

Report on Short-term Power Market in India: 2014-15



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Preface

Electricity Act 2003 ushered in the reform process in the country and accelerated the development of Electricity Sector from a vertically integrated structure to a competition based model. Central Electricity Regulatory Commission (CERC) was entrusted with an important responsibility of promoting competition, efficiency and economy in bulk power market, improving the quality of supply and promoting investments. CERC set this process in motion through Trading Licensee and Open Access regulations in 2004. Through its various regulations and orders CERC has created a framework for a robust and healthy short-term power market in the country. The short-term power market (including Deviation Settlement Mechanism) cover contracts of less than a year through bilateral agreements and power exchanges. It constitutes 9 % (about 100 BU) of the total electricity generation in 2014-15. In the last decade, the short- term power market has become an integral part of the electricity sector in the country. It has helped the electricity providers to balance their portfolios on day ahead basis and adjust to fluctuating power requirements. It has also enabled power producers and procurers to sell their surpluses.

Access to information is one of the key elements to ensure efficiency and competition in the sector and strengthen the faith of the stakeholders and consumers in the system. CERC brings out monthly and annual short-term power market reports to keep market participants as well as stakeholders aware and updated on the state of the power market. The annual report provides a snapshot of the short-term power transactions through different instruments by various market participants. This report covers 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 various types of participants and effect of congestion on volumes traded on power exchanges. It also covers tariffs of long-term contracts and analysis of trading of Renewable Energy Certificates (RECs).

This report can be useful to all individuals and organizations interested in the power sector. In order to ensure ease of access, this report is available on the CERC website www.cercind.gov.in. We are confident that market participants and stakeholders will find the Report on Short-term Power Market in India, 2014-15 useful.

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Abbreviations

| Abbreviation | Expanded Version |
|--------------|-------------------------------------------------------|
| APL | Adani Power Limited |
| APM | Administered Price Mechanism |
| APPCC | Andhra Pradesh Power Coordination Committee |
| BEST | Bombay Electric Supply & Transport Undertaking |
| Block | 15 Minutes Time Block |
| BMMI | BMM Ispat Limited |
| BSEB | Bihar State Electricity Board |
| BSPHCL | Bihar State Power Holding Company Limited |
| BU | Billion Units (Billion kWh) |
| CCGT | Combined Cycle Gas Turbine |
| CERC | Central Electricity Regulatory Commission |
| CGS | Central Generating Stations |
| CPP | Captive Power Producer/Plant |
| CSPDCL | Chhattisgarh State Power Distribution Company Limited |
| CSPTCL | Chhattisgarh State Power Trading Company Limited |
| DAM | Day Ahead Market |
| DISCOMs | Distribution Companies |
| DSM | Deviation Settlement Mechanism |
| DVC | Damodar Valley Corporation |
| ER | Eastern Region |
| FGUTPP | Firoz Gandhi Unchahar Thermal Power Project |
| GOHP/GoHP | Government of Himachal Pradesh |
| GPS | Gas Power Station |
| GRIDCO | Grid Corporation of Orissa Limited |
| GUVNL | Gujarat UrjaVikas Nigam Limited |
| HEP | Hydro Electric Project |
| HHI | Herfindahl-Hirschman Index |
| HPPC | Haryana Power Purchase Centre |
| HPSEB | Himachal Pradesh State Electricity Board |
| HSD | High Speed Diesel |
| IFFCO | Indian Farmers Fertiliser Cooperative Limited |
| IEX | Indian Energy Exchange Limited |
| ISGS | Inter State Generating Station |

| Abbreviation | Expanded Version |
|---------------------|------------------------------------------------------------|
| J&K | Jammu & Kashmir |
| JPL | Jindal Power Limited |
| JSPL | Jindal Steel and Power Limited |
| JSWEL | JSW Energy Limited |
| JVVNL | Jaipur Vidyut Vitaran Nigam Limited |
| KSEB | Kerala State Electricity Board |
| kWh | Kilo Watt Hour |
| KWHEP/S | KarchamWangtoo Hydro Electric Power Station |
| LNG | Liquefied Natural Gas |
| LOI | Letter of Intent |
| Ltd | Limited |
| MCP | Market Clearing Price |
| MEPL | Meenakshi Energy Private Limited |
| MPPMCL | M P Power Management Company Limited |
| MPPTCL | Madhya Pradesh Power Trading Company Limited |
| MSEDCL | Maharashtra State Electricity Distribution Company Limited |
| MU | Million Units |
| MW | Mega Watts |
| MWh | Mega Watt Hour |
| NCTP | National Capital Thermal Power Plant (Dadri) |
| NDMC | New Delhi Municipal Corporation |
| NEEPCO | North Eastern Electric Power Corporation Limited |
| NER | North Eastern Region |
| NEW Grid | Northern, Eastern, Western and North-Eastern Region Grid |
| NHDC | National Hydro Development Corporation Limited |
| NHPC | National Hydro-Electric Power Corporation Limited |
| NLC | Neyveli Lignite Corporation Limited |
| NLDC | National Load Dispatch Centre |
| NPCL | Noida Power Company Limited |
| NR | Northern Region |
| NTPC | National Thermal Power Corporation Limited |
| OA | Open Access |
| OAC | Open Access Consumer |
| OTP | Other than RTC and Peak period |

| Abbreviation | Expanded Version |
|---------------------|----------------------------------------------------------|
| PFC | Power Finance Corporation |
| PPA | Power Purchase Agreement |
| PSEB | Punjab State Electricity Board |
| PX/PXs | Power Exchange/Power Exchanges |
| PXIL | Power Exchange India Limited |
| REC/RECs | Renewable Energy Certificates |
| REL | Reliance Energy Limited |
| ROR | Run of River |
| RTC | Round The Clock |
| S1 | Southern Region 1 |
| S2 | Southern Region 2 |
| SEB/SEBs | State Electricity Board |
| SR Grid | Southern Region Grid |
| St | Stage |
| STPS | Super Thermal Power Station |
| TAM | Term Ahead Market |
| THDC | Tehri Hydro Development Corporation Limited |
| TPCL | Tata Power Company Limited |
| TPS | Thermal Power Station |
| TSSPDCL | Southern Power Distribution Company of Telangana Limited |
| UPCL | Uttarakhand Power Corporation Limited |
| UPPCL | Uttar Pradesh Power Corporation Limited |
| UT | Union Territory |
| W1 | Western Region 1 |
| W2 | Western Region 2 |
| W3 | Western Region 3 |
| WBSEDCL | West Bengal State Electricity Distribution Company Ltd |
| WR | Western Region |

Executive Summary

An analysis of short-term transactions of electricity in India has been made in this Report on Short-term Power Market¹ for the year 2014-15. Here, “short-term transactions of electricity” refers to contracts of less than one year period for electricity transacted under bilateral transactions through Inter-State Trading Licensees (only inter-state part) and directly by the Distribution Licensees (also referred as Distribution Companies or DISCOMs), Power Exchanges (Indian Energy Exchange Ltd (IEX) and Power Exchange India Ltd (PXIL)), and Deviation Settlement Mechanism (DSM). The analysis includes (i) Yearly/monthly/daily trends in short-term transactions of electricity; (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) Tariffs of long-term sources of power for various distribution companies; and (viii) Analysis of transactions of Renewable Energy Certificates (RECs) through power exchanges.

Salient features of the report that are discussed in detail in subsequent sections are listed below.

1. Of the total electricity procured in India in 2014-15, the short-term power market comprised 9% . The balance 91% of generation was procured mainly by distribution companies through long-term contracts and short-term intra-state transactions.
2. In terms of volume, the size of the short-term market in India was 98.99BU (Billion Units) in the year 2014-15. As compared to the volume of electricity transacted through short-term market in the year 2013-14 (104.64BU), this was about 5% lower. This

¹Although Deviation Settlement Mechanism (DSM) is not a market mechanism, electricity transacted under DSM is often considered a part of short-term transaction. Also, electricity transacted bilaterally directly between the distribution companies (without involving trading licensees or power exchanges) is also considered a part of short-term market. In the year 2014-15, the volume of DSM was about 19.45BU and that between distribution companies was about 15.58BU.

negative growth in volume of -5.65BU was accounted mainly by the negative growth in transactions through DSM (-2.02 BU) and by direct bilateral transactions between the DISCOMs (-1.81 BU).

3. Excluding DSM and direct bilateral sale between the DISCOMs, the volume of electricity transacted was 63.96BU in 2014-15. This was about 3% lower than in 2013-14. Volume of electricity transacted through power exchanges witnessed a decrease of about -4%, whereas the volume of electricity transacted through inter-state trading licensees witnessed decrease of -2% over 2013-14. In monetary terms, the size of this segment of the short-term market was ₹25,089 crore in the year 2014-15², which was 5% more than in the year 2013-14. Of this, ₹10,288 crore was the value of electricity transacted through power exchanges (16% more than in 2013-14), and the balance of ₹14,801crore was the value of inter-state transaction of electricity through trading licensees (about 2% less than in 2013-14).
4. The volume of DSM in 2014-15 decreased by 9% over 2013-14. The share of DSM as a percentage of total volume of short-term transactions of electricity continued the downward trend in past years and it declined from 39% in 2009-10 to 20% in 2014-15.
5. In terms of volume, the direct bilateral transactions between DISCOMs witnessed a decrease of about 10% in 2014-15 as compared to 2013-14. The share of direct bilateral transactions between DISCOMs as a percentage of total short term transaction volume increased from 15% in 2014-15 when compared with the previous year 2013-14.
6. The weighted average price of electricity transacted through power exchanges was ₹3.50/kWh and through trading licensees it was ₹4.28/kWh in 2014-15. The corresponding values for the year 2013-14 were ₹2.90/kWh and ₹4.29/kWh, respectively. In the year 2014-15, the weighted average price of electricity transacted through Day Ahead Market sub-segment of the power exchanges was ₹3.49/kWh and that through Term Ahead Market sub-segment was ₹3.77/kWh.

²*Excluding transactions pertaining to banking transactions.*

7. During 2014-15, about 96% of the volume of electricity transacted through traders was at less than ₹6/kWh. About 54% of the volume was transacted at less than ₹4/kWh.
8. During 2014-15, IEX transacted 96% of the volume of electricity at price less than ₹6/kWh. About 76% of the volume was transacted at less than ₹4/kWh. During the year, PXIL transacted 100% of the volume of electricity at price less than ₹6/kWh. About 90% of the volume was transacted at less than ₹4/kWh.
9. During 2014-15, of the total electricity bought under bilateral transactions from traders, 93.56% was bought on round the clock (RTC) basis, followed by 5.83% exclusively bought in periods other than RTC and peak (OTP) and 0.61% was exclusively bought during peak hours. The per unit price of electricity procured during RTC was high (₹4.30/kWh) when compared with the price during Peak period (₹3.89/kWh) and OTP (₹3.67/kWh).
10. It is observed from the block-wise and region-wise prices of electricity transacted through power exchanges in 2014-15 that the price of electricity in Southern Region (S1 and S2 regions) was high when compared to the price in other regions in both the power exchanges.
11. Level of competition among the trading licensees is shown for the period from 2004-05 to 2014-15. During the period, number of traders who were undertaking trading increased from 4 to 28 and concentration of market power (HHI based on volume of trade undertaken by the licensees) declined from high concentration (HHI of 0.5512) to moderate concentration (HHI of 0.1512). The competition among the trading licensees resulted an increase in volume and decrease in prices in the short-term bilateral market.
12. The weighted average trading margin charged by the trading licensees in 2014-15 was ₹0.038/kWh, which is in line with the CERC Trading Margin Regulations, 2010.
13. The procurement of power by the industrial consumers through power exchanges was began in the year 2009. In both power exchanges, Open Access industrial consumers

bought 12.19BU of electricity, which formed 43% of the total day ahead volume transacted in the power exchanges during 2014-15.

14. The weighted average price of electricity bought by open access consumers at IEX was lower (₹3.05/kWh) compared to the weighted average price of total electricity transacted through IEX (₹3.49/kWh). The weighted average price of electricity bought by open access consumers at PXIL was lower (₹2.88/kWh) compared to the weighted average price of total electricity transacted through PXIL (₹3.09/kWh).
15. The year also witnessed constraints on the volume of electricity transacted through power exchanges, mainly due to transmission congestion. During 2014-15, the actual transacted volume was about 10% less than the unconstrained volume. Because of congestion and the splitting of day ahead market at both the power exchanges, the congestion amount collected during the year was ₹504.05 crore.
16. In 2014-15, the number of Solar RECs transacted on IEX and PXIL were 1,00,661 and 62,839 respectively and the market clearing price of these RECs was ₹7850/MWh on both IEX and PXIL. During the year, market clearing volume of Non-Solar RECs transacted on IEX and PXIL were 14,46,963 and 14,51,459 respectively and the market clearing price of these RECs was ₹1500/MWh on both IEX and PXIL.

Introduction

A brief analysis of the short-term transactions of electricity in India has been done in this Report on Short-term Power Market³ for the year 2014-15. Here, “short-term transactions of electricity” refers to the contracts less than one year for the following trades:

- (a) Electricity traded under bilateral transactions through Inter-State Trading Licensees (only inter-state trades),
- (b) Electricity traded directly by the Distribution Licensees (also referred as Distribution Companies or DISCOMs),
- (c) Electricity traded through Power Exchanges (Indian Energy Exchange Ltd (IEX) and Power Exchange India Ltd (PXIL)), and
- (d) Electricity transacted through Deviation Settlement Mechanism(DSM).

The analysis includes:

- (i) Yearly/monthly/daily trends in short-term transactions of electricity;
- (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) Tariffs of long-term sources of power for various distribution companies; and
- (viii) Analysis of transactions of Renewable Energy Certificates (RECs) through power exchanges.

³Although Deviation Settlement Mechanism (DSM) is not a market mechanism, electricity transacted under DSM is often considered a part of short-term transaction. Also, electricity transacted bilaterally directly between the distribution companies (without involving trading licensees or power exchanges) is also considered a part of short-term market. In the year 2014-15, the volume of DSM was about 19.45BU and that between distribution companies was about 15.58BU.

1. Yearly Trends in Short-term Transactions of Electricity (2008-09 to 2014-15)

The analysis on yearly trends in short-term transactions 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 both Day Ahead and Term Ahead Markets,
- DSM segment, and
- Direct transactions of electricity between DISCOMs.

Inter-state trading licensees (traders) have been undertaking trading in electricity since 2004 and the power exchanges started operating since 2008. The two power exchanges, IEX and PXIL started their operations in June 2008 and October 2008 respectively. As of March 2015, there were 47 inter-state trading licensees (list is enclosed at Annexure-I) and two power exchanges.

1.1.Total Short-term Transactions of Electricity with respect to Total Electricity Generation

Total volume of short-term transactions of electricity increased from 65.90BU in 2009-10 to 98.99BU in 2014-15. The annual growth in volume was 24% from 2009-10 to 2010-11, 16% from 2010-11 to 2011-12, 5% from 2011-12 to 2012-13, 6% from 2012-13 to 2013-14 and -5% from 2013-14 to 2014-15. Total volume of short-term transactions of electricity as percentage of total electricity generation was varied between 9% and 11% during the period from 2009-10 to 2014-15 (Table-1).

Table-1: Total Volume of Short-term Transactions of Electricity with respect to Total Electricity Generation

| Year | Total Volume of Short-term Transactions of Electricity (BU) | Total Electricity Generation (BU) | Total volume of Short-term Transactions of Electricity as % of Total Electricity Generation |
|-------------|--------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------------|
| 2009-10 | 65.90 | 764.03 | 9% |
| 2010-11 | 81.56 | 809.45 | 10% |
| 2011-12 | 94.51 | 874.17 | 11% |
| 2012-13 | 98.94 | 907.49 | 11% |
| 2013-14 | 104.64 | 962.90 | 11% |
| 2014-15 | 98.99 | 1045.09 | 9% |

Source: NLDC

The analysis of yearly trends of short-term transactions of electricity for various segments, i.e. electricity transacted through traders and power exchanges, DSM, and directly between DISCOMs is included in the sections that follow.

1.1.1 Electricity Transacted through Traders and Power Exchanges

Table-2, Table-3, Figure-1 & Figure-2 show details of volume of electricity transacted through traders under bilateral transactions and through power exchanges for the period from 2008-09 to 2014-15. The volume of electricity transacted through traders and power exchanges increased from 24.69BU in 2008-09 to 63.96BU in 2014-15. The share of electricity transacted through traders and power exchanges (in volume terms) as a percentage of total short-term transactions of electricity has increased from 51.45% in 2009-10 to 64.62% in 2014-15. It can be observed from the table that the share of electricity transacted through traders and power exchanges as a percentage of total short-term transactions of electricity has continuously increased during the period. However, the growth in volume for this segment during the year 2014-15 was negative as compared to 2013-14 and it was -1.82BU(-3%).

Table-2: Volume of Electricity Transacted through Traders and Power Exchanges

| Year | Electricity Transacted through traders (BUs) | Electricity Transacted through IEX (BUs) | | Electricity Transacted through PXIL (BUs) | | Electricity Transacted through IEX and PXIL (BUs) | Total (BUs) |
|---------|----------------------------------------------|------------------------------------------|-------------------|-------------------------------------------|-------------------|---------------------------------------------------|-------------|
| | | Day Ahead Market | Term Ahead Market | Day Ahead Market | Term Ahead Market | | |
| 2008-09 | 21.92 | 2.62 | | 0.15 | | 2.77 | 24.69 |
| 2009-10 | 26.72 | 6.17 | 0.095 | 0.92 | 0.003 | 7.19 | 33.91 |
| 2010-11 | 27.70 | 11.80 | 0.91 | 1.74 | 1.07 | 15.52 | 43.22 |
| 2011-12 | 35.84 | 13.79 | 0.62 | 1.03 | 0.11 | 15.54 | 51.38 |
| 2012-13 | 36.12 | 22.35 | 0.48 | 0.68 | 0.04 | 23.54 | 59.66 |
| 2013-14 | 35.11 | 28.92 | 0.34 | 1.11 | 0.30 | 30.67 | 65.78 |
| 2014-15 | 34.56 | 28.12 | 0.22 | 0.34 | 0.72 | 29.40 | 63.96 |

Note 1: The volume of electricity transacted through traders in 2008-09 (April to July 2008) includes cross border trading and intra-state trading volume.

