1.56	2.77%	10.00
6	Adani Electricity Mumbai Limited	Maharashtra	1.21	2.14%	10.00
7	JBVNL	Jharkhand	1.05	1.86%	10.00
8	RUVNL	Rajasthan	0.85	1.51%	6.65
9	BSES Rajdhani Power Limited	Delhi	0.56	0.98%	9.73
10	BSPHCL	Bihar	0.43	0.76%	5.75
Note: Total Volume transacted in the Day Ahead Market of PXIL was about 56.46 MU.					

Table-26(b): Major Buyers of Electricity in Green Day Ahead Market of PXIL, 2024-25

Sr. No	Name of the Buyer	State/Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through G-DAM of PXIL	Weighted Average Buy Price (₹/kWh)
1	ArcelorMittal Nippon Steel India Private Ltd	Gujarat	0.74	100.00%	3.40
Note: Total Volume transacted in the Green Day Ahead Market of PXIL was about 0.74 MU.					

Table-26(c): Major Buyer of Electricity in the Real Time Market of PXIL, 2024-25

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through RTM of PXIL	Weighted Average Buy Price (₹/kWh)
1	RUVNL	Rajasthan	21.04	37.94%	9.91
2	TANGEDCO	Tamil Nadu	6.74	12.15%	9.95
3	UPPCL	Uttar Pradesh	6.10	11.00%	10.00
4	CSPDCL	Chhattisgarh	4.97	8.97%	10.00
5	GUVNL	Gujarat	4.07	7.33%	8.91
6	PCKL	Karnataka	2.96	5.34%	10.00
7	BSPHCL	Bihar	1.77	3.18%	10.00
8	Vedanta Ltd Jharsuguda	Odisha	1.69	3.05%	10.00
9	DVC	DVC	1.43	2.58%	10.00
10	RUVSL	Rajasthan	0.98	1.77%	10.00
Note: Total Volume transacted through Real Time Market in PXIL was about 55.46 MU.					

From Table-26(a), it can be observed that the weighted average prices of electricity for major buyers such as RUVNL, BRPL and BSPHCL in the DAM of PXIL were lower than the weighted average price of the electricity transacted through the entire DAM of PXIL (₹9.81/kWh). From Table-26(b), it can be observed that there is only one buyer in G-DAM of PXIL and the weighted average price of electricity of that buyer was (₹3.40/kWh). In case of RTM of PXIL, the weighted average price of electricity for GUVNL was lower than the weighted average price of the electricity transacted through the entire RTM of PXIL (₹9.65/kWh) as may be seen in Table-26(c).

Table-27 (a) and 27 (b) provide details of the top sellers of electricity traded in DAM and RTM of HPX and Table 28(a) and 28(b) provide details of the top buyers of electricity traded in DAM and RTM of HPX. There was no trade of electricity in G-DAM and HP-DAM on HPX in 2024-25.

Table-27(a): Major Sellers of Electricity in the Day Ahead Market of HPX, 2024-25

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the total volume transacted through DAM of HPX	Weighted Average Sell Price (₹/kWh)
1	UPPCL	Uttar Pradesh	0.28	46.68%	9.52
2	Punjab SPCL	Punjab	0.15	24.61%	10.00
3	Adani Wind Energy Kutchh Ltd	Gujarat	0.10	16.41%	10.00
4	DVC	West Bengal	0.08	12.31%	10.00
Note: Total Volume transacted through Day Ahead Market in HPX was about 0.61 MU.					

Table-27(b): Major Sellers of Electricity in the Real Time Market of HPX, 2024-25

S.No.	Name of Seller	State/ Regional Entity	Sell Volume (MU)	Percentage of the total volume transacted through RTM of HPX	Weighted Average Sell Price (₹/kWh)
1	GUVNL	Gujarat	27.59	50.79%	9.98
2	PCKL	Karnataka	22.2	40.87%	9.98
3	UPPCL	Uttar Pradesh	3.06	5.64%	9.51
4	KSEBL	Kerala	1	1.84%	10
5	Punjab SPCL	Punjab	0.25	0.46%	10
6	DGEN MPP	Gujarat	0.11	0.20%	10
7	Meghalaya PDCL	Meghalaya	0.08	0.15%	10
8	Jhabua Power Ltd	Madhya Pradesh	0.03	0.05%	10
9	APCPDCL	Andhra Pradesh	0	0.00%	0
Note: Total Volume transacted through Real Time Market in HPX was about 54.31 MU.					

Table-28(a): Major Buyers of Electricity in Day Ahead Market of HPX, 2024-25

Sr.No	Name of the Buyer	State/Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through DAM of HPX	Weighted Average Buy Price (₹/kWh)
1	GUVNL	Gujarat	0.43	71.29%	9.69
2	Adani Electricity Mumbai Ltd	Maharashtra	0.18	28.71%	10.00
Note: Total Volume transacted in the Day Ahead Market of HPX was about 0.61 MU.					

Table-28(b): Major Buyers of Electricity in the Real Time Market of HPX, 2024-25

S.No.	Name of Buyer	State/ Regional Entity	Buy Volume (MU)	Percentage of the total volume transacted through RTM of HPX	Weighted Average Buy Price (₹/kWh)
1	UPPCL	Uttar Pradesh	50.11	92.26%	9.99
2	PCKL	Karnataka	2.64	4.86%	10.00

3	TANGEDCO	Tamilnadu	1.13	2.08%	8.67
4	Adani Electricity Mumbai Ltd	Maharashtra	0.33	0.61%	10.00
5	Torrent Power, Ahmedabad	Gujarat	0.11	0.20%	10.00
Note: Total Volume transacted through Real Time Market in HPX was about 54.31 MU.					

From Table-28(a), it can be observed that the weighted average price of electricity for GUVNL was lower than the weighted average price of the electricity transacted through the entire DAM of HPX (₹9.78/kWh). Similarly, in case of RTM, the weighted average price of electricity for TANGEDCO was lower than the weighted average price of electricity transacted through the entire RTM of HPX (₹9.96/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 2024-25 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 109.15 BU and 108.62 BU, respectively, in 2024-25. 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 2024-25

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%
2024-25	109.15	108.62	0.53	0.48%

** 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

The details of congestion in power exchanges are provided in Table-30. During 2024-25, in IEX, the unconstrained cleared volume and the actual volume transacted was 61.47 BU and 61.23 BU, respectively, in the DAM segment. In case of RTM, the unconstrained cleared volume and the actual volume transacted was 8.37 BU and 8.32 BU, respectively. In GDAM and HP-DAM segments, the unconstrained cleared volume and the actual cleared volume was not significant and it was less than 0.1 BU.