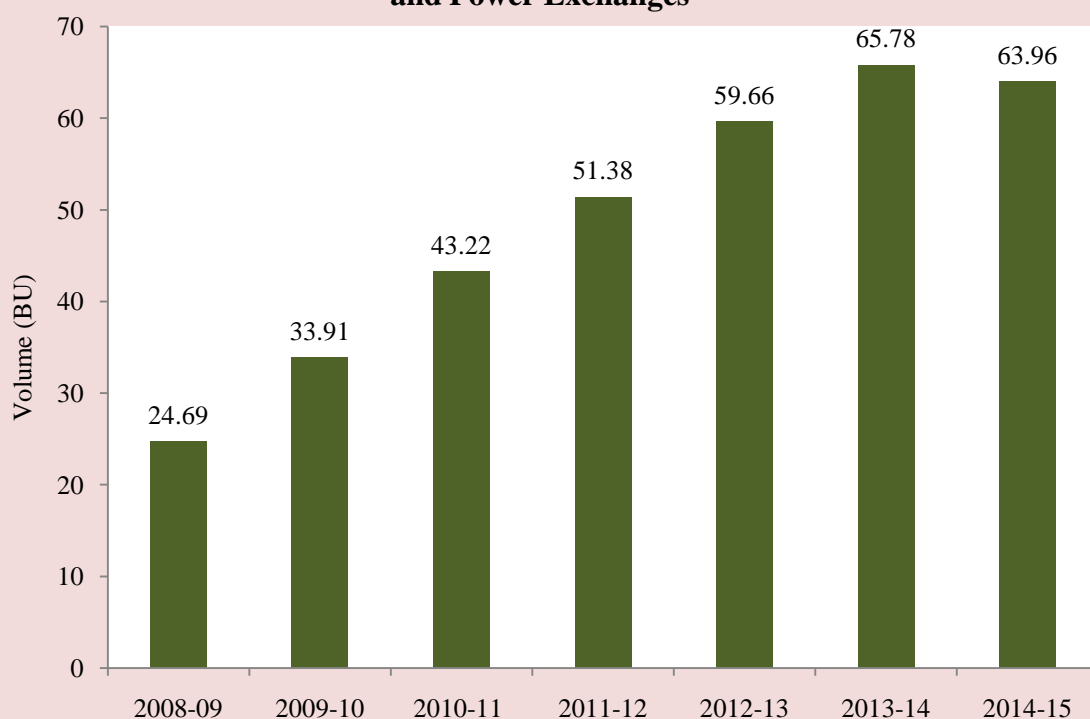
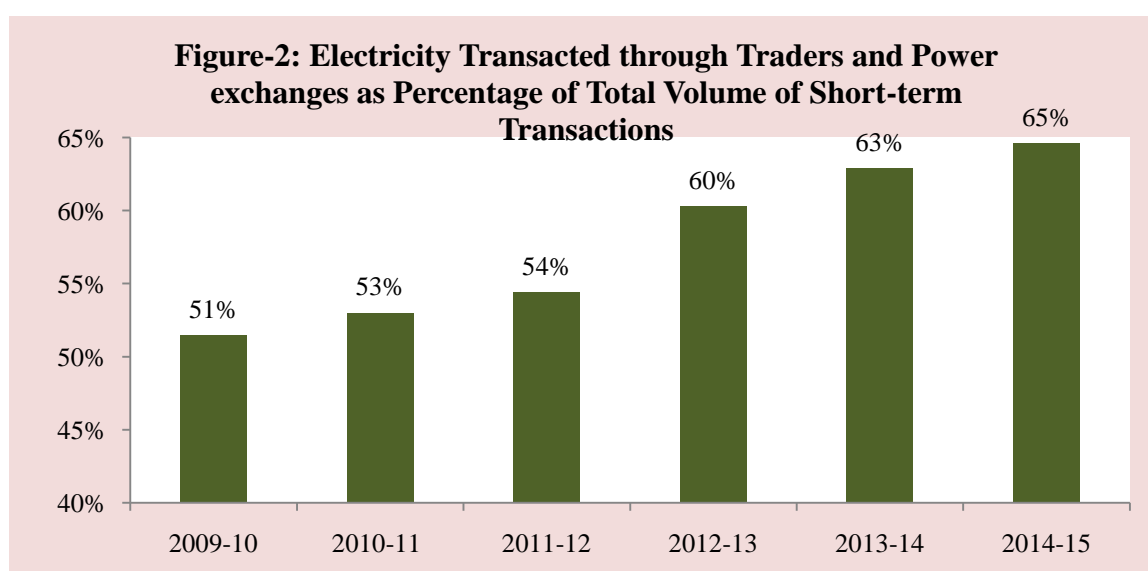
Figure-1: Total Volume of Electricity Transacted through Traders and Power Exchanges

Table-3: Electricity Transacted through Traders and Power Exchanges as percentage of Total Volume of Short-term Transactions

| Year | Volume of Electricity Transacted through Traders and Power Exchanges (BUs) | Total Short-term Transactions of Electricity (BUs) | Electricity Transacted through traders and PXs as % to Total Volume of Short-term |
|---------|----------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------------------------------|
| 2009-10 | 33.91 | 65.90 | 51.45% |
| 2010-11 | 43.22 | 81.56 | 53.00% |
| 2011-12 | 51.38 | 94.51 | 54.37% |
| 2012-13 | 59.66 | 98.94 | 60.30% |
| 2013-14 | 65.78 | 104.64 | 62.87% |
| 2014-15 | 63.96 | 98.99 | 64.62% |

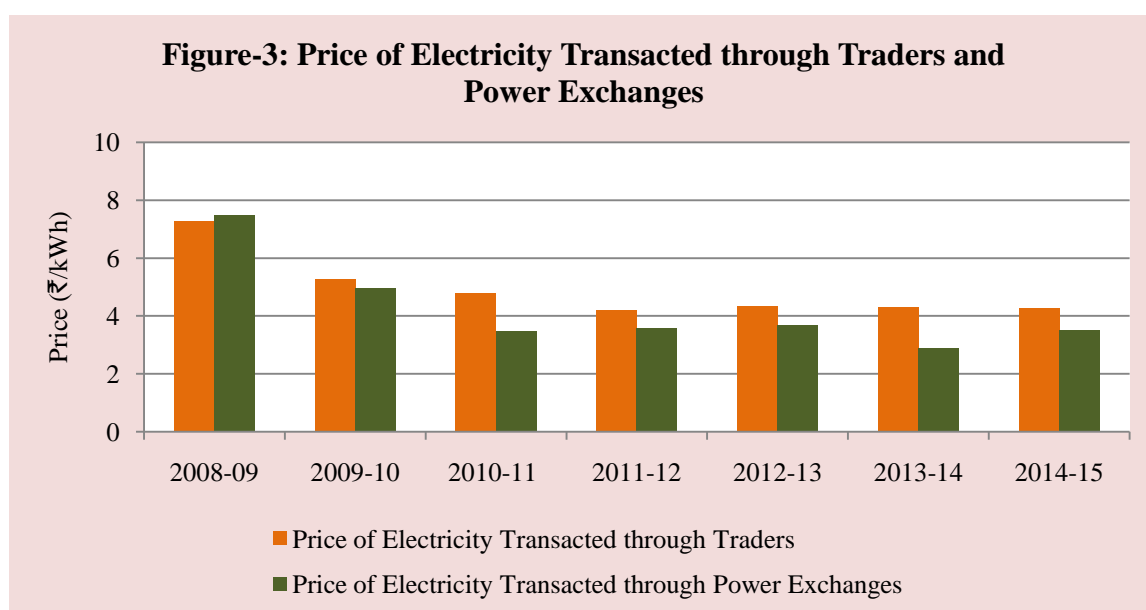


The prices of electricity transacted through traders and Power Exchanges are shown in Table-4 and Figure-3. The weighted average price of electricity transacted through traders and power exchanges declined from ₹7.29/kWh and ₹7.49/kWh respectively in 2008-09 to ₹4.28/kWh and ₹3.50/kWh respectively in 2014-15.

The decreasing trend in weighted average prices affected the market size of this segment in monetary terms (Table-5). In volume terms (BU terms) the size of this segment registered a negative growth by about -3 % in the year 2014-15 compared to 2013-14, whereas in monetary terms the growth was positive by about 5%. The power exchange sub-segment registered a negative growth of about -4% in volume terms and a high growth of about 16% in monetary terms. The bilateral trader segment registered a negative growth in both volume terms (-2%) and monetary terms (-2%).

Table-4: Price of Electricity Transacted through Traders and Power Exchanges

| Year | Price of Electricity transacted through Traders (₹/kWh) | Price of Electricity transacted through Power Exchanges (DAM+TAM) (₹/kWh) |
|---------|---------------------------------------------------------|---------------------------------------------------------------------------|
| 2008-09 | 7.29 | 7.49 |
| 2009-10 | 5.26 | 4.96 |
| 2010-11 | 4.79 | 3.47 |
| 2011-12 | 4.18 | 3.57 |
| 2012-13 | 4.33 | 3.67 |
| 2013-14 | 4.29 | 2.90 |
| 2014-15 | 4.28 | 3.50 |

Figure-3: Price of Electricity Transacted through Traders and Power Exchanges**Table-5: Size of the Bilateral Trader and Power Exchange Market in Monetary Terms**

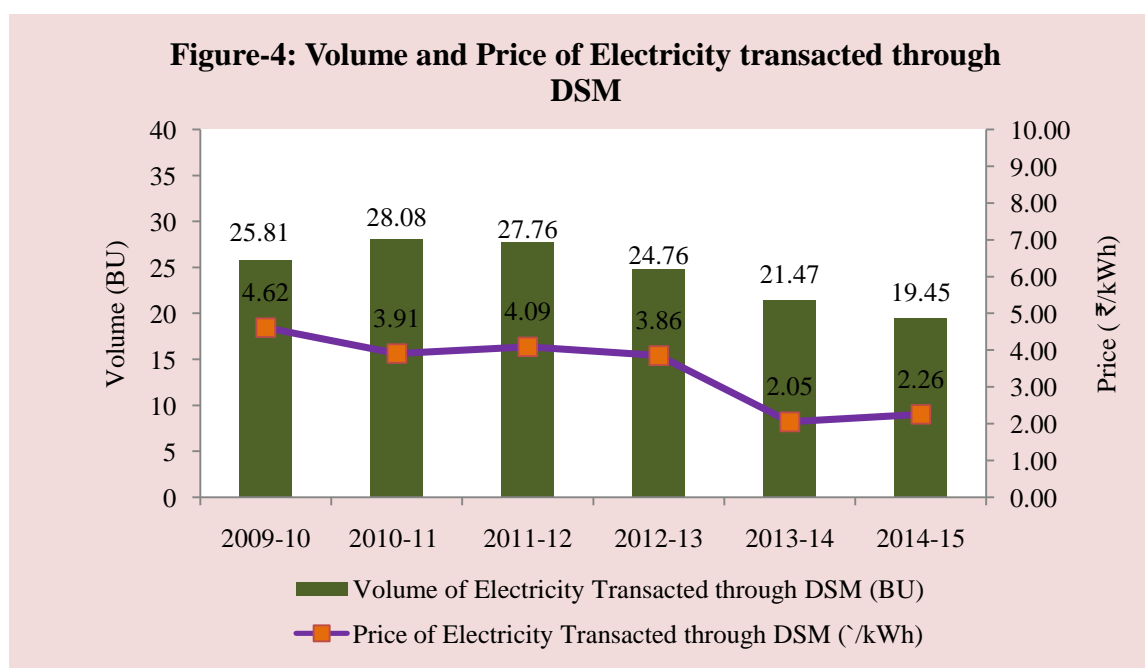
| Year | Electricity Transacted through traders (BU) | Price of Electricity Transacted through Traders (₹/kWh) | Size of bilateral trader Market in ₹Crore | Electricity Transacted through Power Exchanges (BU) | Price of Electricity Transacted through Power Exchanges (₹/kWh) | Size of Power Exchange Market in ₹ Crore | Total Size of the bilateral trader + Power Exchange Market (₹Crore) |
|---------|---------------------------------------------|---------------------------------------------------------|-------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------------|------------------------------------------|---------------------------------------------------------------------|
| 2009-10 | 26.72 | 5.26 | 14055 | 7.19 | 4.96 | 3563 | 17617 |
| 2010-11 | 27.70 | 4.79 | 13268 | 15.52 | 3.47 | 5389 | 18657 |
| 2011-12 | 35.84 | 4.18 | 14979 | 15.54 | 3.57 | 5553 | 20532 |
| 2012-13 | 36.12 | 4.33 | 15624 | 23.54 | 3.67 | 8648 | 24272 |
| 2013-14 | 35.11 | 4.29 | 15061 | 30.67 | 2.90 | 8891 | 23952 |
| 2014-15 | 34.56 | 4.28 | 14801 | 29.40 | 3.50 | 10288 | 25089 |

1.1.2 Electricity Transacted through DSM

The volume and price of electricity transacted through DSM is shown in Table-6 and Figure-4. It can be observed from Table-6 that the volume of electricity transacted through DSM declined from 25.81 BU in 2009-10 to 19.45 BU in 2014-15, and the volume of DSM as percentage of total short-term volume declined to 20% in 2014-15 from 39% in 2009-10. It can also be observed from the table that the average price of DSM declined from ₹4.62/kWh in 2009-10 to ₹2.26/kWh in 2014-15.

Table-6: Volume and Price of Electricity transacted through DSM

| Year | Volume of Electricity Transacted through DSM (BU) | Total Volume of Short term (BU) | Volume of DSM as % of total volume of Short term | Price of Electricity Transacted through DSM (₹/kWh) |
|---------|---------------------------------------------------|---------------------------------|--------------------------------------------------|-----------------------------------------------------|
| 2009-10 | 25.81 | 65.90 | 39% | 4.62 |
| 2010-11 | 28.08 | 81.56 | 34% | 3.91 |
| 2011-12 | 27.76 | 94.51 | 29% | 4.09 |
| 2012-13 | 24.76 | 98.94 | 25% | 3.86 |
| 2013-14 | 21.47 | 104.64 | 21% | 2.05 |
| 2014-15 | 19.45 | 98.99 | 20% | 2.26 |

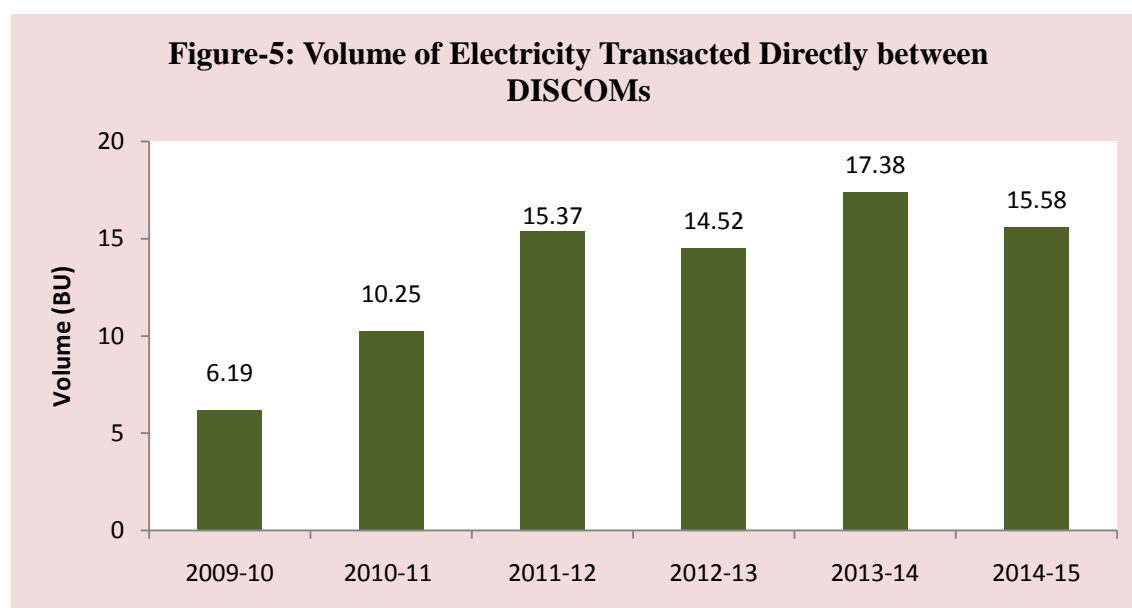


1.1.3 Electricity Transacted Directly Between DISCOMs

The volume of electricity transacted directly between DISCOMs is shown in Table-7 and Figure-5. It can be observed from the table that the volume of electricity transacted directly between DISCOMs increased from 6.19 BU in 2009-10 to 15.58 BU in 2014-15. It can also be observed that the share of electricity transacted directly between DISCOMs as percentage to total volume of short-term transaction of electricity also increased from 9% to 16% in the same period. When compared to 2013-14, the volume of electricity transacted directly between DISCOMs decreased, whereas the share of electricity transacted directly between DISCOMs as percentage of total volume of short-term increased in 2014-15.

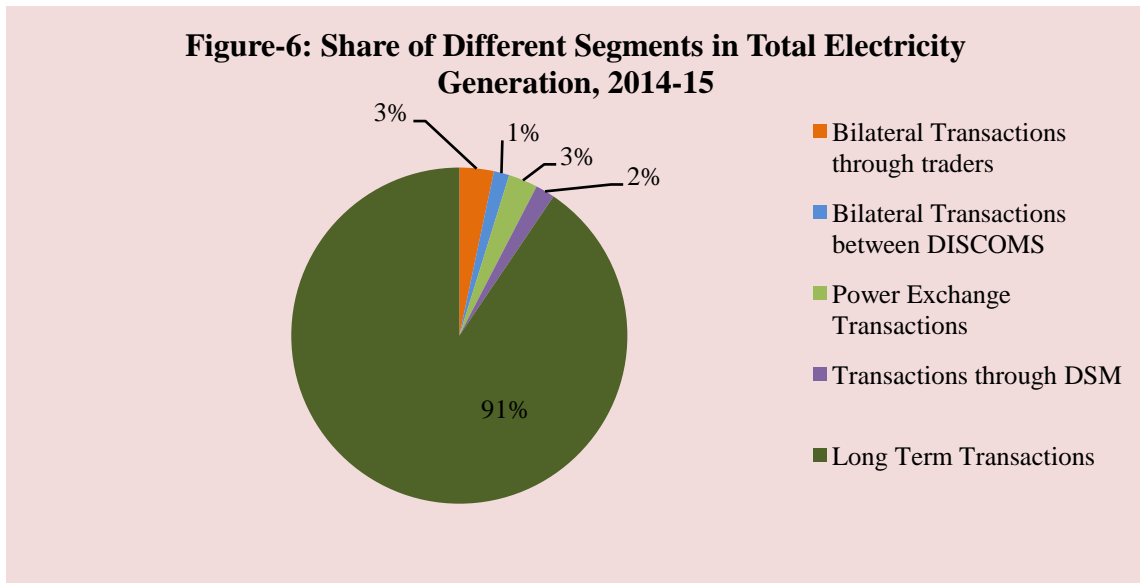
Table-7: Volume of Electricity Transacted Directly between DISCOMs

| Year | Volume of Electricity Transacted Directly between DISCOMs (BU) | Total Volume of Short term (BU) | Volume of Bilateral Direct as % of total volume of Short term |
|---------|----------------------------------------------------------------|---------------------------------|---------------------------------------------------------------|
| 2009-10 | 6.19 | 65.9 | 9% |
| 2010-11 | 10.25 | 81.56 | 13% |
| 2011-12 | 15.37 | 94.51 | 16% |
| 2012-13 | 14.52 | 98.94 | 15% |
| 2013-14 | 17.38 | 104.64 | 15% |
| 2014-15 | 15.58 | 98.99 | 16% |

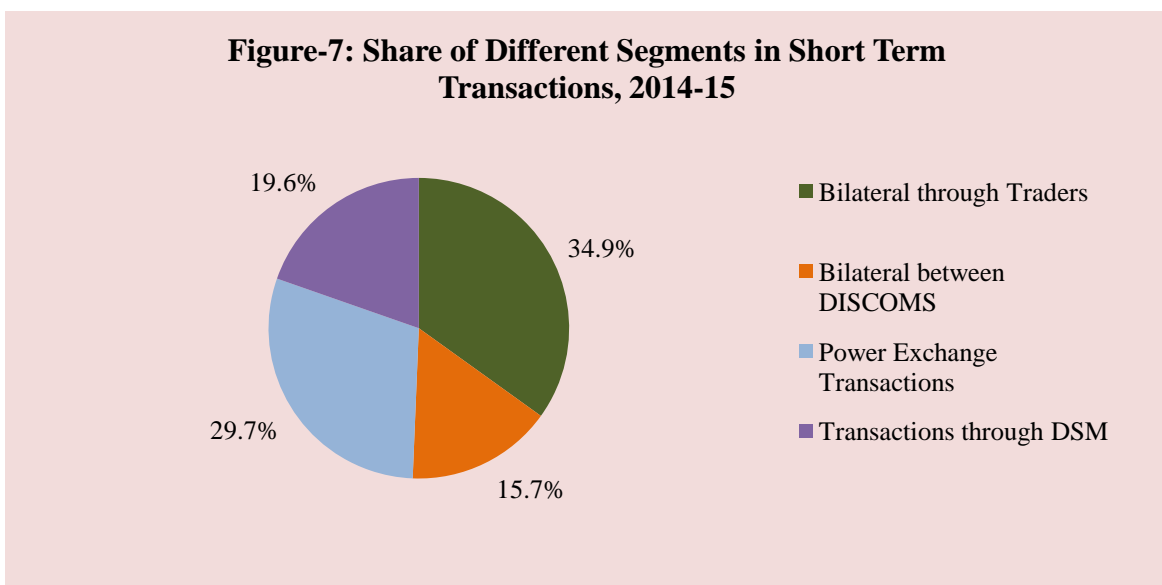


2. Monthly Trends in Short-term Transactions of Electricity (April 2014-March 2015)

During 2014-15, the share of the total short-term transactions in volume terms, including DSM as a percentage of total electricity generation in the country was about 9% (Figure-6 and Table-8).



The share of different segments within the total short-term transaction for the year 2014-15 has been shown in the Figure-7 below.



2.1. Volume of Short-term Transactions of Electricity

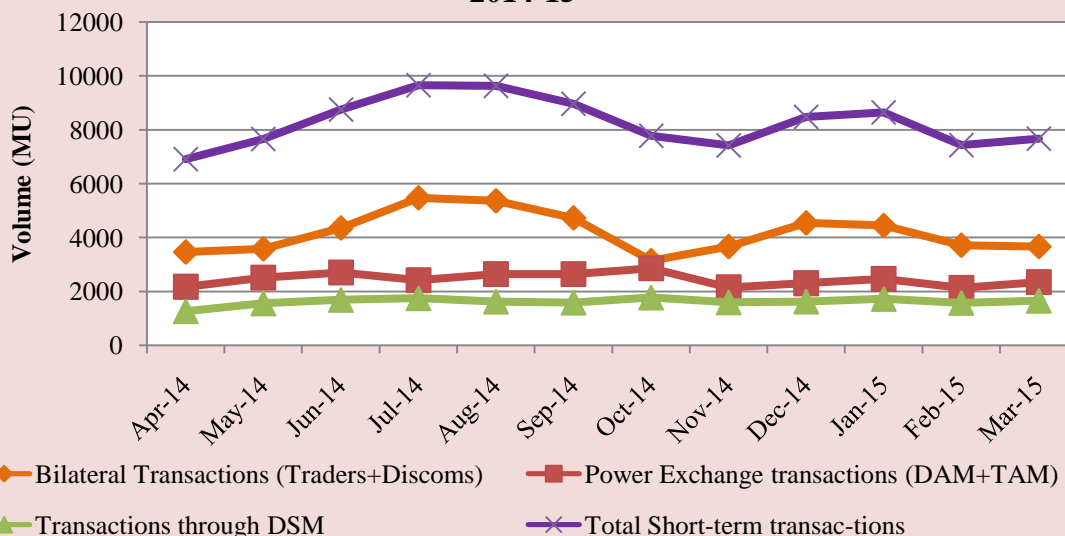
The volume of short-term transactions of electricity during different months of 2014-15 with break-up for different segments is shown in Table-8 and Figure-8.

Table-8: Volume of Short-term Transactions of Electricity (MU), 2014-15

| Period | Bilateral through Traders | Bilateral between DISCOMS | Total Bilateral transactions | Power Exchange transactions (DAM+TAM) | Transactions through DSM | Total Short-term transactions | Total Electricity Generation |
|------------------------------|---------------------------|---------------------------|------------------------------|---------------------------------------|--------------------------|-------------------------------|------------------------------|
| Apr-14 | 2835.07 | 625.13 | 3460.20 | 2177.600 | 1270.73 | 6908.53 | 87152.23 |
| May-14 | 2735.80 | 842.57 | 3578.37 | 2513.910 | 1559.89 | 7652.17 | 89661.58 |
| Jun-14 | 3252.92 | 1102.44 | 4355.36 | 2709.660 | 1690.82 | 8755.84 | 88480.04 |
| Jul-14 | 3537.66 | 1939.56 | 5477.22 | 2426.720 | 1750.55 | 9654.49 | 89490.59 |
| Aug-14 | 3387.80 | 1978.15 | 5365.95 | 2642.860 | 1625.34 | 9634.15 | 89858.57 |
| Sep-14 | 2775.49 | 1953.13 | 4728.62 | 2645.240 | 1587.97 | 8961.83 | 85717.64 |
| Oct-14 | 2253.98 | 887.24 | 3141.22 | 2859.930 | 1775.60 | 7776.75 | 90417.87 |
| Nov-14 | 2528.82 | 1133.03 | 3661.85 | 2154.820 | 1599.13 | 7415.80 | 85273.56 |
| Dec-14 | 3194.86 | 1348.43 | 4543.29 | 2309.340 | 1626.84 | 8479.47 | 85994.74 |
| Jan-15 | 3038.25 | 1409.16 | 4447.41 | 2473.080 | 1725.61 | 8646.10 | 86028.68 |
| Feb-15 | 2632.59 | 1082.24 | 3714.83 | 2137.310 | 1578.64 | 7430.78 | 80680.34 |
| Mar-15 | 2388.11 | 1275.07 | 3663.18 | 2351.640 | 1656.08 | 7670.90 | 86337.81 |
| Total | 34561.35 | 15576.15 | 50137.50 | 29402.11 | 19447.20 | 98986.81 | 1045093.65 |
| % share in total generation | 3% | 1% | 5% | 3% | 2% | 9% | 100% |
| % share in Short-term Volume | 34.9% | 15.7% | 50.7% | 29.7% | 19.6% | 100% | |

It is observed from Figure-8 that there is a cyclical trend in the total volume of short-term transactions of electricity. A similar trend is also observed in the volume of bilateral transactions. It is also observed from the figure that the volume of all other segments of the short-term transactions of electricity does not reflect any trend of increase or decrease.

Figure-8: Volume of Short-term Transactions of Electricity, 2014-15



The volume of short-term transactions of electricity as percentage of total electricity generation varied between 7.93% and 10.79% during the months from April 2014 to March 2015 (Table-9).

Table-9: Volume of Short-term transactions of electricity as % of total electricity generation, 2014-15

| Period | Short-term transactions as % of total electricity generation |
|--------|--------------------------------------------------------------|
| Apr-14 | 7.93% |
| May-14 | 8.53% |
| Jun-14 | 9.90% |
| Jul-14 | 10.79% |
| Aug-14 | 10.72% |
| Sep-14 | 10.46% |
| Oct-14 | 8.60% |
| Nov-14 | 8.70% |
| Dec-14 | 9.86% |
| Jan-15 | 10.05% |
| Feb-15 | 9.21% |
| Mar-15 | 8.88% |

There were 47 inter-state trading licensees as on 31.3.2015. Of the total, 28 trading licensees actively traded during the year 2014-15 (Table-10).

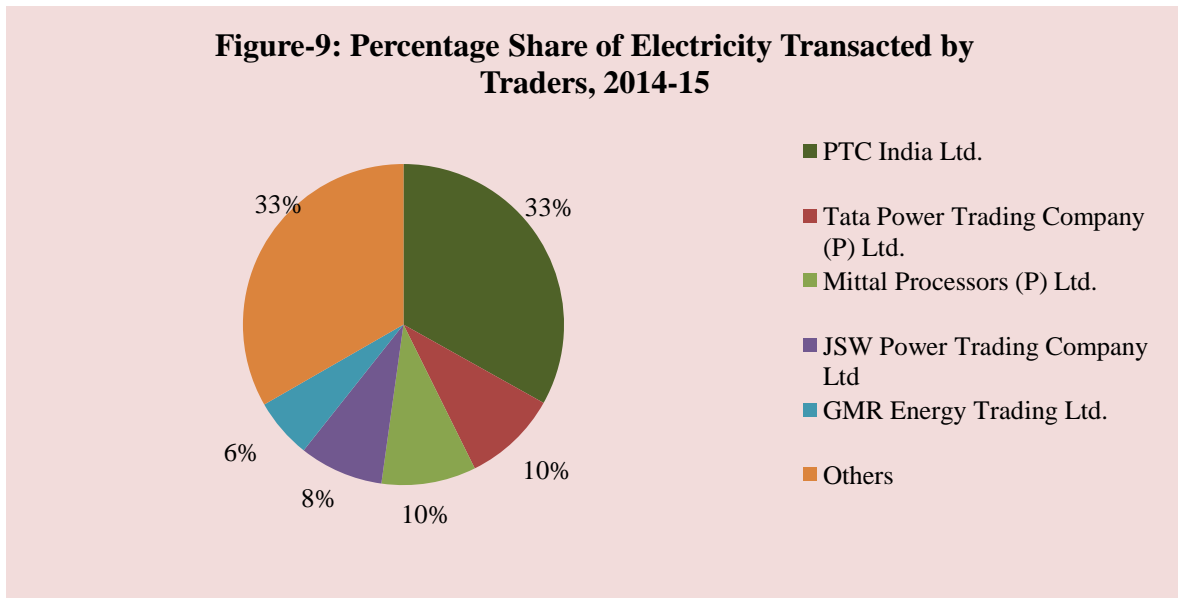
The volume of electricity transacted through traders (traders inter-state bilateral transactions + traders transactions through Power Exchanges) has been analysed using the Herfindahl-Hirschman Index (HHI) for measuring the competition among the traders (Table-10). Increase in the HHI generally indicates a decrease in competition and an increase of market power, whereas decrease indicates the opposite. A HHI value below 0.15 indicates no 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 2014-15 was 0.1512, which indicates moderate concentration of market power among the traders.

Table-10: Percentage Share of Electricity Transacted by Traders and HHI, 2014-15

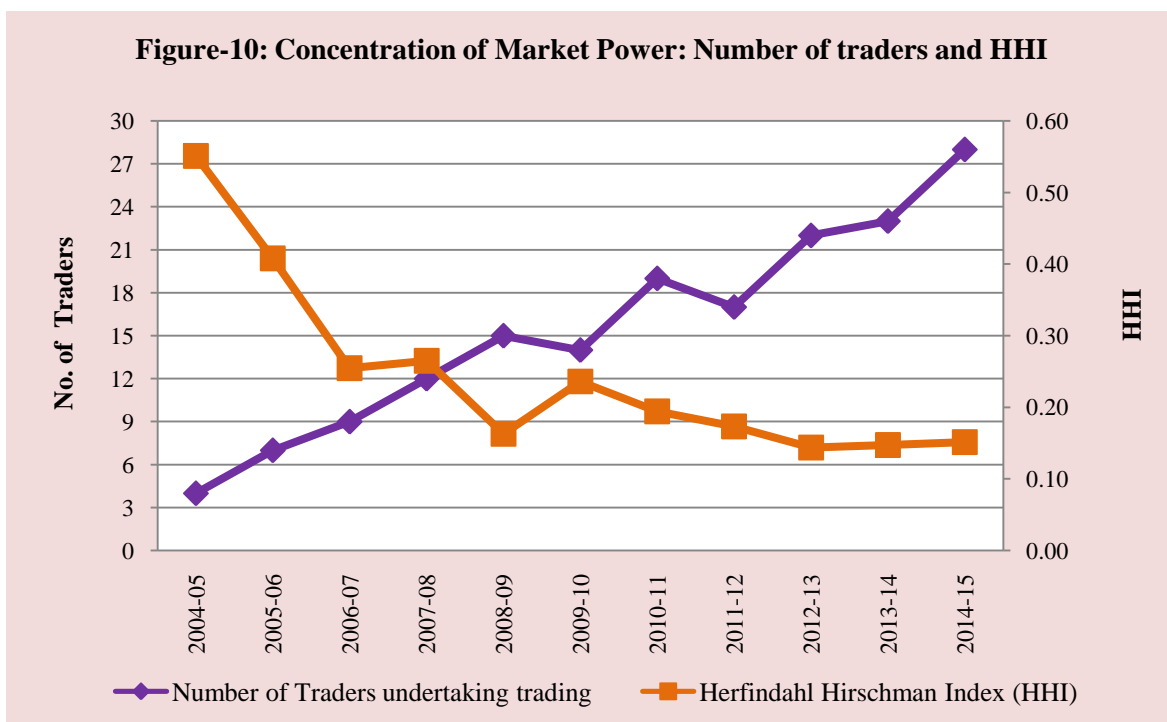
| Sr No | Name of the Trader | Share of Electricity transacted by Traders in 2014-15 | Herfindahl Herschman Index (HHI) |
|-------|---------------------------------------------|-------------------------------------------------------|----------------------------------|
| 1 | PTC India Ltd. | 33.12% | 0.110 |
| 2 | Tata Power Trading Company (P) Ltd. | 9.56% | 0.009 |
| 3 | Mittal Processors (P) Ltd. | 9.53% | 0.009 |
| 4 | JSW Power Trading Company Ltd | 8.47% | 0.007 |
| 5 | GMR Energy Trading Ltd. | 6.03% | 0.004 |
| 6 | Adani Enterprises Ltd. | 5.65% | 0.003 |
| 7 | NTPC Vidyut Vyapar Nigam Ltd. | 5.26% | 0.003 |
| 8 | Knowledge Infrastructure Systems (P) Ltd | 4.90% | 0.002 |
| 9 | Shree Cement Ltd. | 4.07% | 0.002 |
| 10 | Manikaran Power Ltd. | 3.35% | 0.001 |
| 11 | Jaiprakash Associates Ltd. | 2.07% | 0.000 |
| 12 | Reliance Energy Trading (P) Ltd | 1.81% | 0.000 |
| 13 | National Energy Trading & Services Ltd. | 1.53% | 0.000 |
| 14 | RPG Power Trading Company Ltd. | 1.22% | 0.000 |
| 15 | Instinct Infra & Power Ltd. | 0.90% | 0.000 |
| 16 | Arunachal Pradesh Power Corporation (P) ltd | 0.79% | 0.000 |
| 17 | Essar Electric Power Development Corp. Ltd. | 0.56% | 0.000 |
| 18 | Ambitious Power Trading Company Ltd. | 0.34% | 0.000 |
| 19 | My Home Power Private Ltd. | 0.32% | 0.000 |
| 20 | SN Power Markets Pvt. Ltd. | 0.27% | 0.000 |
| 21 | Indrajit Power Technology (P) Ltd. | 0.10% | 0.000 |
| 22 | Customized Energy Solutions India (P) Ltd. | 0.09% | 0.000 |
| 23 | HMM Infra ltd. | 0.02% | 0.000 |
| 24 | Pune Power Development (P) Ltd. | 0.02% | 0.000 |

| | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------|---------------|
| 25 | Parshavanath Power Projects Private Ltd | 0.02% | 0.000 |
| 26 | Adhunik Alloys Private Ltd | 0.01% | 0.000 |
| 27 | Vandana Vidyut Ltd | 0.01% | 0.000 |
| 28 | Vedprakash Power Private Ltd | 0.0001% | 0.000 |
| Total Volume | | 100.00% | 0.1512 |
| Share of the Top 5 Trading | | 66.70% | |
| <i>Note: Percentage share in total volume transacted by Traders in 2014-15 computed based on the volume which includes the volume traded by inter-state traders through bilateral and power exchanges.</i> | | | |
| <i>Source: Information submitted by Traders.</i> | | | |

The percentage share of electricity transacted by major traders in the total volume of electricity transacted by all the traders is shown in Figure-9.



Level of competition among the traders (HHI based on volume of trade undertaken by the traders) is shown in Figure-10 for the period 2004-05 to 2014-15. Number of traders, who were undertaking trading bilaterally or through power exchanges or through both, increased from 4 in 2004-05 to 28 in 2014-15. It can be observed from the figure that there is an inverse relationship between number of traders and the HHI. The concentration of market power declined from high concentration (HHI of 0.55) in 2004-05 to moderate concentration (HHI of 0.1512) in 2014-15. The competition among the traders resulted in increase in volume and decrease in prices in the short-term bilateral market (Table-5).



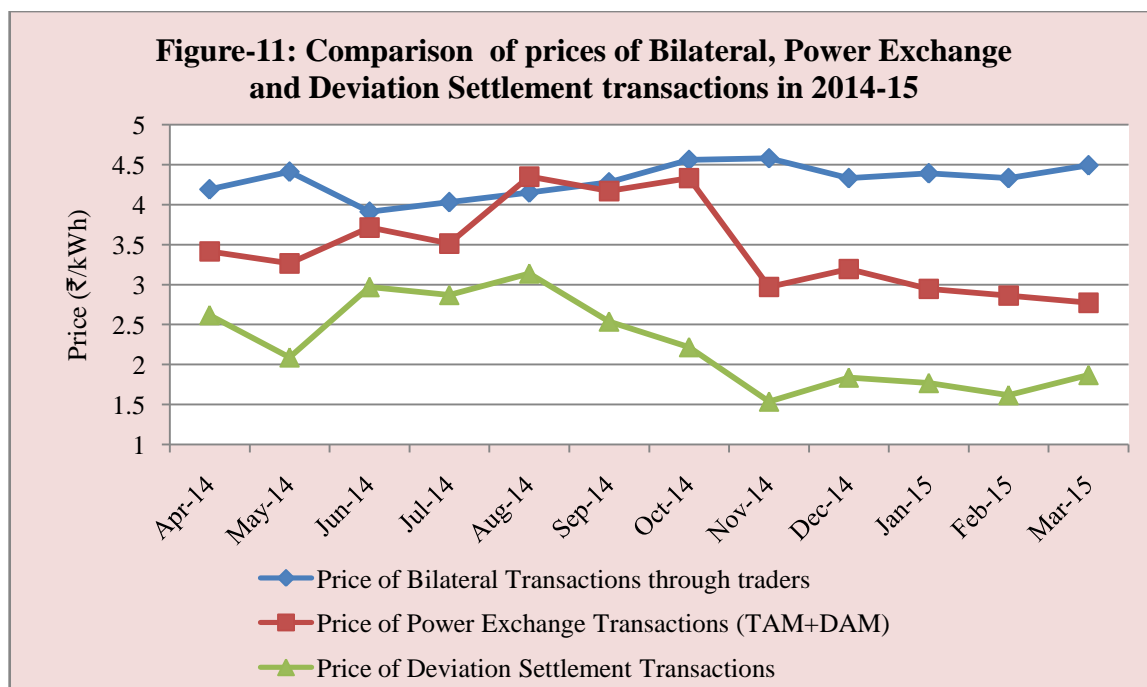
2.2. Price of Short-term Transactions of Electricity

The monthly trends in price of short-term transactions of electricity are shown in Table-11 and Figure-11&12. The price analysis is mainly based on the average price of DSM and the weighted average price of other short-term transactions of electricity. The price of bilateral trader transactions represents the price of electricity transacted through traders. The trends in price of electricity transacted through traders (bilateral trader transactions) were studied separately for total transactions as well as for the transactions undertaken Round the Clock (RTC), during Peak, and during Off-peak periods.