During 2024-25, in PXIL, the unconstrained cleared volume and the actual volume transacted was not significant and it was less than 0.1 BU and there was no congestion in DAM and HP-DAM segments (Table-30). There was no trade in G-DAM and RTM at PXIL.

During 2024-25, In HPX, there was no trade in DAM. The unconstrained cleared volume and the actual volume transacted in G-DAM was 39.13 BU and 38.90 BU, respectively. The unconstrained cleared volume and the actual volume transacted was not significant and it was less than 0.1 BU in HP-DAM and RTM at HPX.

Table-30: Details of Congestion in Power Exchanges, 2024-25

	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)	61.471	0.056	0.001	8.369	0.001	0.000	0.003	0.000	0.000	39.131	0.056	0.059	109.15
B	Actual Cleared Volume and hence scheduled* (BU)	61.231	0.056	0.001	8.321	0.001	0.000	0.003	0.000	0.000	38.896	0.055	0.054	108.62
C	Volume of electricity that could not be cleared and hence not scheduled because of congestion (BU)	0.238	0.000	0.000	0.049	0.000	0.000	0.000	0.000	0.000	0.235	0.000	0.005	0.53
D	Volume of electricity that could not be cleared as % to Unconstrained Cleared Volume	0.39%	0.00%	0.00%	0.58%	0.00%	0.00%	0.00%	0.00%	0.00%	0.60%	0.67%	7.75%	0.48%

** 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 details on annual congestion charges of all the three power exchanges (i.e. in IDAM and RTM) for the period from 2008-09 to 2024-25 are provided in Table-31.

Table-31: Congestion Charges of Power Exchanges, 2008-09 to 2024-25

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	86.61	-	359.75
2011-12	419.13	65.62	-	484.76
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	0.09	-	306.08
2017-18	56.56	0.00	-	56.56
2018-19	137.52	0.00	-	137.52
2019-20	55.65	0.00	-	55.65
2020-21	70.95	0.01	-	70.96
2021-22	23.35	0.00	-	23.35
2022-23	16.57	0.01	0.00	16.58
2023-24	25.20	0.00	0.00	25.20
2024-25	155.45	0.00	0.05	155.51

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 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 became effective from 01.06.2023. It can be observed from the table

that during the year 2024-25 in a time block, maximum power despatched was 6548 MW in May 2024, while the maximum power regulated was 8969 MW in May 2024.

Table-32: Maximum Ancillary (TRAS) despatched in a Time Block (MW), 2024-25

Month	Max regulation "UP"	Max regulation "DOWN"
Apr-24	3844	7359
May-24	6548	8969
Jun-24	5037	8003
Jul-24	3500	7200
Aug-24	5490	7960
Sep-24	5200	5288
Oct-24	3800	5960
Nov-24	4500	6390
Dec-24	3531	5000
Jan-25	2718	6000
Feb-25	6386	7500
Mar-25	2000	8857

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 for the period from 2023-24 (June onwards) to 2024-25.

Table 33: Energy Scheduled and Payments 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	939.78	42.39
2017-18	4149.25	243.72	2011.47	43.6
2018-19	4811.69	685.42	2810.73	140.83
2019-20	2435.01	1941.31	1333.36	398.4
2020-21	1649.5	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-May 2023)	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 to 2024-25

Year	TRAS-Up Cleared (MU)		TRAS-Up Scheduled (MU)		TRAS-Down Scheduled (MU)		Net Charges (₹Crore)
	Day Ahead ASM	Real Time ASM	Day Ahead ASM	Real Time ASM	Day Ahead ASM	Real Time ASM	
2023-24 (Jun-23 onwards)	35.05	45.55	30.87	16.27	2.97	0.06	85.45
2024-25	3.80	6.81	2.13	2.45	19.38	0.99	3.61

Source: Grid-India Monthly Ancillary Services Reports

Table 34(b): Energy Scheduled and Payments for TRAS under Shortfall/ Emergency, 2023-24 to 2024-25

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
2024-25	5130.80	10453.70	4496.20	2973.10

Source: Grid-India Monthly Ancillary Services Reports

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Chapter-III

Cross Border Trade of Electricity

1. Background

The cross border trade of electricity (import or export of electricity between India and its neighbouring countries) between India and Nepal and between India and Bhutan has been taking place for more than fifty years. The cross border trade with Bangladesh and Myanmar was respectively started in the year 2013 and year 2017, respectively.

The cross border trade of electricity has mainly been taking place under bilateral Memorandum of Understanding/ Power Trade Agreement. The South Asian Association for Regional Cooperation (SAARC) countries envisaged the need for cross border electricity cooperation and signed the SAARC Framework Agreement for Energy Cooperation on 27.11.2014, recognizing the importance of electricity in promoting economic growth and improving the quality of life in the region. In order to facilitate and promote cross border trade of electricity with greater transparency, consistency and predictability in regulatory approaches across jurisdictions and minimize perception of regulatory risks, the Guidelines on Cross Border Trade of Electricity had been prepared by the Inter-Ministerial Working Group in consultation with various stakeholders.

The Ministry of Power (MOP) issued the Guidelines on Cross Border Trade of Electricity on 5.12.2016, which was subsequently substituted by the 'Guidelines for Import/Export (Cross Border) of Electricity-2018' issued on 18.12.2018, to promote cross border trade of electricity with neighbouring countries. Following the guidelines, the Central Electricity Regulatory Commission issued the CERC (Cross Border Trade of Electricity) Regulations, 2019 on 8.03.2019. The Central Electricity Authority (CEA) issued 'Draft Conduct of Business Rules of the Designated Authority' on 25.04.2019 for facilitating the Cross Border Trade of Electricity. In continuation to the draft business rules, CEA notified the 'Procedure for Approval and Facilitating Import/Export (Cross Border) of Electricity by the Designated Authority' on 26.2.2021. With a view to facilitate

transfer of power through Real Time Market (RTM) segment of Indian power exchanges under clause 5.3 of the Guidelines, the CEA, on 31.7.2023, issued certain modifications in the Procedure for Approval and Facilitating Import/Export of Electricity by the Designated Authority.

Under the CERC (Cross Border Trade of Electricity) Regulations 2019, the sale and purchase of electricity between India and the neighbouring countries is allowed through mutual agreements between the local entities and the entities of the neighbouring countries, through bilateral agreements between two countries, bidding route or through mutual agreements between entities. Any Indian trader, after obtaining approval from Designated Authority, can trade in Indian Power Exchanges on behalf of any entity of neighbouring country complying with these regulations.

2. Cross Border Trade of Electricity between India and its Neighbouring Countries

Presently, India is a net exporter of electricity to Bangladesh, and Myanmar, and a net importer of electricity from Bhutan and Nepal. Table-35 and Figure-39 below provide the details on Cross Border Trade of Electricity between India and its neighbouring countries during the period from 2013-14 to 2024-25. It can be observed from the Table-35, that India was a net importer of electricity from 2013-14 to 2015-16, and became a net exporter of electricity from 2016-17 onwards.

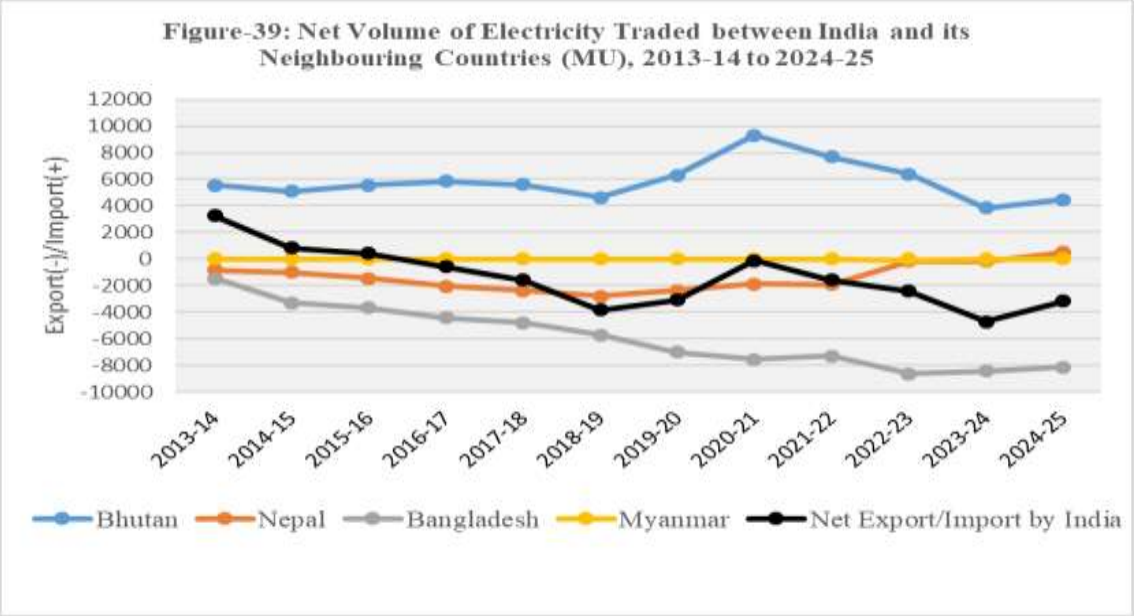
Table-35: Cross Border Trade of Electricity between India and its Neighbouring Countries (MU), 2013-14 to 2023-24

Year	Bhutan	Nepal	Bangladesh	Myanmar	Net Export/ Import by India
2013-14	5555.18	-840.37	-1448.19	0.00	3266.62
2014-15	5109.48	-997.17	-3271.89	0.00	840.42
2015-16	5555.07	-1469.59	-3654.4	0.00	431.08
2016-17	5863.58	-2021.21	-4419.61	-3.23	-580.47
2017-18	5611.14	-2388.96	-4808.83	-5.07	-1591.72
2018-19	4657.07	-2798.84	-5690.31	-6.67	-3838.75
2019-20	6310.73	-2373.06	-6987.94	-8.61	-3058.88
2020-21	9318.17	-1865.05	-7551.99	-9.24	-108.11

2021-22	7670.34	-1921.09	-7301.74	-8.8	-1561.29
2022-23	6379.95	-158.05	-8622.14	-9.8	-2410.04
2023-24	3862.78	-154.08	-8413.52	-8.47	-4713.29
2024-25	4466.45	497.29	-8118.27	-9.01	-3163.54

(-) Export; (+) Import

Source: Grid-India Monthly Reports



3. Cross Border Trade of Electricity through Power Exchanges

The Cross-Border Trade of Electricity commenced in the Day Ahead Market of IEX in 2021-22. The trade with Nepal commenced on 17.04.2021, whereas the trade with Bhutan commenced on 01.01.2022. Cross-Border Trade in Real Time Market commenced from October 2023. Table-36 below presents the details of cross-border trade with Nepal and Bhutan through power exchanges for the period 2021-22 to 2024-25. During the last two years i.e. 2023-24 and 2024-25, Nepal and Bhutan purchased electricity at lower price and sold electricity at higher price, therefore, both the countries gained through cross border trade of electricity at IEX. There was no cross border trading undertaken at PXIL and HPX during the period.

Table-36: Cross Border Trade of Electricity at IEX, 2021-22 to 2024-25

Year	Nepal				Bhutan			
	Buy		Sell		Buy		Sell	
	Volume Traded	Weighted Average Price	Volume Traded	Weighted Average Price	Volume Traded	Weighted Average Price	Volume Traded	Weighted Average Price
	(MU)	(₹/kWh)	(MU)	(₹/kWh)	(MU)	(₹/kWh)	(MU)	(₹/kWh)
2021-22	785.84	3.59	32.04	3.20	240.11	2.89	-	-
2022-23	1035.69	5.95	1357.77	5.14	318.84	4.39	-	-
2023-24	1310.81	4.43	1556.33	5.61	1299.42	3.74	40.28	5.78
2024-25	1365.08	3.50	1606.37	4.22	1097.90	3.06	239.78	4.94

Source: IEX
Note: The volume traded represents the volume traded in both DAM and RTM.

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Chapter-IV

Trading of Renewable Energy Certificates

1. Renewable Energy Certificate Mechanism

The Renewable Energy Certificate (REC) mechanism is a market-based instrument, to promote renewable sources of energy and development of market in electricity. The REC mechanism provides an alternative voluntary route to a generator to sell his electricity from renewable sources just like conventional electricity and sell the green attribute separately to obligated entities to fulfill their Renewable Purchase Obligation (RPO). Such a generator can either opt to enter into a Power Purchase Agreement for sale at preferential full cost tariff to a distribution licensee or can opt to take the REC route for such untied capacity. If he opts for the REC route, he can sell his electricity to a distribution licensee such as a conventional source-based generation at an average power purchase cost. Alternatively, he can sell it to a third party, that is, to an open access consumer at mutually settled price, or even on power exchanges. On every one-megawatt hour of such electricity generated, the generator is entitled to get one REC from the central registry (which is regulated by the CERC) after getting registered once with this registry. Such registration requires prior accreditation with the state nodal agency for verifying the source of generation, capacity, and grid metering.