Table-11: Price of Short-term Transactions of Electricity (₹/KWh), 2014-15

| Period | Bilateral through Traders | | | | Power Exchange | | DSM |
|--------|---------------------------|------|----------|-------|----------------|------|----------------|
| | RTC | Peak | Off-peak | Total | IEX | PXIL | All India Grid |
| Apr-14 | 4.21 | 3.56 | 3.51 | 4.19 | 3.42 | 3.05 | 2.62 |
| May-14 | 4.50 | 3.32 | 3.46 | 4.41 | 3.26 | 3.15 | 2.09 |
| Jun-14 | 3.93 | 3.12 | 3.54 | 3.91 | 3.71 | 3.63 | 2.97 |
| Jul-14 | 4.06 | 4.37 | 3.53 | 4.03 | 3.50 | 3.53 | 2.87 |
| Aug-14 | 4.15 | 4.82 | 3.98 | 4.15 | 4.33 | 3.68 | 3.14 |
| Sep-14 | 4.31 | 4.33 | 3.87 | 4.28 | 4.14 | 3.48 | 2.54 |
| Oct-14 | 4.61 | 4.77 | 4.15 | 4.56 | 4.33 | 3.45 | 2.22 |

| | | | | | | | |
|--------|------|------|------|------|------|------|------|
| Nov-14 | 4.66 | 5.06 | 3.48 | 4.58 | 2.97 | 2.67 | 1.54 |
| Dec-14 | 4.37 | 4.32 | 3.45 | 4.33 | 3.20 | 2.85 | 1.84 |
| Jan-15 | 4.43 | 4.15 | 3.53 | 4.39 | 2.95 | 2.67 | 1.77 |
| Feb-15 | 4.38 | 4.57 | 3.60 | 4.33 | 2.87 | 2.70 | 1.62 |
| Mar-15 | 4.57 | 4.08 | 3.34 | 4.49 | 2.78 | 2.65 | 1.87 |

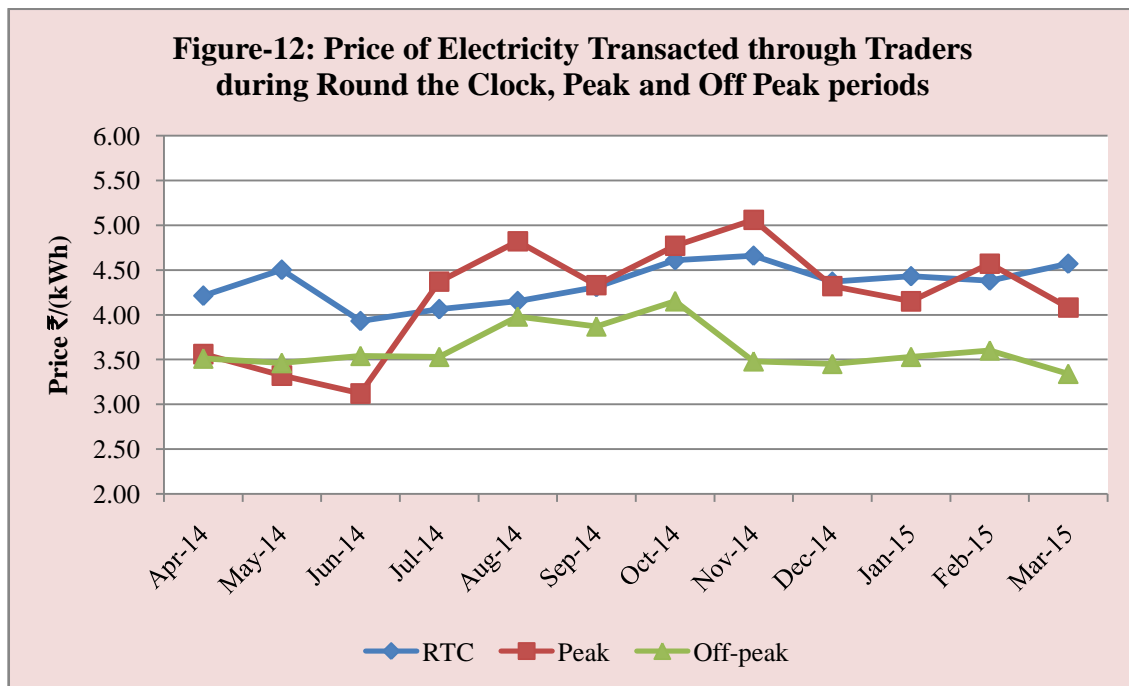


It can be observed from the above figure that the price of electricity transacted through traders was relatively high when compared with the price of electricity transacted through power exchanges and DSM during all the months except in August 2014.⁴ In August 2014 the price of electricity transacted through power exchanges was marginally high when compared with the price of electricity transacted through traders.

The trends in price of electricity transacted by traders during RTC, Peak and Off-peak periods are shown in Table-11 & Figure-12. It can be observed from the figure that the price of electricity during peak period is higher in most of the months from July to November 2014 and in February 2015 when compared with the price during RTC and off peak periods. The price of electricity during RTC is high from April 2014 to June 2014,

⁴ The comparison between the price of power exchanges and the price of bilateral transactions should also be seen in the light that the delivery point for transactions of power exchanges is the periphery of regional transmission system in which the grid connected entity is located whereas the delivery point for bilateral transactions may vary from transaction to transaction. The delivery point may be state or regional periphery or any other point as per the contract executed.

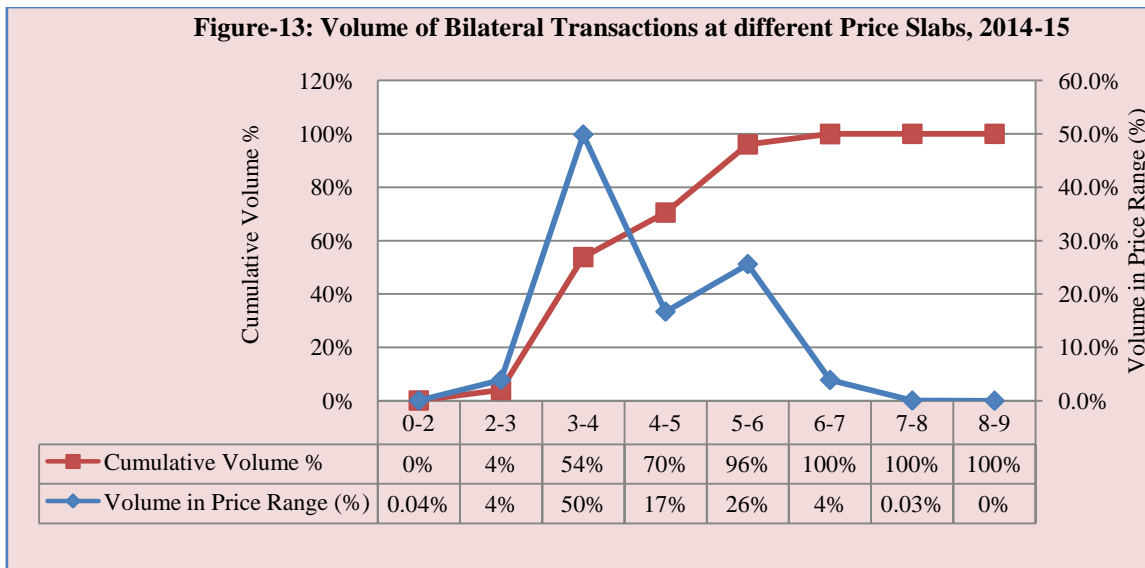
December 2014, January and March 2015 when compared with the price during peak and off peak periods.



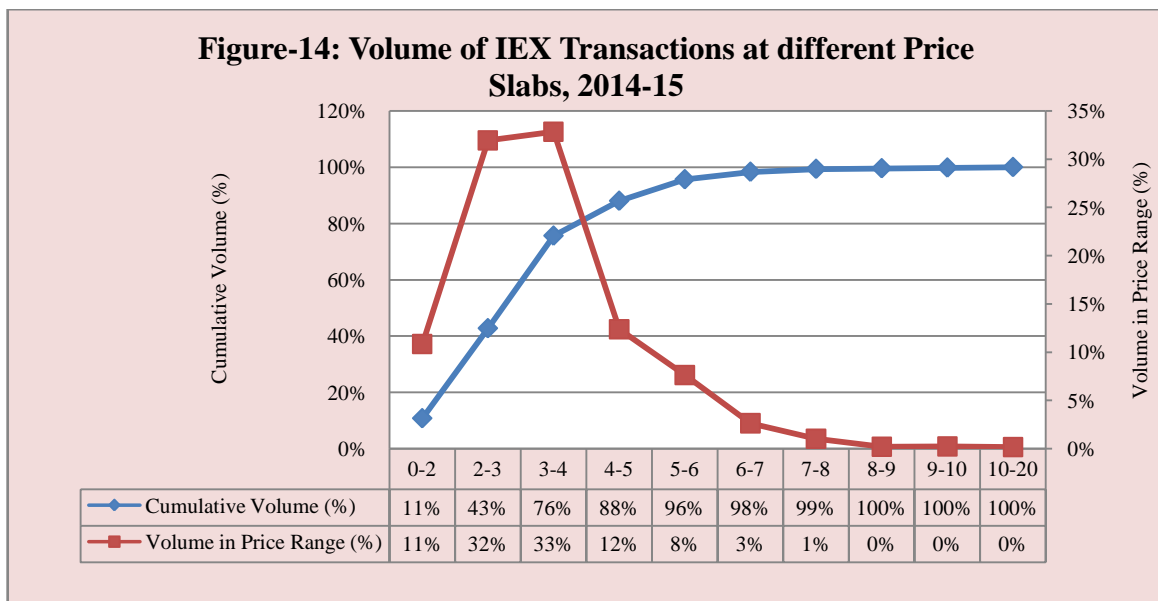
2.3 Volume of Electricity Transacted in Various Price Slabs

Volume of electricity transacted in various price slabs is shown for bilateral trader segment and power exchange segment separately. In the case of power exchanges, it is the Day Ahead Market sub-segment that has been considered.

Volume of bilateral transactions at different price slabs in 2014-15 is depicted in Figure -13. The figure shows that 54% of the volume of electricity was transacted through traders at less than ₹4/kWh and 96% of the volume was transacted through traders at less than ₹6/kWh.

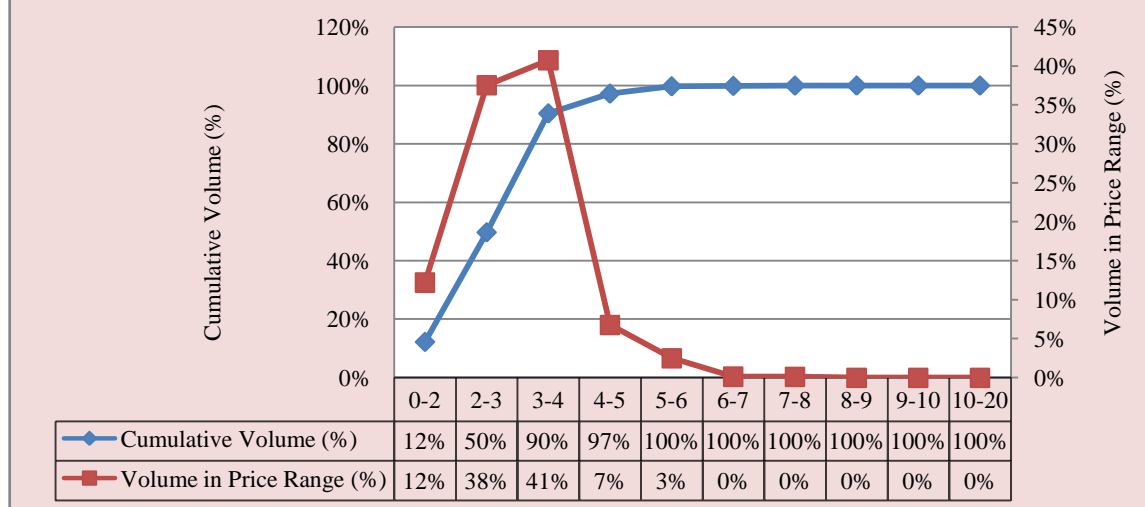


Volume of IEX transactions at different price slabs in 2014-15 is depicted in Figure -14. The figure shows that 76% of the volume of electricity was transacted through IEX at less than ₹4/kWh and 96% of the volume was transacted through IEX at less than ₹6/kWh.



Volume of PXIL transactions at different price slabs in 2014-15 is depicted in Figure -15. The figure shows that 90% of the volume of electricity was transacted through PXIL at less than ₹4/kWh and 100% of the volume was transacted through PXIL at less than ₹6/kWh.

Figure-15: Volume of PXIL Transactions at different Price Slabs, 2014-15

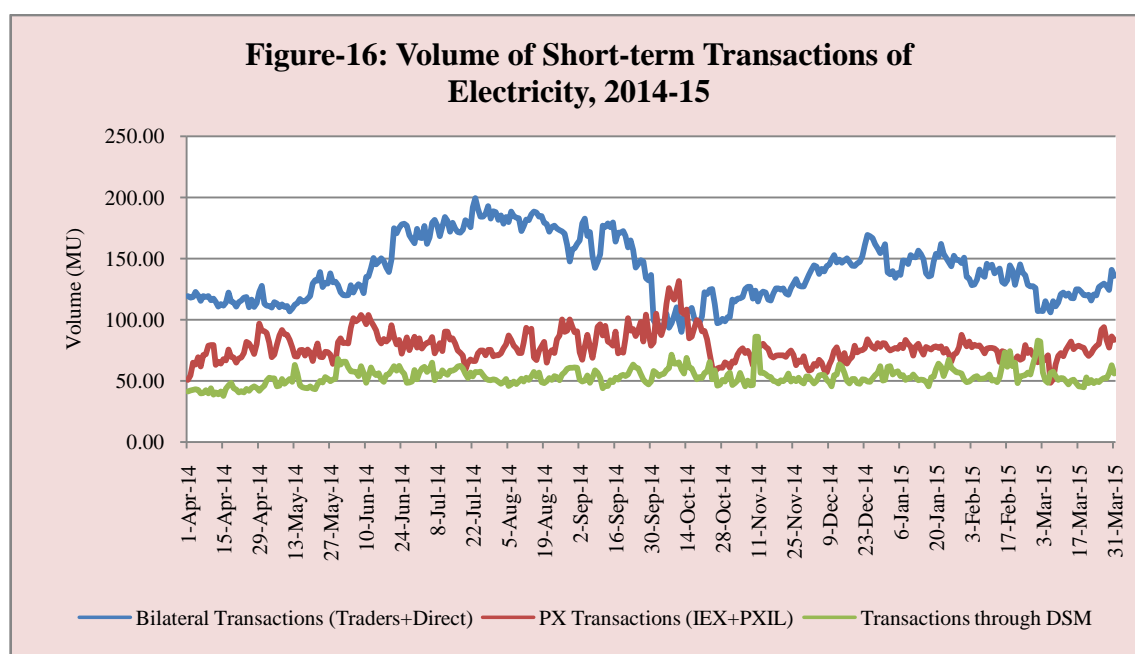


The Volume of electricity transacted at ₹4/kWh or less is more in PXIL (90%) when compared to IEX (76%). This was mainly due to different set of participants in different exchanges. In PXIL most of the participants were state utilities whereas there were mixed participants in IEX. The state utilities generally buy or sell electricity at restricted price when compared to others.

3. Daily Trends in Short-term Transactions of Electricity (1st April 2014 to 31st March 2015)

3.1 Volume of Short-term Transactions of Electricity

Trends in daily volume of short-term transactions are shown in Figure-16. It can be observed from the figure that there was a cyclical trend in the volume of electricity transacted through bilateral transactions during 2014-15. It can also be observed that there is no definite trend in the volume of electricity transacted through power exchanges and through DSM during the year.



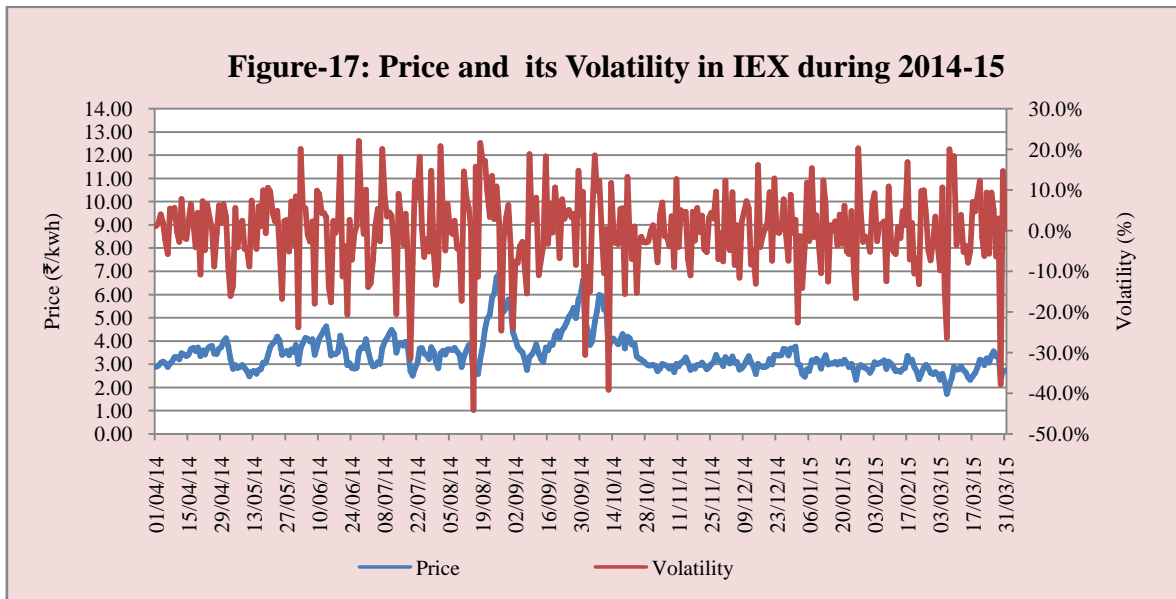
3.2 Price of Short-term Transactions of Electricity

Trends in daily price of short-term transactions have been illustrated in this section for power exchanges and DSM.

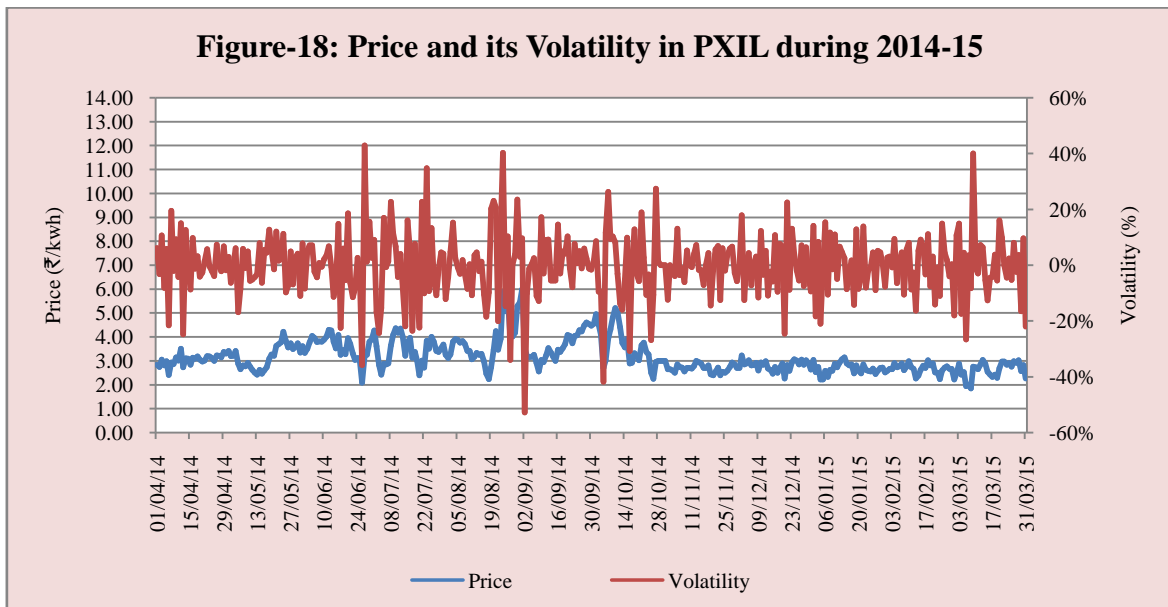
3.2.1 Trends in Price of Electricity Transacted through Power Exchanges

The weighted average price of electricity transacted through IEX and its volatility is shown in Figure-17. Volatility in the Price of electricity transacted through IEX has been

computed using daily data for 2014-15 and it works out to 9.63%. (See Annexure-II for historic volatility formula).