There had been two categories of RECs, namely solar and non-solar, to meet the RPO of the corresponding category. This was because the cost of solar-based generation is very high compared to all other sources. The RE generator as an eligible entity applies for issuance of REC within 6 months from the month in which RE power was generated and injected into the grid. The central agency issues the RECs to the eligible entity within 15 working days from the date of physical receipt of the application by the eligible entity. The validity of issued REC had been 1095 days. It is to be sold on power exchanges regulated by CERC, which also fixed a price band for exchange of REC (the band of forbearance price and floor price) to protect the interests of obligated entities and generators, respectively. Obligated entities can fulfill RPO by purchasing renewable electricity at full cost preferential tariff or by purchasing REC equivalent to their RPO. Voluntary buyers

can also purchase REC. Regulatory charge for shortfall of RPO compliance was at the rate of forbearance price.

The Central Electricity Regulatory Commission (Terms and Conditions for recognition and issuance of Renewable Energy Certificate for Renewable Energy Generation) Regulations, 2010 were issued on 14th January, 2010 for the development of market in power from non-conventional energy sources by issuance of transferable and saleable credit certificates. The CERC has nominated NLDC as the Implementing Agency (for the Central Registry), which prepares procedures and a web-based platform for the REC mechanism. The REC mechanism was formally launched on 18th November 2010.

CERC notified the Central Electricity Regulatory Commission (Terms and Conditions for Renewable Energy Certificates in Renewable Energy Generation) Regulations, 2022 on 9th May 2022. Some of the key features of REC Regulations 2022 are as under:

I. **Validity of RECs:** As per the new regulations, the certificates issued shall remain valid until they are redeemed.

II. **Eliminated Floor and Forbearance Price:** Floor and Forbearance price are not required for trading of RECs. Prices would be discovered in the power exchanges and as mutually agreed between eligible entities and electricity traders. The Commission by an order may give such directions to the Power Exchange(s) or the electricity traders or the Nodal Agency as may be considered necessary, on being satisfied that any of the following circumstances exist or are likely to occur-

   i. Abnormal increase or decrease in prices of Certificates;
   ii. Sudden volatility in the prices of Certificates;
   iii. Sudden high or low transaction volumes of Certificates on a Power Exchange

III. **REC Fungibility:** There is a new concept of fungibility for Renewable Energy Certificates, where the categorization of RECs, i.e., solar and non-solar has been eliminated in the REC Regulations, 2022. The regulations have provision for all

types of renewable energy technologies, like solar, wind, hydro, biomass and biofuel, conversion of waste into energy and any other RE technology into a new REC contract through which RECs of all RE technologies are traded.

IV. **Certificate Multiplier:** A new concept of Certificate Multiplier has been introduced for promoting less mature and high-price RE technologies. The multiplier will increase the market value of different RE technologies. The certificate multiplier assigned to RE technologies depends upon the date of commissioning of the project. Multipliers are assigned as per the tariff range (in Rs/kWh) for different RE technologies, as given in Table-37 below:

Table-37: Multipliers for different RE Technologies

RE Technologies	Tariff Range (Rs/kWh)	Certificate Multiplier
On Shore Wind and Solar	<=4	1
Hydro	4-6	1.5
Municipal Solid Waste and Non-Fossil Fuel based Cogeneration	6-8	2
Biomass and Biofuel	8-10	2.5

Multipliers have been assigned for the next three years from the date of effect of new regulations or such other period as may be decided by CERC. The Certificate Multiplier, once assigned to RE generating stations and Captive generating stations, shall be valid for fifteen years from the date of commissioning of these RE and captive generating stations. The RE projects which have already been commissioned before the new REC regulations came into effect shall not be subjected to these conditions.

V. **Transactions of RECs through Trading Licensees:** With a view to increase competition in the Renewable Energy Market and reducing the transaction costs of RECs, the Commission approved the transactions of RECs through the trading licensees. It will give long-term visibility to all the buyers of RECs, as they can fulfil their RPOs easily. This will facilitate even the small buyers who face difficulty in trading REC to fulfil their RPO.

2. Trading of Renewable Energy Certificates

Trading of RECs, till September 2023, was being held on Power Exchanges on the last Wednesday of every month. Subsequent to CERC order dated 8th October 2023 in Petition No. 375/MP/2022 and 379/MP/2022, trading of RECs is being held on Power Exchanges on the second and the last Wednesday of each month.

The CERC has notified the band of floor price and forbearance (ceiling) price for trading of RECs, from time to time (Table-38).

Table-38: Floor and Forbearance Price applicable for REC Transactions

Applicable Period	Floor Price (₹/MWh)		Forbearance Price (₹/MWh)	
	Solar	Non-Solar	Solar	Non-Solar
w.e.f. 1st June 2010	12000	1500	17000	3900
w.e.f. 1st April 2012	9300	1500	13400	3300
w.e.f. 1st March 2015	3500	1500	5800	3300
w.e.f. 1st April 2017	1000	1000	2400	3000
w.e.f. 5th December 2022	The Commission decided to do away with the requirement of determining floor and forbearance price for REC			

The first REC trading session was held on power exchanges in March 2011. The growth of RECs transacted on power exchanges and through trading licensees for the period from 2011-12 to 2024-25 is given in Table-39. As may be seen in the table, the number of RECs transacted increased significantly from 10.15 lakh in 2011-12 to 162.00 lakh in 2017-18, declined to 89.28 lakh in 2019-20 and again increased from 82.50 lakh in 2022-23 to 343.10 lakh in 2024-25. As per the Hon'ble APTEL Order, trading sessions of RECs at both the Power Exchanges remained suspended from July 2020 to October 2021 and resumed from November 2021 as per Hon'ble APTEL Order dated 09.11.2021.

The categorization of RECs between solar and non-solar has been dispensed with the introduction of the concept of multiplier under the REC Regulations, 2022 w.e.f. 05.12.2022. Accordingly, the power exchanges deactivated the Solar and Non-Solar REC contract for trading w.e.f. December 2022. A new contract, namely "REC", has been made available for trading. The number of RECs during the year 2022-23 and onwards is

inclusive of RECs transacted on the power exchanges and traded bilaterally through trading licensees.

Table-39: Growth of RECs transacted through Power Exchanges & Traders, 2011-12 to 2024-25

Year	Number of buyers	Number of sellers	Number of RECs transacted (Lakhs)	% increase in Number of RECs Transacted
2011-12	390	168	10.15	-
2012-13	790	487	25.90	155%
2013-14	1071	703	27.49	6%
2014-15	801	906	30.62	11%
2015-16	1313	1010	49.55	62%
2016-17	1734	1062	64.88	31%
2017-18	1140	1088	161.84	149%
2018-19	988	830	126.09	-22%
2019-20	830	820	89.28	-29%
2020-21	277	523	9.21	-90%
2021-22	541	749	84.60	819%
2022-23	520	820	82.50	-2%
2023-24	493	723	138.53	68%
2024-25	484	364	343.10	148%

Note: 2022-23 onwards includes RECs traded bilaterally through Trading Licensees.
Source:NLDC

Table-40 provides on the demand and supply of RECs (i.e., the gap between the volume of buy and sell bids of RECs) transacted on power exchanges from 2012-13 to 2024-25. As may be observed from the table, the volume of buy bids as a percentage of the volume of sell bids initially showed a declining trend from 2012-13 to 2016-17, followed by an increasing trend from 2017-18 to 2019-20 in both IEX and PXIL because of change in demand for both Solar and Non-Solar RECs. It can also be observed from the table that the dynamics of demand and supply of RECs have been completely changed from December 2022 onwards, and this was mainly due to the removal of the distinction between Solar RECs and Non-Solar RECs.