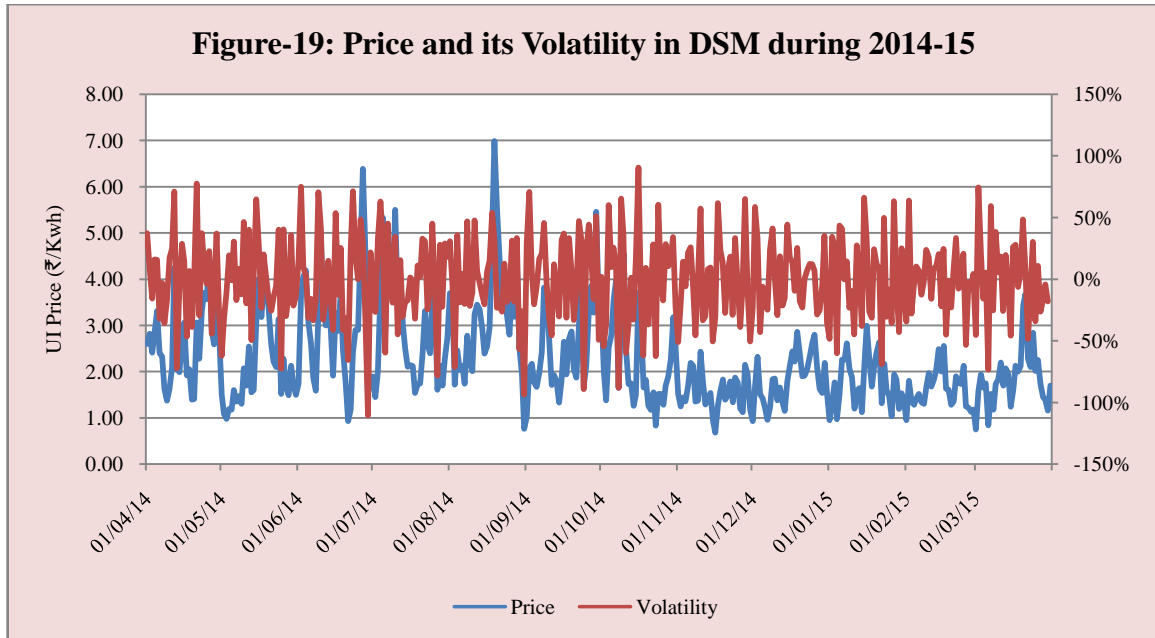


The weighted average price of electricity transacted through PXIL and its volatility is shown in Figure-18. Volatility in the price of electricity transacted through PXIL has been computed using daily data for 2014-15 and it works out to 11.47%.



3.2.2 Trends in Price of Electricity Transacted through DSM

The average price of electricity transacted through DSM and its volatility is shown in Figure-19.



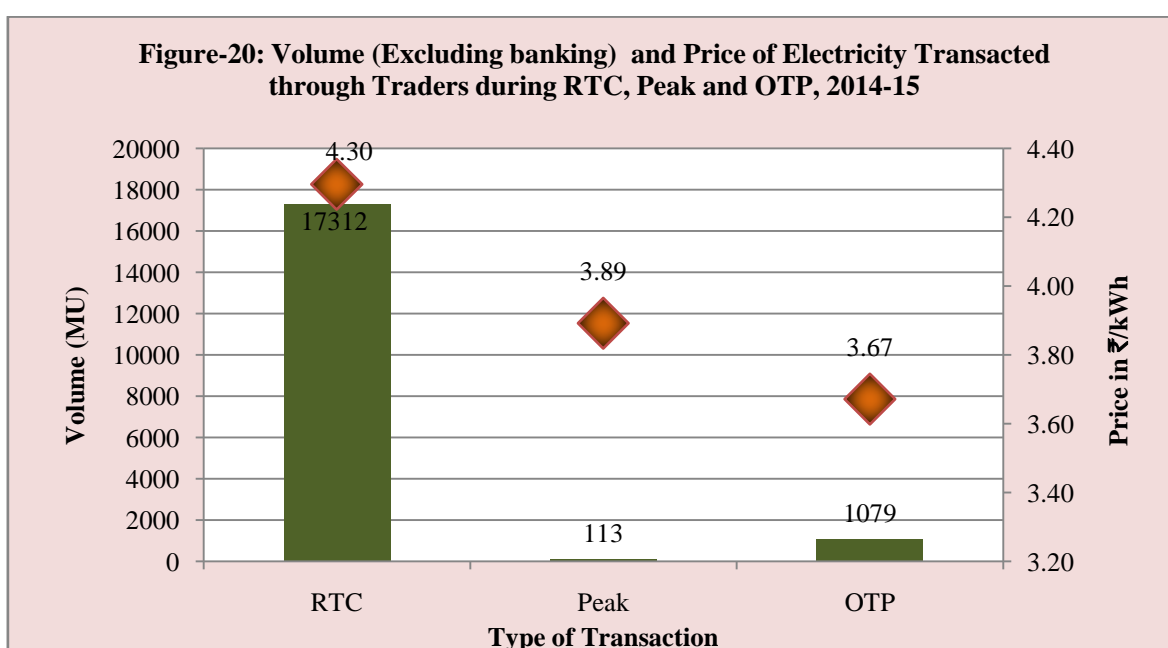
Volatility in the price of electricity transacted through DSM has been computed using daily data for 2014-15 and it works out 34.03%.

4. 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 is shown block-wise. Price of electricity transacted through power exchanges is also shown region-wise and block-wise.

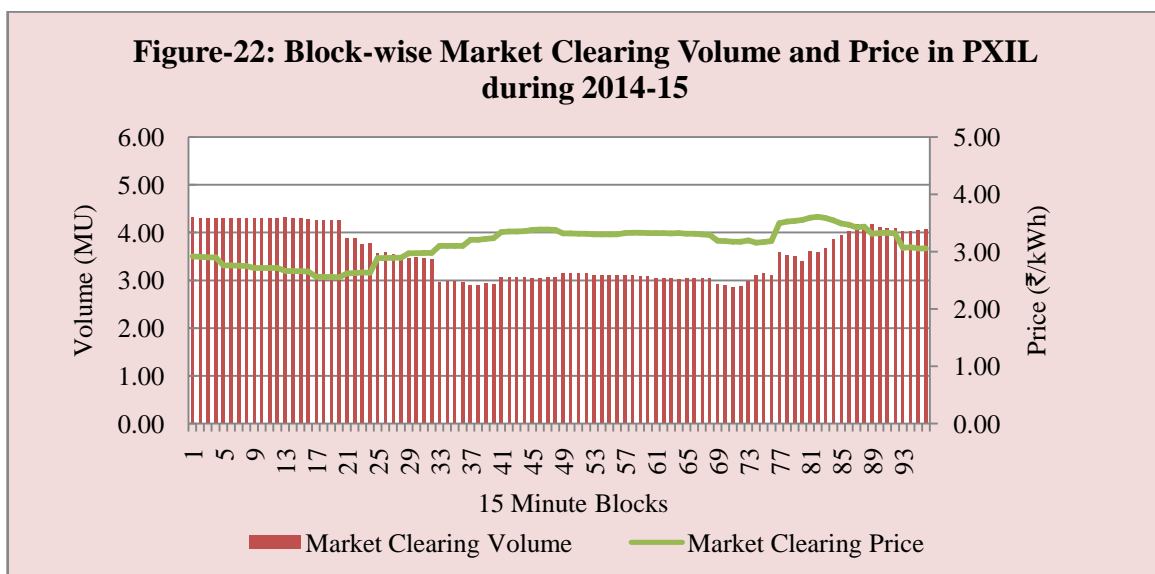
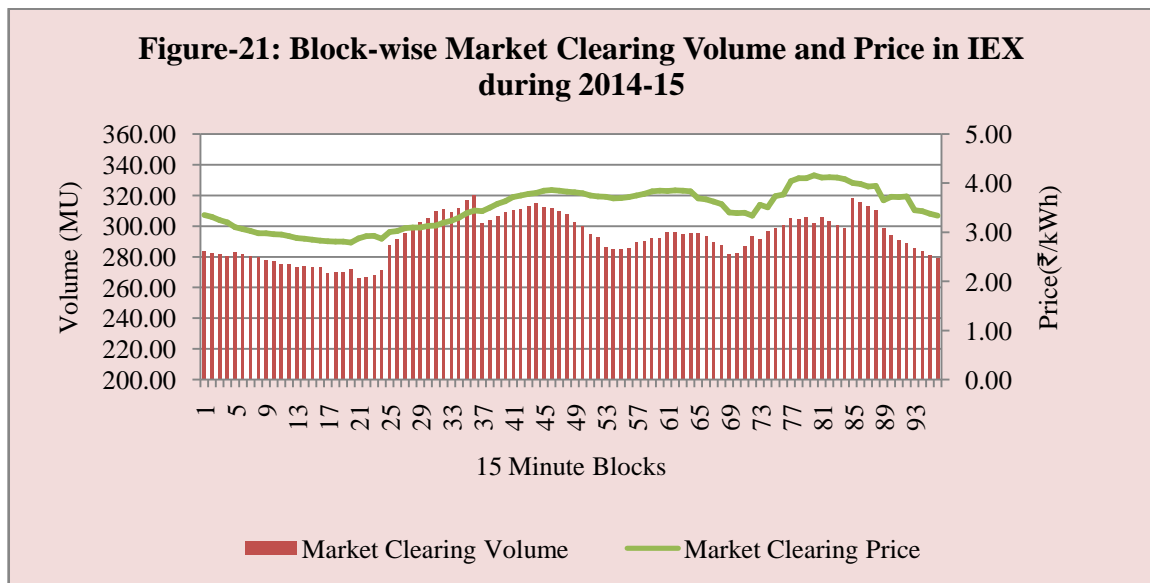
4.1 Time of the Day Variation in Volume and Price of Electricity Transacted through Traders

Time of the day variation in volume and price of electricity transacted through bilateral trader transactions during 2014-15 is shown in Figure-20. The volume of the traders represents inter-state transaction volume i.e. excluding banking transaction volume. 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, 93.56% was transacted during RTC followed by 5.83% during OTP, and 0.61% during peak period. It can be observed from the figure that there is hardly any volume transacted during peak period. It can also be observed that the weighted average price during RTC is high (₹4.30/kWh), when compared with the price during Peak period (₹3.89/kWh) and OTP (₹3.67/kWh).

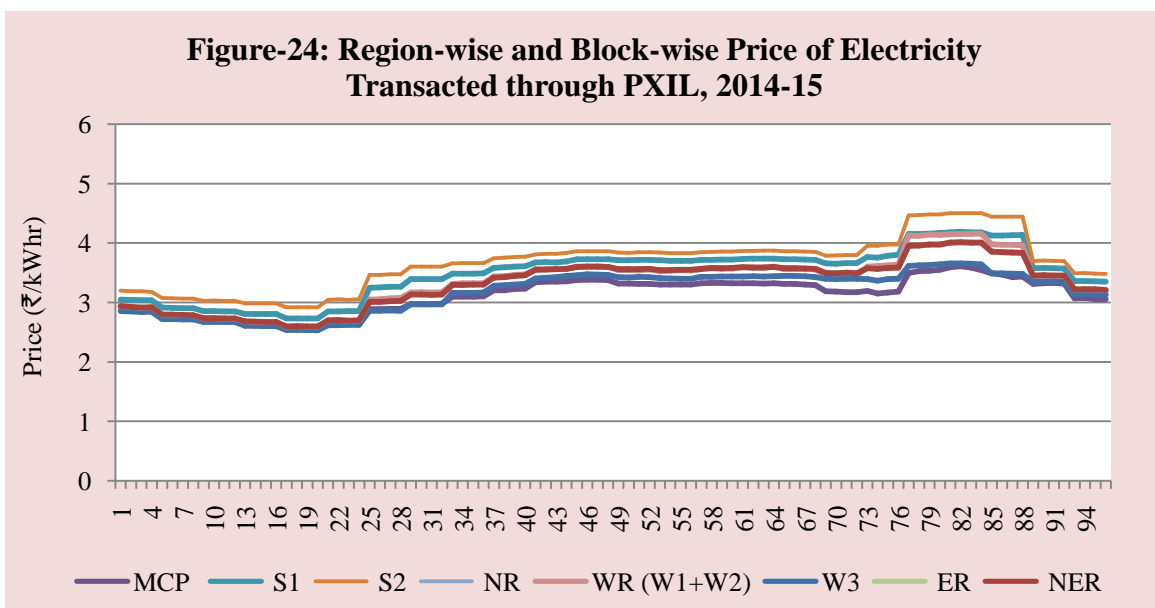
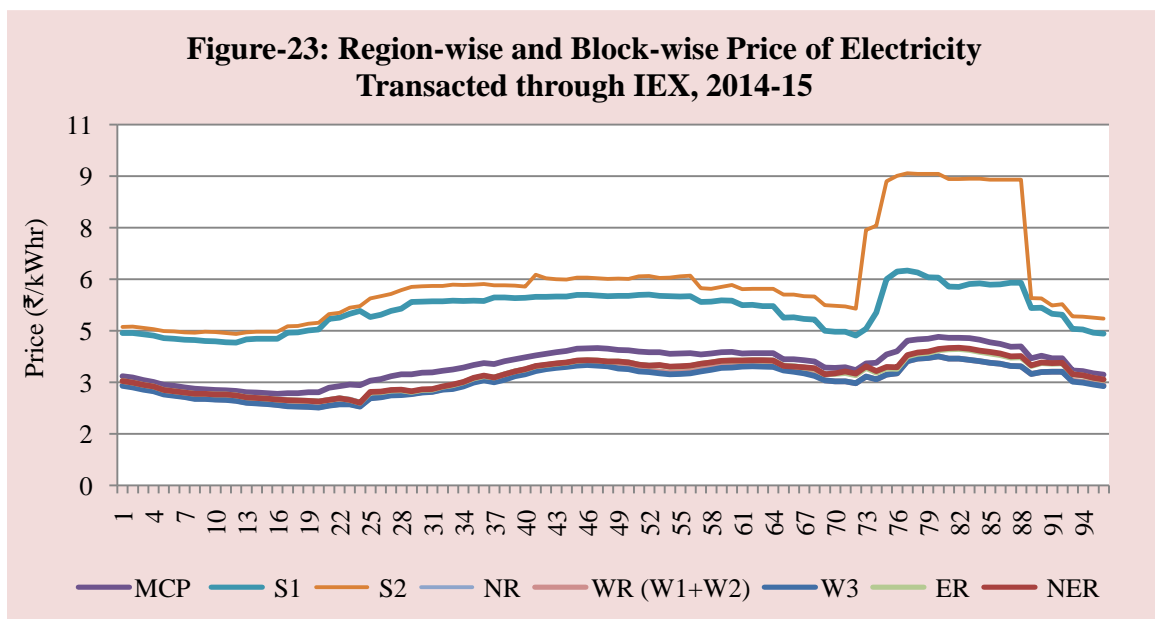


4.2 Time of the Day Variation in Volume and Price of Electricity Transacted through Power Exchanges

Time of the day variation in volume and price of electricity transacted through IEX and PXIL (Day ahead market) during 2014-15 are shown block-wise in Figure-21 and Figure-22. It can be observed from the figure that the weighted average price in both the power exchanges was higher during peak period (between hours 18:00 to 23:00), when compared to the weighted average price in rest of the hours.



Region-wise and hour-wise prices of electricity transacted through power exchanges are shown in Figure-23 and Figure-24. It can be observed from the figures that during the entire 2014-15, the price of electricity in Southern region (S1 and S2 regions) was high when compared with the price in other regions in both the power exchanges. It can also be observed that in the evening peak period, the price in the Southern region was even much higher in IEX when compared with other regions. This is mainly due to high demand for electricity in the southern region. The prices were high due to congestion between southern region and rest of the regions, accompanied by market splitting on the power exchanges.



5. Trading Margin Charged by Trading Licensees for Bilateral Transactions

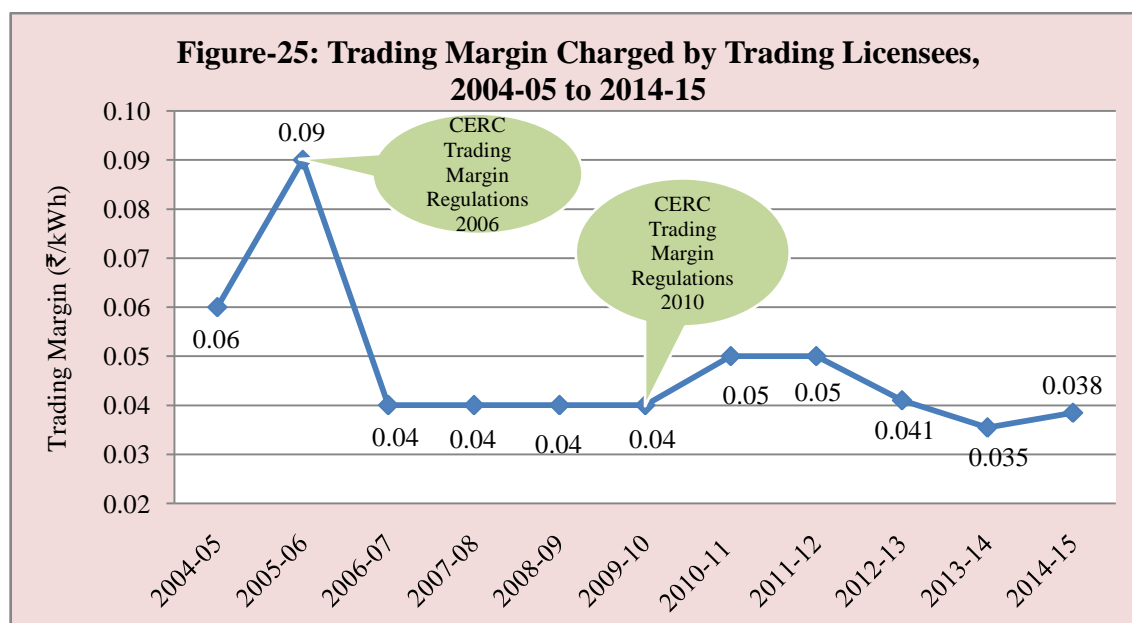
During the year 2004-05 (when trading started through licensees), the licensees voluntarily charged 5 paise/kWh or less as the trading margin. However, trading margin increased in 2005 and the weighted average trading margin charged by the licensees went up to 10 paise/kWh during April to September 2005 period. The Commission then decided to regulate the margin and fixed the trading margin at 4 paise/kWh vide "CERC (Fixation of Trading Margin) Regulations" notification dated 26.1.2006. As a result of these trading margin regulations, the licensees charged trading margin of 4 paise or less from 26.1.2006 onwards until revised Trading Margin Regulations, 2010 came into existence on 11.1.2010 (see Table-12 & Figure-25).

Based on feedback and experience with 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 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. The trading licensees have been charging the trading margin accordingly, and weighted average trading margin for bilateral transactions during 2004-05 to 2014-15 is given in Table-12.

Table -12: Weighted Average Trading Margin Charged by Trading Licensees, 2004-05 to 2014-15

| Period | Trading Margin (₹/kWh) |
|---------|------------------------|
| 2004-05 | 0.06 |
| 2005-06 | 0.09 |
| 2006-07 | 0.04 |
| 2007-08 | 0.04 |
| 2008-09 | 0.04 |
| 2009-10 | 0.04 |
| 2010-11 | 0.05 |
| 2011-12 | 0.05 |
| 2012-13 | 0.041 |
| 2013-14 | 0.035 |
| 2014-15 | 0.038 |

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



Weighted average trading margin charged by the trading licensees for bilateral transactions for different sale price ranges during 2014-15 is provided in Table-13 below.

Table -13: Weighted Average Trading Margin Charged by Trading Licensees during 2014-15

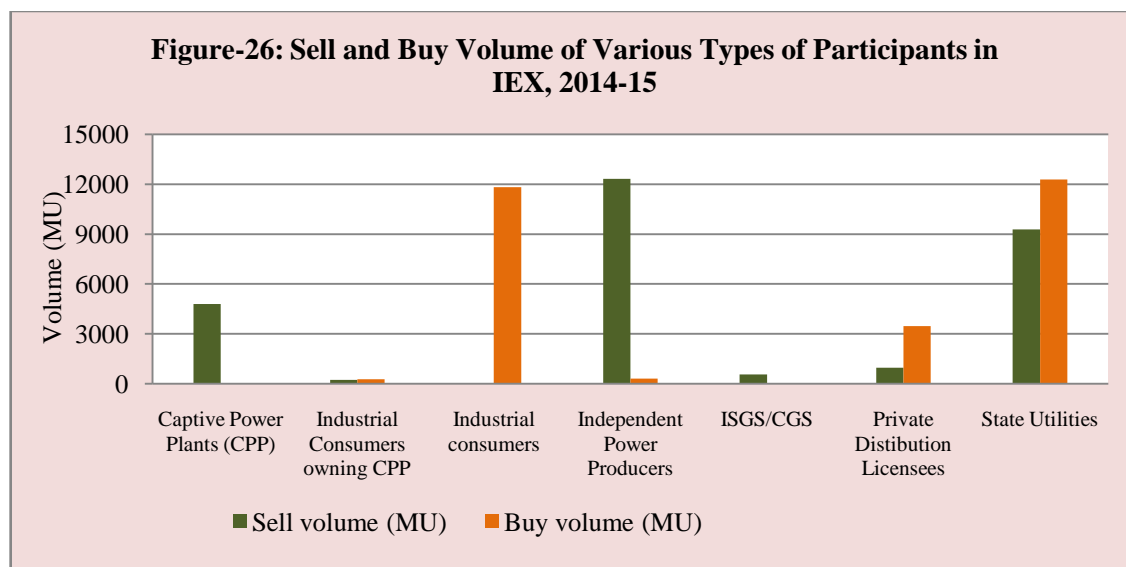
| Sale Price of Electricity Transacted by Trading Licensees(₹/kWh) | Weighted Average Trading Margin Charged by Trading Licensees(₹/kWh) |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| When Sale Price is less than or Equal to ₹3/kWh | 0.025 |
| When Sale Price is greater than ₹3/kWh | 0.039 |
| <i>Note 1: Weighted Average Trading Margin is computed based on all Inter-state Trading Transactions excluding Banking Transactions</i> | |

6. Analysis of Open Access Consumers on Power Exchanges

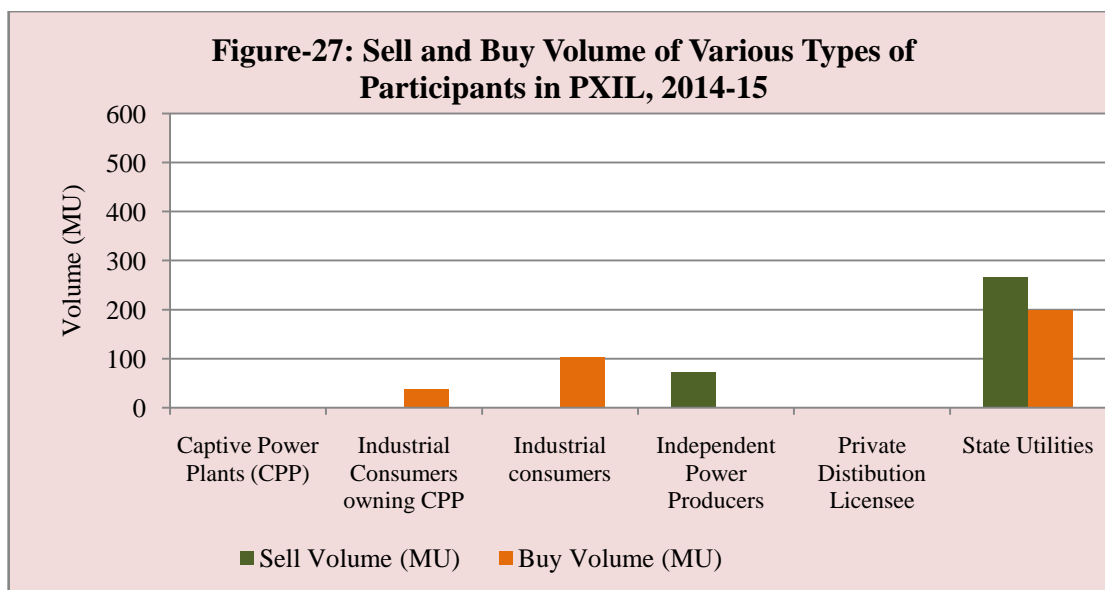
This section contains analysis of various types of participants and analysis of open access consumers in day ahead market of power exchanges.

6.1 Analysis of Various Types of Participants in Power Exchanges

There are seven types of participants in IEX, as shown in Figure-26. It can be observed from the figure that major sellers of electricity through IEX were independent private producers followed by state utilities, and captive power plants. It can also be observed that major buyers of electricity through IEX were state utilities followed by industrial consumers, and private distribution licensees.

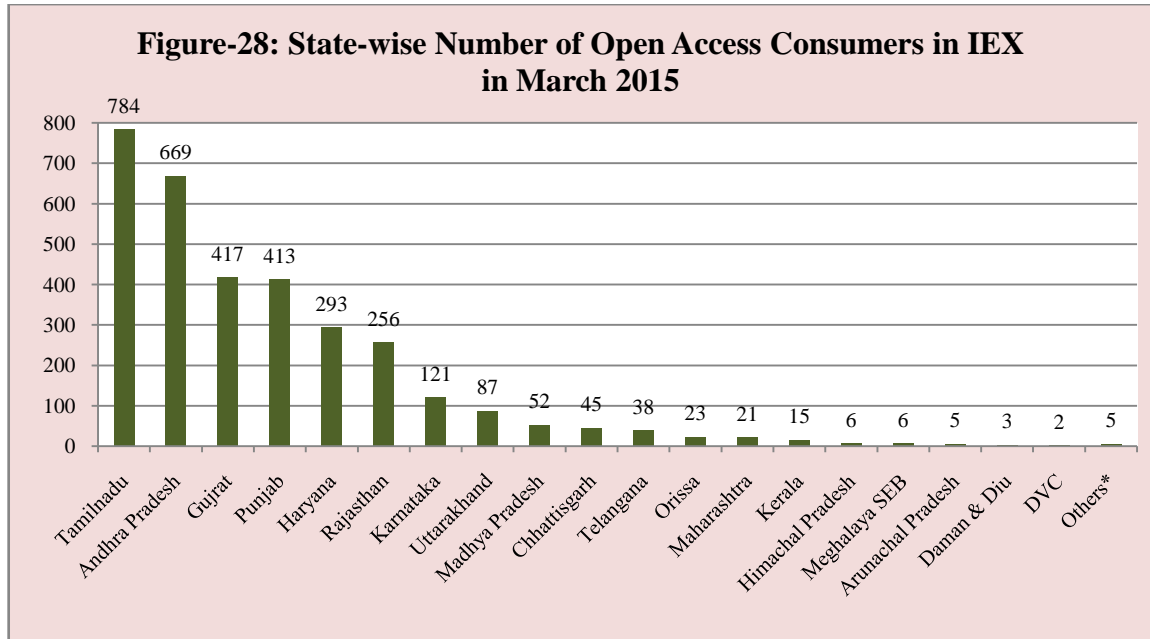


There are six types of participants in PXIL, as shown in Figure-27. It can be observed from the figure that major sellers of electricity through PXIL were state utilities and independent private producers. It can also be observed that major buyers of electricity through PXIL were state utilities followed by industrial consumers, and industrial consumers owning CPP.

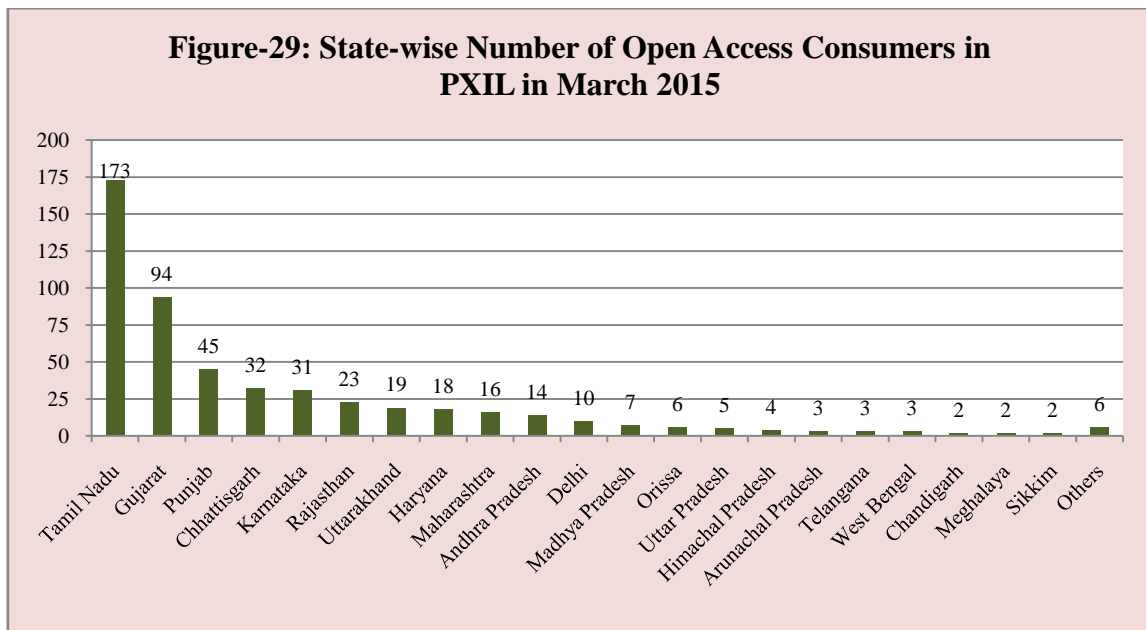


6.2 Analysis of Open Access Consumers in Power Exchanges

The year 2010-11 witnessed collective open access transactions, a significant development in procurement of power by the industrial consumers through power exchanges. It can be observed that 3269 Open Access (OA) Consumers were procuring part of their power requirements through IEX at the end of March 2015. These consumers were mostly located in Tamil Nadu, Andhra Pradesh, Gujarat, Punjab, Haryana and Rajasthan (Figure-28). During the year, these OA consumers procured a total of 12084MU of electricity through IEX. In 2014-15, the weighted average price of electricity bought by OA consumers at IEX was lower (₹3.05/kWh) when compared to the weighted average price of total electricity transacted through IEX (₹3.49/kWh).



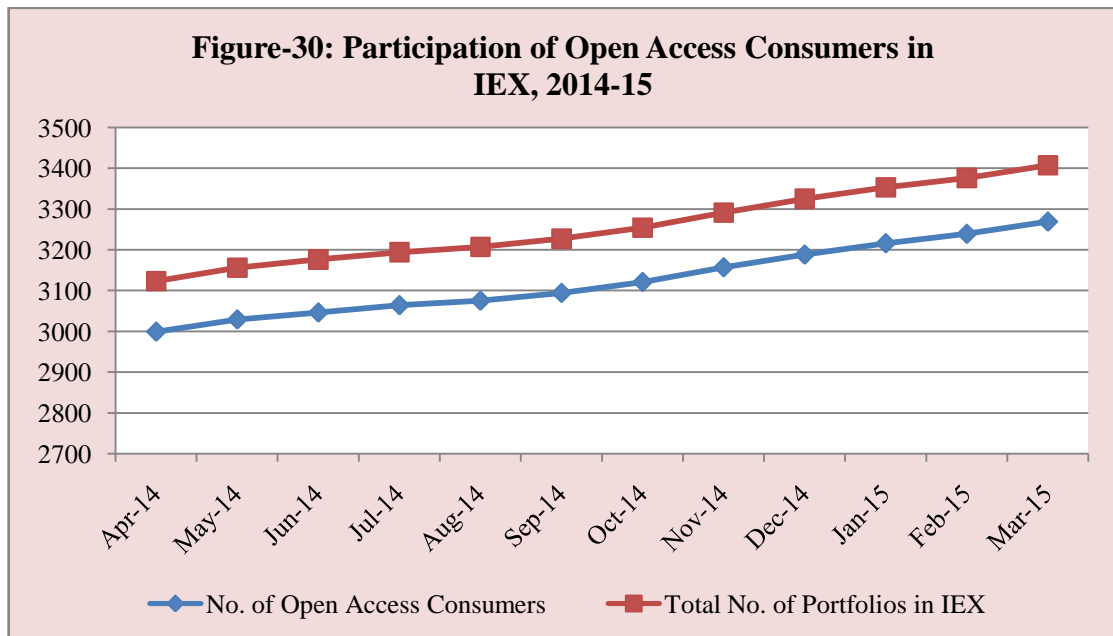
About 517 OA consumers procured a part of their power requirements through PXIL. These consumers were mostly located in Tamil Nadu, Gujarat and Punjab (Figure-29). During the year, these OA consumers procured a total of about 103MU of electricity through PXIL. In 2014-15, the weighted average price of electricity bought by open access consumers at PXIL was lower (₹2.88/kWh) when compared to the weighted average price of total electricity transacted through PXIL (₹3.09/kWh).



In Table-14 & Figure-30, a month-wise comparison is made between the number of OA consumer participants and the total number of portfolios in IEX. It can be seen that the number of OA consumers as a percentage of total number of portfolios in IEX was varying between 95.88% and 96.03% during 2014-15. It can be observed from the figure that there is an increasing trend in the number of OA consumers and total number of portfolios in IEX.

Table-14: Number of Open Access Consumers in IEX, 2014-15

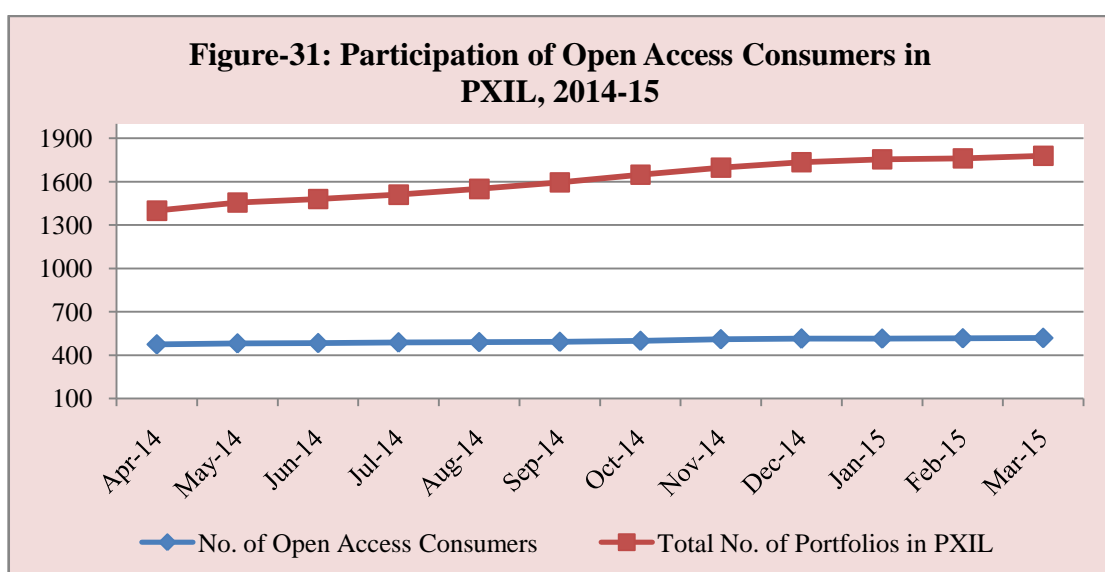
| Month | No. of Open Access Consumers | Total No. of Portfolios in IEX | % of Open Access Consumers |
|--------|------------------------------|--------------------------------|----------------------------|
| Apr-14 | 2999 | 3123 | 96.03% |
| May-14 | 3029 | 3156 | 95.98% |
| Jun-14 | 3046 | 3176 | 95.91% |
| Jul-14 | 3064 | 3194 | 95.93% |
| Aug-14 | 3075 | 3207 | 95.88% |
| Sep-14 | 3094 | 3227 | 95.88% |
| Oct-14 | 3121 | 3254 | 95.91% |
| Nov-14 | 3157 | 3291 | 95.93% |
| Dec-14 | 3188 | 3325 | 95.88% |
| Jan-15 | 3216 | 3353 | 95.91% |
| Feb-15 | 3239 | 3376 | 95.94% |
| Mar-15 | 3269 | 3407 | 95.95% |



In Table-15 & Figure-31, month-wise comparison is made between the number of OA consumer participants and the total number of portfolios in PXIL. It can be seen that the number of OA consumers as a percentage of total number of portfolios in PXIL was varying between 29.06% and 33.88% during 2014-15. It can be observed from the figure that there is an increasing trend in the number of OA consumers and total number of portfolios in PXIL.

Table-15: Number of Open Access Consumers in PXIL, 2014-15

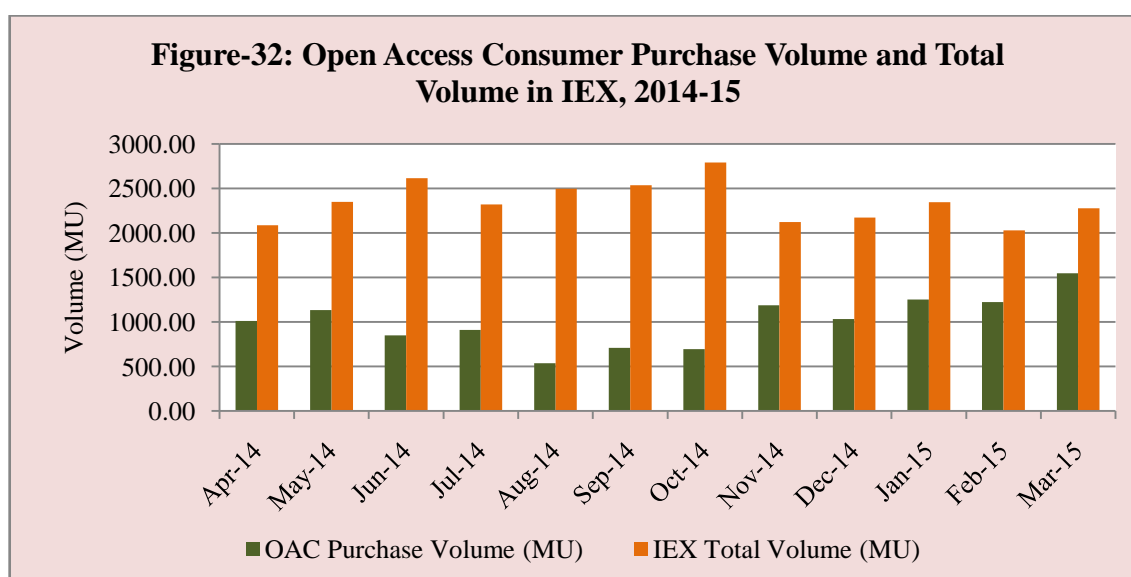
| Month | No. of Open Access Consumers | Total No. of Portfolios in PXIL | % of Open Access Consumers |
|--------|------------------------------|---------------------------------|----------------------------|
| Apr-14 | 474 | 1399 | 33.88% |
| May-14 | 480 | 1455 | 32.99% |
| Jun-14 | 483 | 1480 | 32.64% |
| Jul-14 | 486 | 1510 | 32.19% |
| Aug-14 | 489 | 1550 | 31.55% |
| Sep-14 | 492 | 1595 | 30.85% |
| Oct-14 | 498 | 1648 | 30.22% |
| Nov-14 | 509 | 1697 | 29.99% |
| Dec-14 | 513 | 1735 | 29.57% |
| Jan-15 | 514 | 1755 | 29.29% |
| Feb-15 | 516 | 1762 | 29.28% |
| Mar-15 | 517 | 1779 | 29.06% |



In Table-16 & Figure-32, month-wise comparison is shown between purchase volume of OA consumers and total volume of IEX. During 2014-15, volume of electricity procured by OA consumers as a percentage of total volume transacted in IEX was varying between 21.48% and 67.97%. For the year as a whole, the volume procured by OA consumers as a percentage of total volume transacted in IEX was 42.94%.