Table-40: Demand and Supply of RECs on Power Exchanges, 2012-13 to 2024-25

Year	IEX			PXIL			HPX		
	Volume of Buy Bid of RECs (Lakhs)	Volume of Sell Bid of RECs (Lakhs)	Volume of Buy Bid as % of volume of Sell Bid	Volume of Buy Bid of RECs (Lakhs)	Volume of Sell Bid of RECs (Lakhs)	Volume of Buy Bid as % of volume of Sell Bid	Volume of Buy Bid of RECs (Lakhs)	Volume of Sell Bid of RECs (Lakhs)	Volume of Buy Bid as % of volume of Sell Bid
Solar									
2012-13	0.77	0.14	549%	0.12	0.05	265%	-	-	-
2013-14	0.54	5.86	9%	0.14	1.35	10%	-	-	-
2014-15	1.01	37.00	3%	0.63	33.46	2%	-	-	-
2015-16	4.65	227.67	2%	1.83	93.80	2%	-	-	-
2016-17	4.04	323.70	1%	1.53	147.66	1%	-	-	-
2017-18	0.89	34.99	3%	1.20	13.68	9%	-	-	-
2018-19	86.45	152.51	57%	44.46	99.85	45%	-	-	-
2019-20	71.49	19.45	367%	26.80	8.12	330%	-	-	-
2020-21*	1.46	2.44	60%	0.37	0.71	51%	-	-	-
2021-22*	38.73	30.01	129%	6.21	5.58	111%	-	-	-
2022-23 (upto Nov-22)	23.28	215.24	11%	9.33	92.67	10%	0.02	0.09	23%
Non Solar									
2012-13	24.35	91.85	27%	6.55	24.90	26%	-	-	-
2013-14	12.71	251.65	5%	14.11	172.33	8%	-	-	-
2014-15	14.47	553.25	3%	14.51	550.88	3%	-	-	-
2015-16	26.73	889.92	3%	16.34	644.01	3%	-	-	-
2016-17	42.15	981.50	4%	17.16	596.37	3%	-	-	-
2017-18	94.17	635.09	15%	67.89	324.13	21%	-	-	-
2018-19	88.05	60.43	146%	37.82	16.53	229%	-	-	-
2019-20	91.87	94.72	97%	46.71	48.15	97%	-	-	-
2020-21*	5.78	41.70	14%	1.91	21.05	9%	-	-	-
2021-22*	50.84	90.58	56%	21.52	40.41	53%	-	-	-
2022-23 (upto Nov-22)	19.70	238.86	8%	9.70	111.02	9%	0.04	0.12	33%
REC**									
2022-23 (Dec-22 to Mar-23)	25.00	114.35	22%	4.52	33.16	14%	1.10	1.48	74%
2023-24	89.04	1511.64	6%	53.36	693.34	8%	1.35	73.72	2%
2024-25	287.03	799.64	36%	197.35	598.89	33%	31.13	341.47	9%

** As per Hon'ble APTEL Order trading sessions of RECs at both the Power Exchanges was suspended from Jul'20 to Oct'21 and resumed from Nov'21 as per Hon'ble APTEL Order dated 09.11.2021*

*** The categorization of RECs has been dispensed with, on introduction of the concept of multiplier under the CERC REC Regulations, 2022 w.e.f. 05.12.2022. Accordingly, the power exchanges deactivated the Solar and Non-Solar REC contract for trading w.e.f. December 2022. A new contract named "REC" has been made available for trading.*

Source: CERC MMC Report (Data from Power Exchanges)

The volume and price of RECs transacted on the power exchanges from 2012-13 to 2024-25 are given in Table-41, and the volume and price of RECs transacted through the trading licensees are given in Table-42.

The market clearing volume of Solar RECs transacted on the power exchanges increased from 0.14 lakhs in 2012-13 to 25.86 lakhs in 2022-23 (upto November 2022), whereas the weighted average market clearing price of these RECs declined from ₹12740/MWh in 2012-13 to ₹1189/MWh in 2022-23 (upto November 2022). The market clearing volume of Non-Solar RECs transacted on the power exchanges also increased from 25.76 lakhs in 2012-13 to 29.43 lakhs in 2022-23 (upto November 2022), whereas the weighted average market clearing price of these RECs declined from ₹1692/MWh in 2012-13 to ₹1000/MWh in 2022-23 (upto November 2022).

It can also be observed from the table that the market clearing volume of RECs (both Solar and Non-solar) increased from 26.32 lakhs in 2022-23 (December, 2022 to March, 2023) to 304.18 lakhs in 2024-25, whereas the market clearing price of these RECs declined from ₹1000/MWh to ₹225/MWh.

Table-41: Volume and Price of RECs Transacted on Power Exchanges, 2012-13 to 2024-25

Month	IEX		PXIL		HPX		Total	
	Volume of RECs (MWh) in Lakhs	Weighted Average Price of RECs (₹/MWh)	Volume of RECs (MWh) in Lakhs	Weighted Average Price of RECs (₹/MWh)	Volume of RECs (MWh) in Lakhs	Weighted Average Price of RECs (₹/MWh)	Volume of RECs (MWh) in Lakhs	Weighted Average Price of RECs (₹/MWh)
Solar								
2012-13	0.10	12782	0.04	12615	-	-	0.14	12740
2013-14	0.53	9383	0.14	9668	-	-	0.67	9441
2014-15	1.01	3725	0.63	4756	-	-	1.64	4121
2015-16	4.65	3500	1.83	3500	-	-	6.48	3500
2016-17	4.04	3500	1.53	3500	-	-	5.57	3500
2017-18	0.89	1000	1.20	1000	-	-	2.08	1000
2018-19	46.59	1113	25.36	1067	-	-	71.95	1097
2019-20	17.11	2293	6.04	2292	-	-	23.15	2293
2020-21*	1.19	1491	0.33	1290	-	-	1.52	1447
2021-22*	11.21	2201	2.42	2166	-	-	13.63	2195
2022-23 (upto Nov-22)	18.71	1182	7.13	1208	0.02	1000	25.86	1189
Non-Solar								