Table-16: Volume of Open Access Consumers in Day Ahead Market of IEX, 2014-15

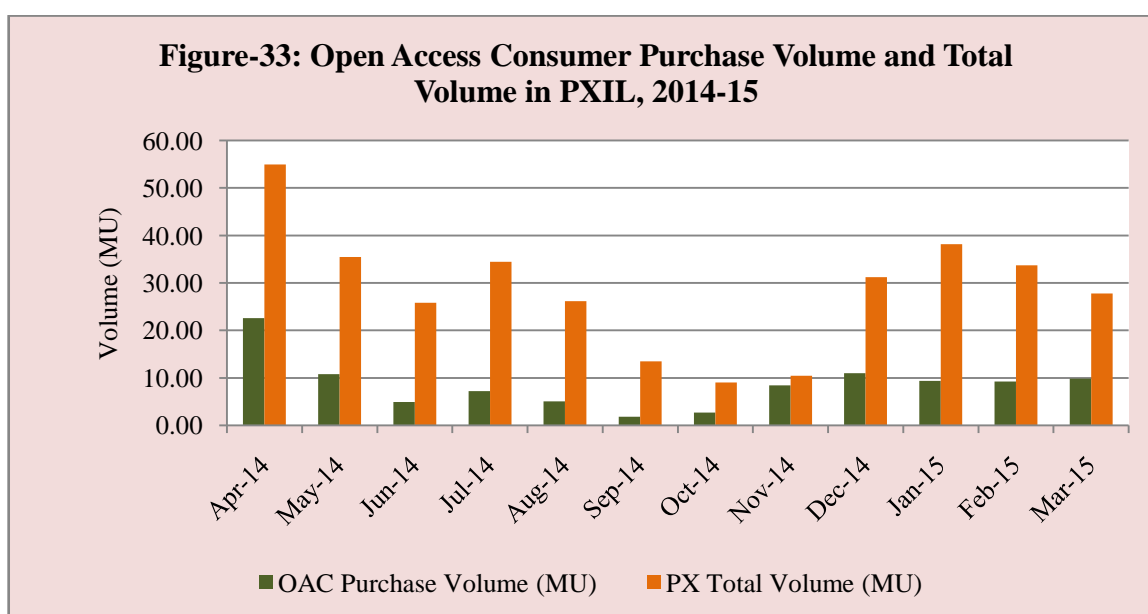
| Month | OAC Purchase Volume (MU) | IEX Total Volume (MU) | % OAC Purchase Participation |
|--------------|--------------------------|-----------------------|------------------------------|
| Apr-14 | 1011.75 | 2087.96 | 48.46% |
| May-14 | 1131.66 | 2347.53 | 48.21% |
| Jun-14 | 850.35 | 2616.78 | 32.50% |
| Jul-14 | 909.96 | 2318.86 | 39.24% |
| Aug-14 | 536.06 | 2495.91 | 21.48% |
| Sep-14 | 707.90 | 2536.80 | 27.91% |
| Oct-14 | 693.45 | 2790.75 | 24.85% |
| Nov-14 | 1188.57 | 2123.55 | 55.97% |
| Dec-14 | 1033.45 | 2173.56 | 47.55% |
| Jan-15 | 1250.91 | 2344.09 | 53.36% |
| Feb-15 | 1222.62 | 2028.17 | 60.28% |
| Mar-15 | 1547.50 | 2276.76 | 67.97% |
| Total | 12084.18 | 28140.72 | 42.94% |



In Table-17 & Figure-33, month-wise comparison is shown between purchase volume of OA consumers and total volume of PXIL. During 2014-15, volume of electricity procured by OA consumers as a percentage of total volume transacted in PXIL was varying between 13.41% and 80.62%. For the year as a whole, the volume procured by OA consumers as a percentage of total volume transacted in PXIL was 30.12%.

Table-17: Volume of Open Access Consumers in Day Ahead Market of PXIL, 2014-15

| Month | OAC Purchase Volume (MU) | PX Total Volume (MU) | % OAC Purchase Participation |
|--------------|--------------------------|----------------------|------------------------------|
| Apr-14 | 22.57 | 54.95 | 41.07% |
| May-14 | 10.78 | 35.46 | 30.41% |
| Jun-14 | 4.89 | 25.80 | 18.96% |
| Jul-14 | 7.24 | 34.47 | 20.99% |
| Aug-14 | 5.03 | 26.18 | 19.21% |
| Sep-14 | 1.81 | 13.47 | 13.41% |
| Oct-14 | 2.73 | 9.04 | 30.18% |
| Nov-14 | 8.45 | 10.48 | 80.62% |
| Dec-14 | 10.97 | 31.24 | 35.10% |
| Jan-15 | 9.37 | 38.17 | 24.55% |
| Feb-15 | 9.26 | 33.71 | 27.47% |
| Mar-15 | 9.85 | 27.78 | 35.46% |
| Total | 102.95 | 340.77 | 30.21% |



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

Table-18 and Table-19 show top 10 sellers and buyers of electricity through traders(bilateral trader segment transactions). The same data for IEX is shown in Table-20 and Table-21 and for PXIL in Table-22 and Table-23. It can be seen that the dominant sellers, both at the power exchanges and traders, are a mixed group comprising of independent power producers, distribution companies, state government agencies, and captive power plants. The major buyers from traders and at power exchanges are mostly state distribution companies.

Table-18: Major Sellers of Electricity through Traders, 2014-15

| S.No. | Seller | State | Volume (MU) | Approximate Percentage of total volume transacted through Traders | Weighted Average Sale Price ₹/kWh |
|-------|----------------------|------------------|-------------|-------------------------------------------------------------------|-----------------------------------|
| 1 | APL | Gujarat | 2583.37 | 13.96% | 3.88 |
| 2 | JSWEL | Karnataka | 2399.39 | 12.97% | 5.68 |
| 3 | JPL | Chattisgarh | 1775.82 | 9.60% | 3.32 |
| 4 | GOHP | Himachal Pradesh | 1704.26 | 9.21% | 3.81 |
| 5 | Sterlite Energy Ltd | Odisha | 1542.21 | 8.33% | 3.47 |
| 6 | Simhapuri Energy Ltd | Andhra Pradesh | 1039.63 | 5.62% | 5.46 |
| 7 | MEPL | Andhra Pradesh | 650.26 | 3.51% | 5.50 |
| 8 | BMM-I | Karnataka | 489.75 | 2.65% | 5.56 |
| 9 | HPSEB | Himachal Pradesh | 464.65 | 2.51% | 4.38 |
| 10 | CSPDCL | Chattisgarh | 460.08 | 2.49% | 3.69 |

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

Table-19: Major Buyers of Electricity through Traders, 2014-15

| S.No. | Buyer | State | Volume (MU) | Approximate percentage of total volume transacted through traders | Weighted Average Purchase Price ₹/kWh |
|-------|-----------|----------------|-------------|-------------------------------------------------------------------|---------------------------------------|
| 1 | APPCC | Andhra Pradesh | 5846.49 | 31.59% | 5.09 |
| 2 | PSEB | Punjab | 2684.76 | 14.51% | 3.83 |
| 3 | BEST MSEB | Maharashtra | 1846.47 | 9.98% | 4.12 |
| 4 | BSEB | Bihar | 1291.08 | 6.98% | 4.47 |
| 5 | KSEB | Kerala | 1233.59 | 6.67% | 5.42 |
| 6 | TPCL | Maharashtra | 1076.82 | 5.82% | 3.29 |
| 7 | UPPCL | Uttar Pradesh | 853.15 | 4.61% | 3.59 |
| 8 | UPCL | Uttarakhand | 749.04 | 4.05% | 3.40 |
| 9 | NPCL | Uttar Pradesh | 721.68 | 3.90% | 3.58 |
| 10 | MSEDCL | Maharashtra | 592.99 | 3.20% | 3.35 |

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

From Table-19 it can be seen that weighted average purchase prices of electricity of major buyers such as APPCC, BSEB and KSEB from traders (bilateral transactions) were higher than the weighted average price for the entire bilateral trader segment (₹4.28/kWh).

Table-20: Major Sellers of Electricity in the Day Ahead Market of IEX, 2014-15

| S.No | Name of Seller | State | Sell Volume (MU) | Percentage of the total volume transacted in IEX | Weighted Average Sale Price (₹/kWh) |
|------|-------------------|----------------------------|------------------|--------------------------------------------------|-------------------------------------|
| 1 | GOHP | H.P. | 2552.83 | 9.07% | 3.29 |
| 2 | Sesa Sterlite Ltd | Sterlite Energy | 1798.58 | 6.39% | 3.52 |
| 3 | JPL | Jindal Power | 1647.92 | 5.86% | 3.19 |
| 4 | JSPL | Jindal Steel and Power Ltd | 1277.88 | 4.54% | 2.96 |
| 5 | MPPMCL | Madhya Pradesh | 1106.79 | 3.93% | 2.69 |
| 6 | HPPC | Haryana | 996.43 | 3.54% | 3.53 |
| 7 | GUVNL | Gujarat | 984.87 | 3.50% | 2.97 |
| 8 | JPL Stage 2 | Jindal Power Ltd Stage 2 | 901.66 | 3.20% | 3.26 |

| | | | | | |
|------------------------------------------------------------------------------------------|--------|-----------------------|--------|-------|------|
| 9 | KWHEP | KarchamWangtoo HEP | 757.31 | 2.69% | 3.41 |
| 10 | CSPDCL | Chhattisgarh | 704.78 | 2.50% | 3.20 |
| <i>Note: Total Volume transacted through Day Ahead Market in IEX was about 28140 MU.</i> | | | | | |

Table-21: Major Buyers of Electricity in the Day Ahead Market of IEX, 2014-15

| S.No | Name of Buyer | State | Buy Volume (MU) | Percentage of the total volume transacted in IEX | Weighted Average Buy Price (₹/kWh) |
|---------------------------------------------------------------------|-----------------------------|-------------|-----------------|--------------------------------------------------|------------------------------------|
| 1 | Essar Steel India Ltd | Gujarat | 1975.56 | 7.02% | 2.98 |
| 2 | MSEDCL GEPL | Maharashtra | 1854.29 | 6.59% | 3.81 |
| 3 | UPPCL | U.P. | 1771.04 | 6.29% | 3.87 |
| 4 | UPCL | Uttarakhand | 1181.48 | 4.20% | 3.15 |
| 5 | BSPHCL | Bihar | 1076.29 | 3.82% | 3.90 |
| 6 | WBSEDCL | West Bengal | 986.81 | 3.51% | 3.85 |
| 7 | Torrent Power Ltd | Gujarat | 958.75 | 3.41% | 3.56 |
| 8 | JVVNL | Rajasthan | 939.91 | 3.34% | 4.19 |
| 9 | TSSPDCL | Telangana | 882.26 | 3.14% | 5.78 |
| 10 | Reliance Infrastructure Ltd | Maharashtra | 775.88 | 2.76% | 3.62 |
| <i>Note: Total Volume transacted through IEX was about 28140MU.</i> | | | | | |

From Table-21 it can be seen that weighted average prices of electricity for major buyers such as MSEDCL, UPPCL, BSPHCL, WBSEDCL, Torrent Power Ltd, JVVNL, TSSPDCL and Reliance Infrastructure Ltd in the day ahead market of IEX were higher than the weighted average price for the entire day ahead market of IEX (₹3.49/kWh).

Table-22 : Major Sellers of Electricity in the Day Ahead Market of PXIL, 2014-15

| S. No | Name of the Seller | State | Sell Volume (MU) | Percentage of total volume transacted in PXIL | Weighted Average Sell Price (₹/kWh) |
|-------|--------------------|-------|------------------|-----------------------------------------------|-------------------------------------|
| 1 | NDMC | Delhi | 145.53 | 42.71% | 3.10 |

| | | | | | |
|------------------------------------------------------------------------------------|---------------------|----------------|-------|--------|------|
| 2 | GUVNL | Gujarat | 54.69 | 16.05% | 3.10 |
| 3 | Jindal Steel Plant | Chhattisgarh | 36.46 | 10.70% | 2.68 |
| 4 | Sterlite Energy Ltd | Odisha | 19.22 | 5.64% | 3.30 |
| 5 | GRIDCO Ltd | Odisha | 17.31 | 5.08% | 3.67 |
| 6 | Vandana Vidyut Ltd | Chhattisgarh | 15.88 | 4.66% | 3.39 |
| 7 | CSPDCL | Chhattisgarh | 13.88 | 4.07% | 3.07 |
| 8 | MSEDCL | Maharashtra | 9.77 | 2.87% | 2.20 |
| 9 | JVVNL | Rajasthan | 9.20 | 2.70% | 3.00 |
| 10 | MPPTCL | Madhya Pradesh | 7.29 | 2.14% | 2.51 |
| <i>Note :The Volume transacted in the Day Ahead Market of PXIL was about 340MU</i> | | | | | |

Table-23 : Major Buyers of Electricity in the Day Ahead Market of PXIL, 2014-15

| S.No. | Name of the Buyer | State | Buy Volume (MU) | Percentage of total volume transacted in PXIL | Weighted Aaverage Buy Price ₹/kWh |
|----------------------------------------------------------------------------------------|-----------------------------------|-------------|-----------------|-----------------------------------------------|-----------------------------------|
| 1 | UPCL | Uttarakhand | 96.23 | 28.24% | 2.85 |
| 2 | UPPCL | UP | 65.69 | 19.28% | 3.63 |
| 3 | Essar Steel India Ltd | Gujarat | 38.94 | 11.43% | 3.05 |
| 4 | Bodal Chemical Ltd | Gujarat | 14.66 | 4.30% | 2.79 |
| 5 | KSEB | Kerala | 14.07 | 4.13% | 3.46 |
| 6 | Bhansali Engineering Polymers Ltd | Rajasthan | 11.07 | 3.25% | 2.85 |
| 7 | IFFCO Plant Kandla | Gujarat | 10.63 | 3.12% | 2.90 |
| 8 | BSPHCL | Bihar | 8.77 | 2.57% | 4.06 |
| 9 | Oracle Granito Ltd | Gujarat | 8.31 | 2.44% | 2.72 |
| 10 | Orient Abrasives Ltd | Gujarat | 8.04 | 2.36% | 2.81 |
| <i>Note : Total Volume transacted in the Day Ahead Market of PXIL was about 340 MU</i> | | | | | |

From Table-23 it can be seen that weighted average prices of electricity for major buyers such as UPPCL, KSEB, BSPHCL and Dishman Pharmaceutica and Chemicals Ltd in the PXIL Day Ahead Market were higher than the weighted average price for the entire day ahead market in the PXIL (₹3.09/kWh).

8. Effect of Congestion on Volume of Electricity Transacted through Power Exchanges

The volume of electricity transacted/sold through power exchanges is sometimes constrained due to transmission congestion. The details of congestion in both the power exchanges are shown in Table-24 and Table-25.

Annual details of congestion in power exchanges are shown in Table-24. It can be observed from the table that there is an increasing trend in the unconstrained cleared volume and actual volume transacted (excluding the year 2014-15). Unconstrained cleared volume and actual volume transacted increased from 8.10 BU and 7.09 BU respectively in 2008-09 to 31.61BU and 28.46BU respectively in 2014-15. It can also be observed from the table that there is an increasing trend in the volume of electricity that could not be cleared (i.e. the difference of unconstrained cleared volume and actual volume transacted) as % to unconstrained cleared volume from 2010-11 to 2012-13 and a declining trend from 2012-13 to 2014-15. Congestion has been reduced since grid integration (integration of NEW Grid and SR Grid) in December 2013, therefore, there is a declining trend in the volume of electricity that could not be cleared as % to unconstrained cleared volume in both the power exchanges in 2013-14 and 2014-15.

Table-24: Annual Details of Congestion in Power Exchanges, 2009-10 to 2014-15

| Year | Unconstrained Cleared Volume* (MU) | Actual Cleared Volume and hence scheduled (MU) | Volume of electricity that could not be cleared due to congestion (MU) | Volume of electricity that could not be cleared as % to Unconstrained Cleared Volume |
|-----------------------------------------------------------------------------|------------------------------------|------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1 | 2 | 3 | 4 (2-3) | 5 (4/2) |
| 2009-10 | 8098.74 | 7087.10 | 1011.65 | 12% |
| 2010-11 | 14263.45 | 13540.75 | 722.70 | 5% |
| 2011-12 | 17084.28 | 14827.68 | 2256.61 | 13% |
| 2012-13 | 27672.30 | 23024.41 | 4647.89 | 17% |
| 2013-14 | 35621.04 | 30029.62 | 5591.42 | 16% |
| 2014-15 | 31607.48 | 28464.33 | 3143.15 | 10% |
| <i>* This power would have been scheduled had there been no congestion.</i> | | | | |
| Source: IEX, PXIL & NLDC | | | | |

During 2014-15, in the IEX, the unconstrained cleared volume and the actual volume transacted were 31.26BU and 28.12BU respectively (Table-25). The actual transacted volume was 9.94% lesser than unconstrained volume. During the same year, in PXIL, the unconstrained cleared volume and the actual volume transacted were 0.38BU and 0.34BU respectively. The actual transacted volume was 10.52% lesser than unconstrained volume.

Table-25: Details of Congestion in Power Exchanges, 2014-15

| | Details of Congestion | IEX | PXIL |
|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------------|-------------|
| A | Unconstrained Cleared Volume* (MU) | 31226.66 | 380.82 |
| B | Actual Cleared Volume and hence scheduled (MU) | 28123.58 | 340.75 |
| C | Volume of electricity that could not be cleared and hence not scheduled because of congestion (MU) (A-B) | 3103.08 | 40.07 |
| D | Volume of electricity that could not be cleared as % to Unconstrained Cleared Volume | 9.94% | 10.52% |
| <i>* This power would have been scheduled had there been no congestion.</i> | | | |
| Source: IEX, PXIL & NLDC | | | |

Congestion, consequent market splitting, and the resultant difference in market prices in different regions give rise to congestion charges. The annual congestion charges of both power exchanges for the period from 2009-10 to 2014-15 is provided in Table-26.

Table-26: Annual Congestion Charges of Power Exchanges, 2009-10 to 2014-15

| Year | Congestion Charges in IEX (₹Crore) | Congestion Charges in PXIL (₹Crore) | Total (₹Crore) |
|---------------------|-------------------------------------------|--------------------------------------------|-----------------------|
| 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 |
| <i>Source: NLDC</i> | | | |

9. Tariffs of Long-term Sources of Power for Various Distribution Companies

It can be seen that short-term market, which includes power transacted through traders (inter-state part), bilateral power transactions directly between DISCOMs, power transacted through power exchanges and DSM, met about 9% of the power requirement of the distribution companies in the year 2014-15. The balance 91% power requirement of the distribution companies was met from power procured under long-term contracts with state and central government owned power generating companies and independent power producers, and also intra-state power purchases from traders under bilateral transactions.