2012-13	19.81	1731	5.95	1564	-	-	25.76	1692
2013-14	12.71	1500	14.11	1500	-	-	26.82	1500
2014-15	14.47	1500	14.51	1500	-	-	28.98	1500
2015-16	26.73	1500	16.34	1500	-	-	43.07	1500
2016-17	42.15	1500	17.16	1500	-	-	59.31	1500
2017-18	92.41	1480	67.35	1487	-	-	159.76	1483
2018-19	41.22	1298	10.77	1274	-	-	51.98	1293
2019-20	43.16	1634	21.71	1659	-	-	64.88	1642
2020-21*	5.78	1000	1.91	1000	-	-	7.69	1000
2021-22*	49.57	1000	21.41	1000	-	-	70.98	1000
2022-23 (upto Nov-22)	19.70	1000	9.70	1000	0.04	1000	29.43	1000
REC **								
2022-23 (Dec-22 to Mar-23)	21.24	1000	4.19	1000	0.89	1000	26.32	1000
2023-24	75.39	447.24	39.85	431.97	1.34	447.92	116.58	442.03
2024-25	178.17	225.52	114.65	218.25	11.36	294.77	304.18	225.36

** As per Hon'ble APTEL Order trading sessions of RECs at both the Power Exchanges was suspended from Jul'20 to Oct'21 and resumed from Nov'21 as per Hon'ble APTEL Order dated 09.11.2021*

*** The categorization of RECs has been dispensed with, on introduction of the concept of multiplier under the CERC REC Regulations, 2022 w.e.f. 05.12.2022. Accordingly, the power exchanges deactivated the Solar and Non-Solar REC contract for trading w.e.f. December 2022. A new contract named "REC" has been made available for trading.*

Source: CERC MMC Report (Data from Power Exchanges)

The REC Regulations, 2022 provides for transactions of RECs through the trading licensees in addition to the transactions of RECs through power exchanges. The volume of RECs transacted through the trading licensees increased from 0.90 lakhs in 2022-23 to 38.91 lakhs in 2024-25 whereas the weighted average price of these RECs declined from ₹925/MWh in 2022-23 to ₹291.32/MWh in 2024-25 (Table-42).

Table-42: Volume and Price of RECs transacted through Trading Licensees, 2022-23 to 2024-25

Year	Volume of RECs (MWh) in Lakhs	Weighted Average Price of RECs (₹/MWh)
2022-23	0.90	925.00
2023-24	21.95	452.00
2024-25	38.91	291.32

Source: NLDC & Trading Licensees

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Annexure-I

List of Transmission Licensees as on 31.03.2025

S. No.	Name of Licensee	Date of grant of licence
1	Powerlinks Transmission Ltd.	13.11.2003
2	Torrent Power Grid Ltd	16.05.2007
3	Jaypee Powergrid Ltd	01.10.2007
4	Essar Power Transmission Company Ltd.	10.04.2008
5	Parbati Koldam Transmission Company Ltd	15.09.2008
6	Western Region Transmission (Maharashtra) (P) Ltd	30.12.2008
7	Western Region Transmission (Gujrat) (P) Ltd	30.12.2008
8	Teestavalley Power Transmission Ltd	14.05.2009
9	North East Transmission Company Ltd	16.06.2009
10	East - North Inter - Connection Company Ltd.	28.10.2010
11	Talcher - II Transmission Company Ltd.	08.11.2010
12	Cross Border Power Transmission Company Ltd	01.12.2010
13	North Karanpura Transmission Company Ltd.	16.12.2010
14	Jindal Power Ltd	09.05.2011
15	Raichur Sholapur Transmission Company Ltd	24.08.2011
16	Jabalpur Transmission Company Ltd	12.10.2011
17	Bhopal Dhule Transmission Company Ltd	12.10.2011
18	Powergrid NM Transmission Ltd	20.06.2013
19	Torrent Power Ltd	16.07.2013
20	Adani Transmission (India) Ltd	29.07.2013
21	Aravali Power Co. Ltd.	07.11.2013
22	Kudgi Transmission Ltd	07.01.2014
23	Powergrid Vizag Transmission Ltd	08.01.2014
24	Darbhanga - Motihari Transmission Company Ltd	30.05.2014
25	Purulia & Kharagpur Transmission Company Ltd	30.05.2014
26	Patran Transmission Company Ltd	14.07.2014
27	Powergrid Unchahar Transmission Ltd	21.07.2014
28	RAPP Transmission Company Ltd	31.07.2014
29	NRSS XXXI (B) Transmission Ltd	25.08.2014
30	Powergrid Kala Amb Transmission Ltd	04.09.2014
31	NRSS XXIX Transmission Ltd (Sterlite)	14.11.2014
32	Powergrid Jabalpur Transmission Ltd	15.06.2015
33	Powergrid Parli Transmission Ltd	10.07.2015
34	POWERGRID Warora Transmission Ltd	05.08.2015

35	Maheshwaram Transmission Ltd	23.11.2015
36	Raipur-Rajandgaon-Warora Transmission Ltd	29.02.2016
37	Chhattisgarh-WR Transmission Ltd	29.02.2016
38	Sipat Transmission Ltd	07.03.2016
39	POWERGRID Southern Interconnector Transmission System Ltd	14.03.2016
40	Alipurduar Transmission Ltd	21.03.2016
41	Odisha Generation Phase-II Transmission Ltd	30.06.2016
42	Gurgaon Palwal Transmission Ltd	29.09.2016
43	Warora-Kurnool Transmission Ltd	29.09.2016
44	North Karanpura Transco Ltd	29.09.2016
45	Khargone Transmission Ltd	17.11.2016
46	NRSS XXXVI Transmission Ltd	07.12.2016
47	NER-II Transmission Ltd	20.06.2017
48	Powergrid Medinipur Jeerat Transmission Ltd	20.06.2017
49	Kohima-Mariani Transmission Ltd	10.07.2017
50	Powergrid Mithilanchal Transmission Limited	24.04.2018
51	Goa - Tamnar Transmission Project Ltd	13.07.2018
52	Fatehgarh-Bhadla Transmission Ltd	27.08.2018
53	Powergrid Varanasi Transmission Ltd (WR-NR Power Transmission Ltd)	27.08.2018
54	Powergrid Khetri Transmission System Limited	19.12.2019
55	Bikaner-Khetri Transmission Limited	27.12.2019
56	Udupi Kasargode Transmission Limited (UKTL)	24.01.2020
57	WRSS XXI (A) Transco Limited	24.01.2020
58	Power Grid Bhuj Transmission Limited (PBTL)	03.03.2020
59	Lakadia Banaskantha Transco Limited	03.03.2020
60	Powergrid Ajmer Phagi Transmission Limited (PAPTL)	04.03.2020
61	Powergrid Fatehgarh Transmission Limited (PFTL)	04.03.2020
62	Lakadia Vadodara Transmission Project Limited (LVTPL)	04.03.2020
63	Jam Khambhaliya Transco Limited	24.03.2020
64	Vapi-II North Lakhimpur Transmission Limited	01.04.2021
65	Powergrid Ramgarh New Transmission Limited	31.05.2021
66	Powergrid Bikaner Transmission System Limited	15.07.2021
67	Powergrid Kala Amb Transmission Ltd (RTM Route)	22.03.2022
68	Koppal-Narendra Transmission Limited	28.03.2022
69	Powergrid Sikar Transmission Limited	27.05.2022
70	POWERGRID Aligarh Sikar Transmission Limited	28.05.2022
71	Karur Transmission Limited	16.06.2022
72	Khavda-Bhuj Transmission Limited	16.06.2022
73	Kallam Transmission Limited	18.07.2022
74	POWERGRID Southern Interconnector Transmission Ltd (RTM	18.07.2022

	Route)	
75	Gadag Transmission Limited	18.07.2022
76	Nangalbibra-Bongaigaon Transmission Limited	28.07.2022
77	Rajgarh Transmission Limited (RTL)	13.09.2022
78	Warora Kurnool Transmission Limited (RTM Route)	13.09.2022
79	Khetri-Narela Transmission Limited	26.09.2022
80	POWERGRID Bikaner Transmission System Limited (RTM Route)	21.11.2022
81	Power Grid Bhadla Transmission Limited,	25.11.2022
82	POWERGRID Neemuch Transmission System Limited,	27.12.2022
83	Khandukhal Rampura Transmission Limited	27.01.2023
84	POWERGRID ER NER Transmission Limited	04.02.2023
85	Gadag II-A Transmission Limited	26.02.2023
86	WRSR Power Transmission Limited	17.04.2023
87	Kishtwar Transmission Limited	12.05.2023
88	Patran Transmission Company Limited (RTM route)	13.06.2023
89	POWERGRID ERWR Power Transmission Limited	31.07.2023
90	Khavda II-C Transmission Limited	31.07.2023
91	POWERGRID Dharamjaigarh Transmission Limited	31.07.2023
92	POWERGRID KPS2 Transmission Limited	04.08.2023
93	Khavda II-A Transmission Limited	09.08.2023
94	POWERGRID Khavda RE Transmission System Limited	17.08.2023
95	POWERGRID Khavda II-B Transmission Limited	22.08.2023
96	POWERGRID Raipur Pool Dhamtari Transmission Limited	23.08.2023
97	POWERGRID Bhadla Sikar Transmission Limited	30.08.2023
98	POWERGRID KPS3 Transmission Limited	31.08.2023
99	KPS1 Transmission Limited	30.09.2023
100	NRSS XXIX Transmission Limited (RTM Mode)	01.11.2023
101	POWERGRID Bikaner Transmission System Limited	28.01.2024
102	Fatehgarh III Transmission Limited	28.01.2024
103	Fatehgarh IV Transmission Limited	30.01.2024
104	POWERGRID Bhadla III Transmission Limited	29.02.2024
105	POWERGRID Ananthpuram Kurnool Transmission Limited	29.02.2024
106	Beawar Transmission Limited	02.03.2024
107	Fatehgarh III Beawar Transmission Limited	05.03.2024
108	Kallam Transmission Limited	06.04.2024
109	POWERGRID Bikaner Neemrana Transmission Ltd	13.04.2024
110	POWERGRID Beawar Dausa Transmission Ltd	13.04.2024
111	POWERGRID Vataman Transmission Ltd	13.04.2024
112	POWERGRID Ramgarh II Transmission Limited	13.04.2024
113	TP Bikaner III Neemrana II Transmission Limited	15.04.2024
114	POWERGRID Ramgarh Transmission Limited	15.04.2024

115	Neemrana II Kotputli Transmission Limited	22.04.2024
116	Neemrana II Bareilly Transmission Limited	22.04.2024
117	Gurgaon Palwal Transmission Limited	22.04.2024
118	Butwal-Gorakhpur Cross Border Power Transmission Ltd	25.04.2024
119	POWERGRID KPS3 Transmission System Limited	03.05.2024
120	Halvad Transmission Limited	24.05.2024
121	POWERGRID Sikar Khetri Transmission Limited	28.05.2024
122	Fatehgarh IV Transmission Limited	28.05.2024
123	Karera Power Transmission Limited	28.05.2024
124	Khavda- Bhuj Transmission Limited	06.06.2024
125	Koppal-Narendra Transmission Limited	13.06.2024
126	Gadag Transmission Limited	13.06.2024
127	Pachora Power Transmission Limited	15.06.2024
128	Solapur Transmission Limited	23.06.2024
129	Warora Kurnool Transmission Limited	24.06.2024
130	Ishanagar Power Transmission Limited	25.06.2024
131	KPS1 Transmission Limited	04.07.2024
132	POWERGRID Parli Transmission Limited	15.07.2024
133	Koppal II Gadag II Transmission Limited	26.07.2024
134	Dhule Power Transmission Limited	09.08.2024
135	POWERGRID Ramgarh Transmission Limited	13.08.2024
136	WRSS XXI (A) Transco Limited	26.08.2024
137	NERES XVI Power Transmission Limited	10.09.2024
138	POWERGRID KPS2 Transmission System Limited	17.09.2024
139	Kallam Transco Limited	19.09.2024
140	POWERGRID Ananthpuram Kurnool Transmission Limited	30.09.2024
141	POWERGRID Bidar Transmission Limited	15.10.2024
142	POWERGRID Khavda IV-E2 Power Transmission Limited	11.11.2024
143	Sirohi Transmission Limited	25.11.2024
144	Bhadla-III Power Transmission Limited	15.12.2024
145	Khavda IVA Power Transmission Limited	27.12.2024
146	Tumkur- II REZ Power Transmission Limited	02.01.2025
147	POWERGRID Bhadla Bikaner Transmission Limited	14.01.2025
148	Khavda IV C Power Transmission Limited	14.01.2025
149	POWERGRID Beawar - Mandsaur Transmission Limited	31.01.2025
150	POWERGRID Bhadla III Transmission Limited	31.01.2025
151	Rajasthan IV C Power Transmission Limited	08.02.2025
152	POWERGRID Neemuch Transmission System Limited	14.02.2025
153	Rajasthan IV E Power Transmission Limited	14.02.2025
154	Rajasthan IV A Power Transmission Limited	14.02.2025
155	POWERGRID Vataman Transmission Limited	21.02.2025

156	POWERGRID Bikaner Neemrana Transmission Limited	05.03.2025
157	Karur Transmission Limited	12.03.2025
158	Khavda IVA Power Transmission Limited	14.03.2025
159	POWERGRID Ramgarh Transmission Limited	19.03.2025
160	POWERGRID Jam Khambhaliya Transmission Limited	21.03.2025
161	POWERGRID Kurawar Transmission Limited	25.03.2025
162	Barmer I Transmission Limited	26.03.2025
163	Khavda PS1 and 3 Transmission Limited	26.03.2025
164	KHAVDA V-A Power Transmission Ltd	26.03.2025
165	POWERGRID Siwani Transmission Limited	26.03.2025
166	POWERGRID Bikaner Transmission System Limited	27.03.2025

Annexure-II

List of Trading Licensee as on 31.03.2025

Sr. No.	Name of Trading Licensee	Date of Issue of License	Category of License
1	Tata Power Trading Company Ltd	09.06.2004	I
2	Powerpulse Trading Solutions Ltd	09.06.2004	I
3	PTC India Ltd.	30.06.2004	I
4	NTPC Vidyut Vyapar Nigam Ltd	23.07.2004	I
5	National Energy Trading & Services Ltd	23.07.2004	III
6	Instinct Infra & Power Ltd	07.09.2005	IV
7	JSW Power Trading Company Ltd.	25.04.2006	IV
8	Greenko Energies (P) Ltd	22.01.2008	III
9	Ambitious Power Trading Company Ltd	16.09.2008	IV
10	RPG Power Trading Company Ltd	23.09.2008	II
11	GMR Energy Trading Ltd	14.10.2008	I
12	Knowledge Infrastructure Systems (P) Ltd	18.12.2008	IV
13	Kreate Energy (I) (P) Ltd.	12.02.2009	II
14	Shree Cement Ltd	16.03.2010	IV
15	ABJA Power (P) Ltd.	26.04.2011	III
16	Customised Energy Solutions India (P) Ltd	08.06.2011	V
17	Statkraft Markets (P) Ltd	21.06.2012	I
18	Manikaran Power Ltd	29.06.2012	I
19	Arunachal Pradesh Power Corporation (P) Ltd	11.09.2012	II
20	Vedprakash Power (P) Ltd.	19.08.2013	IV
21	Solar Energy Corporation of India	01.04.2014	I
22	Saranyu Power Trading (P) Ltd	10.02.2015	III
23	Gita Power & Infrastructure (P) Ltd	20.10.2015	V
24	Phillip Commodities India (P) Ltd.	21.01.2016	IV
25	Atria Energy Services (P) Ltd	20.06.2017	V
26	NHPC Limited	23.04.2018	I
27	NLC India Ltd.	13.07.2018	I
28	Refex Energy Ltd.	30.08.2018	V
29	NTPC Limited	08.07.2019	I
30	Amp Energy Markets India (P) Ltd.	15.04.2021	V
31	Altilium Energies (P) Ltd.	23.05.2021	V
32	Shubheksha Advisors (P) Ltd.	31.07.2021	V
33	Reneurja Power LLP	31.07.2021	V
34	ReNew Energy markets (P) Ltd.	28.11.2021	IV
35	Shell Energy Marketing and Trading India (P) Ltd.	22.12.2021	V

36	SJVN Limited	10.01.2022	I
37	Instant Ventures (P) Ltd.	09.02.2022	V
38	Refex Industries Ltd.	21.03.2022	I
39	Ideal Energy Solutions (P) Ltd.	22.03.2022	V
40	AEI New Energy Trading (P) Ltd.	25.03.2022	III
41	Kundan International (P) Ltd.	29.04.2022	II
42	Saini Power Transactor	06.07.2022	V
43	Powerfull Energy Trading (P) Ltd.	09.08.2022	V
44	Visual Percept Solar Projects (P) Ltd.	27.11.2022	III
45	REL Power Trading LLP	13.12.2022	V
46	VEH Global India (P) Ltd.	26.12.2022	IV
47	Renesys Solar (P) Ltd	23.04.2023	V
48	THDC India Ltd.	06.05.2023	IV
49	Embassy Classic (P) Ltd.	14.07.2023	V
50	Adarsh Stainless (P) Ltd.	15.08.2023	IV
51	Energyedge Power Trading (P) Ltd.	18.09.2023	V
52	Elsa Consultancy	23.10.2023	V
53	Viviid Power Trading (P) Ltd.	11.01.2024	V
54	Yggdrasil Commodities India (P) Ltd.	11.01.2024	V
55	Radiance Green Markets (P) Ltd.	02.03.2024	V
56	Serentica Renewables India 2 (P) Ltd.	15.03.2024	V
57	NEFA Power Trading (P) Ltd.	21.03.2024	V
58	Enfinity Global Power Management (P) Ltd.	04.07.2024	V
59	Fusionx Asia Pacific (P) Ltd.	01.08.2024	V
60	Juniper Green Power Trading (P) Ltd.	26.08.2024	V
61	ENGlE Energy Marketing India (P) Ltd.	03.12.2024	I
62	Avaada Power Trading (P) Ltd.	16.12.2024	V
63	ERO POWER LLP	30.12.2024	IV
64	REC Power Development & Consultancy Ltd.	14.01.2025	I
65	Sunsure Power Markets (P) Ltd.	10.03.2025	V
66	KVK Energy & Infrastructure (P) Ltd.	16.03.2025	IV

Note: This list is exclusive of Global Energy (P) Ltd.

Historical Volatility Formula:

$$\sigma = \sqrt{\frac{1}{(n-1)}\sum_{y=1}^{n}(\ln\frac{y_i}{y_{i-1}} - \mu)^2}$$

$$\mu = \frac{1}{n}\sum_{y=1}^{n}(\ln\frac{y_i}{y_{i-1}})$$

where

1. Daily prices returns = Ln (y_i / y_{i-1}).
2. y_i is price for today; y_{i-1} is price on previous day.
3. Ln is natural logarithm
4. n is the number of observations
5. u is the average daily returns

Annexure-IV

Herfindahl-Hirschman Index (HHI)

Formula for computing the HHI is as under:

$$HHI = \sum_{i=1}^{N} s_i^2$$

where, s_i is the market share of firm *i* in the market, and *N* is the number of firms.

The Herfindahl-Hirschman Index (HHI) ranges from 1/N to 1, where *N* is the number of firms in the market. Equivalently, if percentages are used as whole numbers, as in 75 instead of 0.75, the index can range up to 100^2 or 10,000.

- HHI below 0.01 (or 100) indicates a highly competitive index.
- HHI below 0.15 (or 1,500) indicates an unconcentrated index.
- HHI between 0.15 to 0.25 (or 1,500 to 2,500) indicates moderate concentration.
- HHI above 0.25 (above 2,500) indicates high concentration.

There is also a normalized Herfindahl index. Whereas, the Herfindahl index ranges from 1/N to 1, the normalized Herfindahl index ranges from 0 to 1.



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