The details on tariff of central government power generating companies, tariff (levelised tariff) of power projects under Case-1 bidding, and the details on average cost of supply and average revenue of state power utilities have been provided below.

9.1 Tariff of Central Government power generating companies

In 2014-15, the central government power generating companies were accounted for about 37.67% of the total power generation in the country.

The prices paid by distribution companies to procure power from central government owned generating companies in 2014-15 (under long-term Power Purchase Agreements) are shown in Table-27 and 28. It can be seen that, on an average, the distribution companies paid between ₹1.63 and ₹8.24 per kWh for procuring power from coal based stations, between ₹4.31 and ₹6.57 per kWh from natural gas based power stations, between ₹7.93 and ₹15.00 per kWh from liquid fuel based power stations (Table-27), and between ₹0.79 per kWh and ₹7.65 per kWh from hydro stations (i.e. excluding latest hydro stations of Teesta-LDP and Parbati-III) (Table-28).

Table-27: Tariff of Central Thermal Power Stations, 2014-15

| Sl. No. | Name of the Generating Station | Installed Capacity (MW) as on March, 2015 | Fixed charges (₹/ kWh) | Energy Charges (₹/ kWh) | Total Tariff (₹/ kWh) |
|----------------------------------------------------------|-----------------------------------------|-------------------------------------------|------------------------|-------------------------|-----------------------|
| I: Coal Based thermal generating Stations of NTPC | | | | | |
| A. | Pit head Generating Stations | | | | |
| 1 | Rihand STPS (St-I) | 1000 | 0.90 | 1.67 | 2.57 |
| 2 | Rihand STPS (St-II) | 1000 | 0.96 | 1.71 | 2.66 |
| 3 | Rihand STPS (St-III) | 1000 | 1.36 | 1.70 | 3.06 |
| 4 | Singrauli STPS | 2000 | 0.57 | 1.23 | 1.80 |
| 5 | Vindhyachal STPS (St-I) | 1260 | 0.87 | 1.68 | 2.54 |
| 6 | Vindhyachal STPS (St-II) | 1000 | 0.83 | 1.58 | 2.42 |
| 7 | Vindhyachal STPS (St-III) | 1000 | 1.30 | 1.57 | 2.88 |
| 8 | Vindhyachal STPS (St-IV) | 1000 | 1.59 | 1.58 | 3.17 |
| 9 | Korba STPS (St-I & II) | 2100 | 0.58 | 1.05 | 1.63 |
| 10 | Korba STPS (St-III) | 500 | 1.66 | 1.04 | 2.70 |
| 11 | Ramagundam STPS (St-I&II) | 2100 | 0.61 | 2.44 | 3.05 |
| 12 | Ramagundam STPS (St-III) | 500 | 0.93 | 2.54 | 3.47 |
| 13 | Talcher TPS | 460 | 1.89 | 1.25 | 3.14 |
| 14 | Talcher STPS (St-I) | 1000 | 0.88 | 1.46 | 2.34 |
| 15 | Talcher STPS (St-II) | 2000 | 0.79 | 1.46 | 2.25 |
| 16 | Sipat STPS (St-I) | 1980 | 1.51 | 1.41 | 2.93 |
| 17 | Sipat STPS (St-II) | 1000 | 1.44 | 1.41 | 2.85 |
| | Sub-Total (A) | 20900 | | | |
| B. | Non-Pit head Generating Stations | | | | |
| 18 | FGUTPP TPS (St-I) | 420 | 0.92 | 2.82 | 3.73 |
| 19 | FGUTPP (St-II) | 420 | 0.95 | 2.75 | 3.70 |
| 20 | FGUTPP (St-III) | 210 | 1.39 | 2.75 | 4.14 |
| 21 | NCTP Dadri (St-I) | 840 | 0.90 | 3.88 | 4.78 |
| 22 | NCTP Dadri (St-II) | 980 | 1.82 | 3.63 | 5.46 |
| 23 | Farrakka STPS (St-I&II) | 1600 | 0.98 | 2.95 | 3.93 |
| 24 | Farrakka STPS (St-III) | 500 | 1.88 | 2.92 | 4.80 |
| 25 | Tanda TPS | 440 | 1.13 | 3.37 | 4.50 |
| 26 | Badarpur TPS | 705 | 1.32 | 4.58 | 5.89 |
| 27 | Kahalgaon STPS (St-I) | 840 | 1.02 | 2.58 | 3.60 |
| 28 | Kahalgaon STPS (St-II) | 1500 | 1.42 | 2.42 | 3.84 |

| Sl. No. | Name of the Generating Station | Installed Capacity (MW) as on March, 2015 | Fixed charges (₹/kWh) | Energy Charges (₹/kWh) | Total Tariff (₹/ kWh) |
|----------------------------------------------------------------------------------------------|--------------------------------|-------------------------------------------|-----------------------|------------------------|-----------------------|
| 29 | Simhadri (St-I) | 1000 | 1.06 | 2.61 | 3.66 |
| 30 | Simhadri (St-II) | 1000 | 1.69 | 2.59 | 4.28 |
| 31 | Mauda STPS (St-I) | 1000 | 4.47 | 3.77 | 8.24 |
| 32 | Barh STPS (St-II) | 660 | 2.52 | 3.70 | 6.21 |
| | Sub-Total (B) | 12115 | | | |
| | Total Coal (A+B) | 33015 | | | |
| II: Natural Gas (APM & Non-APM)/LNG/Liquid Fuel based generating stations of NTPC | | | | | |
| A: Using Natural Gas(APM) as Fuel | | | | | |
| 1 | Anta CCGT | 419.33 | 1.30 | 3.01 | 4.31 |
| 2 | Auraiya GPS | 663.36 | 1.62 | 3.68 | 5.31 |
| 3 | Dadri CCGT | 829.78 | 1.38 | 3.64 | 5.02 |
| 4 | Faridabad GPS | 431.59 | 1.59 | 2.77 | 4.36 |
| 5 | Gandhar GPS | 657.39 | 3.24 | 2.55 | 5.79 |
| 6 | Kawas GPS | 656.20 | 2.52 | 2.77 | 5.29 |
| | Total APM Gas | 3658 | | | |
| B: Using Natural Gas(Non-APM) as Fuel | | | | | |
| 1 | Gandhar GPS | 657.39 | 3.24 | 3.33 | 6.57 |
| 2 | Kawas Gas | 656.20 | 2.52 | 3.38 | 5.90 |
| | Total Non-APM Gas | 1314 | | | |
| C: Using LNG as Fuel | | | | | |
| 1 | Anta CCGT | 419.33 | 1.30 | 9.10 | 10.40 |
| 2 | Auraiya GPS | 663.36 | 1.62 | 11.10 | 12.73 |
| 3 | Dadri CCGT | 829.78 | 1.38 | 10.92 | 12.30 |
| 4 | Faridabad GPS | 431.59 | 1.59 | 10.41 | 12.00 |
| 5 | Gandhar GPS | 657.39 | 3.24 | 9.09 | 12.33 |
| 6 | Kawas GPS | 656.20 | 2.52 | 9.29 | 11.82 |
| | Total Naphtha/HSD | 3658 | | | |
| D: Using Liquid Fuel (Naphtha/HSD) as Fuel | | | | | |
| 1 | Auraiya GPS | 663.36 | 1.62 | 9.95 | 11.57 |
| 2 | Dadri CCGT | 829.78 | 1.38 | 6.55 | 7.93 |
| 3 | Kayamkulam CCGT | 359.58 | 2.78 | 12.22 | 15.00 |
| | Total Liquid Fuel | 1853 | | | |

Table-28: Composite Tariff of Central Hydro Power Stations, 2014-15

| Name of Generating Company | Name of the Generating Station | Type | Installed Capacity (MW) | Annual Fixed Charges (₹/Lakhs) | Composite Tariff (₹/kWh) |
|-----------------------------|--------------------------------|---------|-------------------------|--------------------------------|--------------------------|
| NHPC | | | | | |
| 1 | Baira siul | Pondage | 180 | 11917.15 | 1.75 |
| 2 | Loktak | Storage | 105 | 10695.13 | 2.73 |
| 3 | Salal | ROR | 690 | 27094.44 | 1.01 |
| 4 | Tanakpur | ROR | 123 | 8837.69 | 2.24 |
| 5 | Chamera-I | Pondage | 540 | 29071.90 | 2.01 |
| 6 | Uri-I | ROR | 480 | 33853.30 | 1.50 |
| 7 | Rangit | Pondage | 60 | 8134.24 | 2.76 |
| 8 | Chamera-II | Pondage | 300 | 34313.96 | 2.63 |
| 9 | Dhauliganga-I | Pondage | 280 | 27569.10 | 2.79 |
| 10 | Dulhasti | ROR | 390 | 95214.01 | 5.74 |
| 11 | Teesta-V | Pondage | 510 | 49709.79 | 2.22 |
| 12 | Sewa-II | Pondage | 120 | 18790.14 | 4.05 |
| 13 | Chamera-III* | Pondage | 231 | 39043.13 | 4.13 |
| 14 | Chutak* | ROR | 44 | 11985.34 | 6.47 |
| 15 | Uri-II* | ROR | 240 | 74740.16 | 7.65 |
| 16 | Nimoo Bazgo* | Pondage | 45 | 12326.06 | 5.91 |
| 17 | Teesta-LDP | Pondage | 132 | 78426.37 | 15.15 |
| 18 | Parbati-III* | ROR | 520 | 474.56 | 0.08 |
| | Total | | 4990 | | |
| NHDC | | | | | |
| 1 | Indira Sagar | Storage | 1000 | 50756.03 | 2.59 |
| 2 | Omkareshwar | Storage | 520 | 39699.92 | 4.76 |
| | Total | | 1520 | | |
| THDC | | | | | |
| 1 | Tehri Stage-I | Storage | 1000 | 145823.62 | 6.05 |
| 2 | Koteshwar* | Pondage | 400 | 38316.27 | 3.81 |
| | | | 1400 | | |
| SJVNL | | | | | |
| 1 | Naptha Jhakri | RoR | 1500 | 155755.70 | 2.59 |
| 2 | Rampur HP | RoR | 412 | 37938.56 | 2.32 |
| NEEPCO | | | | | |
| 1 | Khandong | Storage | 50 | 3251.75 | 1.34 |
| 2 | Kopili Stage-I | Storage | 200 | 8170.63 | 0.79 |
| 3 | Doyang | Storage | 75 | 8041.32 | 4.06 |
| 4 | Ranganadi | Pondage | 420 | 29535.47 | 1.81 |
| 5 | Kopili Stage-II | Storage | 25 | 1322.83 | 1.76 |
| | Total | | 770 | | |
| <i>* Provisional Tariff</i> | | | | | |

9.2 Levelised tariff of power projects under Case-I Bidding

Table-29 indicates long-term levelised tariff for power available from power projects bid in the year 2013-14 and 2014-15 under Case-I. During 2013-14, the price of the power projects under Case-I for long-term varied in the range of ₹4.52 per kWh to ₹5.59 per kWh. During 2014-15, the price of the power projects under Case-I for long-term varied in the range of ₹3.60 per kWh to ₹4.29 per kWh. The price of power through competitive bidding was relatively low in 2014-15 when compared with the price of power in 2013-14.

Table-29: Capacity Contracted under Case-I Bidding Route, 2013-14 & 2014-15

| S.No. | State | Name of the Developer/Plant | Capacity (MW) | Levelized Tariff (₹/KWh) | Fuel Type | Date of LOI | Medium /Long Term |
|-------|---------------|-----------------------------------|---------------|--------------------------|--------------------------|-------------|-------------------|
| 1 | Gujarat | Adani Power Ltd, Mundra | 50 | 4.67 | Imported & Domestic Coal | 3.10.2013 | Long Term |
| 2 | Rajasthan | Maruti Clean Coal and Power Ltd | 250 | 4.52 | Domestic Coal | 27.09.2013 | |
| 3 | Rajasthan | DB Power Ltd | 410 | 4.81 | | 27.09.2013 | |
| 4 | Rajasthan | Lanco Power Ltd, Dabandh | 350 | 4.89 | | 27.09.2013 | |
| 5 | Uttar Pradesh | PTC India Ltd(TRN Energy Ltd) | 390 | 4.89 | | 22.05.2013 | |
| 6 | Uttar Pradesh | LancoBabandh Power Ltd | 424 | 5.07 | | 22.05.2013 | |
| 7 | Uttar Pradesh | KSK Mahanadi Power Company Ltd | 1000 | 5.59 | | 11.12.2013 | |
| 8 | Uttar Pradesh | PTC India Ltd | 361 | 5.73 | | 11.12.2013 | |
| 9 | Kerala | Jindal Power Ltd | 200 | 3.60 | | 07.11.2014 | |
| 10 | Kerala | Jindal Power Ltd | 150 | 4.29 | | 20.12.2014 | |
| 11 | Kerala | Jabua Power Ltd | 115 | 4.15 | | 07.11.2014 | |
| 12 | Kerala | Jabua Power Ltd | 100 | 4.29 | | 20.12.2014 | |
| 13 | Kerala | Bharat Aluminium Company Ltd | 100 | 4.29 | | 28.11.2014 | |
| 14 | Kerala | Jindal Thermal Power Ltd | 100 | 4.29 | | 20.12.2014 | |
| 15 | Kerala | Bhavanapadu Thermal Power Project | 100 | 4.29 | | 20.12.2014 | |

Source: Forum of Regulators

9.3 Average Cost of Supply and Average Revenue of State Power Utilities

The data on average cost of supply to state power utilities (SEBs, Power Depts., DISCOMs) and average revenue (revenue from sale of power by state power utilities) without subsidy has been taken from the Report on the Performance of the State Power Utilities published by Power Finance Corporation (Table-30).

Table-30: Average Cost of Supply and Average Revenue (without subsidy) of State Power Utilities

| Year | Average Cost of Supply (₹/kWh) | Average Revenue (without subsidy) (₹/kWh) |
|-----------|--------------------------------|-------------------------------------------|
| 2008 – 09 | 3.40 | 2.63 |
| 2009 – 10 | 3.55 | 2.68 |
| 2010 – 11 | 3.98 | 3.03 |
| 2011 – 12 | 4.55 | 3.30 |
| 2012 – 13 | 5.01 | 3.76 |

Source: PFC, "The Performance of State Power Utilities for the years, 2008-09 to 2010-11 and 2010-11 to 2012-13.

The average cost of supply increased from ₹3.40/kWh in 2008-09 to ₹5.01/kWh in 2012-13. The average revenue (without considering subsidy booked) increased from ₹2.63/kWh in 2008-09 to ₹3.76/kWh in 2012-13.

10. Analysis of transactions of Renewable Energy Certificates (RECs) through power exchanges.

The concept of Renewable Energy Certificates (RECs) seeks to address mismatch between geographical availability of renewable energy sources and the requirement of the obligated entities to meet their renewable purchase obligation by purchasing green attributes of renewable energy. The REC mechanism is a market based instrument, to promote renewable sources of energy and development of market in electricity.

One REC is equivalent to 1 MWh of electricity injected into the grid from renewable energy sources. The REC is exchanged only in the power exchanges approved by CERC within the band of a floor price and forbearance (ceiling) price as notified by CERC from time to time. The forbearance price and floor price notified by CERC are as under:

Table-31: Forbearance and Floor Price for REC transactions

| Type of REC | Forbearance and Floor Price w.e.f 1st April 2012 | | Forbearance and Floor Price w.e.f 1st March 2015 | |
|-------------|--------------------------------------------------|---------------------------|--------------------------------------------------|---------------------------|
| | Floor Price (₹/MWh) | Forbearance Price (₹/MWh) | Floor Price (₹/MWh) | Forbearance Price (₹/MWh) |
| Solar | 9300 | 13400 | 3500 | 5800 |
| Non-Solar | 1500 | 3300 | 1500 | 3300 |

The first REC trading session was held on power exchanges in March 2011. The details of REC transactions are shown in Table-32 and Table-33. The market clearing volume of Solar RECs transacted in 2014-15 on IEX and PXIL were 100661 and 62839 respectively and the weighted average of market clearing price of these RECs was ₹7850/MWh on both IEX and PXIL. Market clearing volume of Non-Solar RECs transacted in 2014-15 on IEX and PXIL were 1446963 and 1451459 respectively and the weighted average of market clearing price of these RECs was ₹1500/MWh on both IEX and PXIL.

The gap between the volume of buy and sell bids of RECs placed through power exchanges shows that there was less demand for both Solar RECs and Non-Solar RECs. For Solar RECs, the ratio of buy and sell bids was 0.03 and 0.02 in IEX and PXIL

respectively. For Non-Solar RECs, the ratio of buy and sell bids was 0.03 in both IEX and PXIL .

Table-32 : Annual details of Renewable Energy Certificates transacted through Power Exchanges, 2014-15

| Sr.No. | Details of REC Transactions | RECs transacted on IEX | | RECs transacted on PXIL | |
|--------|-------------------------------------|------------------------|-----------|-------------------------|-----------|
| | | Solar | Non-Solar | Solar | Non-Solar |
| A | Volume of Buy Bid | 100661 | 1446963 | 62839 | 1451459 |
| B | Volume of Sell Bid | 3699739 | 55325280 | 3345696 | 55087857 |
| C | Ratio of Buy Bid to Sell Bid Volume | 0.03 | 0.03 | 0.02 | 0.03 |
| D | Market Clearing Volume (MWh) | 100661 | 1446963 | 62839 | 1451459 |
| E | Market Clearing Price (₹/MWh) | 7850 | 1500 | 7850 | 1500 |

Month-wise volume and price of RECs transacted through power exchanges are shown in the following table (Table-33).

Table-33 : Volume and Price of Renewable Energy Certificates Transacted through Power Exchanges, 2014-15

| Month | IEX | | PXIL | |
|--------------|----------------------------------|----------------------------------------------------|----------------------------------|----------------------------------------------------|
| | Volume of REC Transactions (MWh) | Weighted Average Price of REC Transactions (₹/MWh) | Volume of REC Transactions (MWh) | Weighted Average Price of REC Transactions (₹/MWh) |
| Solar | | | | |
| Apr-14 | 823 | 9300 | 166 | 9300 |
| May-14 | 469 | 9300 | 1651 | 9300 |
| Jun-14 | 636 | 9300 | 1018 | 9300 |
| Jul-14 | 498 | 9300 | 6135 | 9300 |
| Aug-14 | 367 | 9300 | 796 | 9300 |
| Sep-14 | 264 | 9300 | 1099 | 9300 |
| Oct-14 | 232 | 9300 | 147 | 9300 |
| Nov-14 | 245 | 9300 | 904 | 9300 |
| Dec-14 | 366 | 9300 | 1693 | 9300 |
| Jan-15 | 30650 | 3500 | 1490 | 3500 |

| | | | | |
|------------------|--------|------|--------|------|
| Feb-15 | 26726 | 3500 | 18143 | 3500 |
| Mar-15 | 39385 | 3500 | 29597 | 3500 |
| Non-Solar | | | | |
| Apr-14 | 16798 | 1500 | 62556 | 1500 |
| May-14 | 16142 | 1500 | 13113 | 1500 |
| Jun-14 | 50743 | 1500 | 88711 | 1500 |
| Jul-14 | 13609 | 1500 | 18200 | 1500 |
| Aug-14 | 15736 | 1500 | 34945 | 1500 |
| Sep-14 | 8994 | 1500 | 13656 | 1500 |
| Oct-14 | 36411 | 1500 | 37591 | 1500 |
| Nov-14 | 93100 | 1500 | 102913 | 1500 |
| Dec-14 | 177960 | 1500 | 157763 | 1500 |
| Jan-15 | 393081 | 1500 | 143928 | 1500 |
| Feb-15 | 345184 | 1500 | 402303 | 1500 |
| Mar-15 | 279205 | 1500 | 375780 | 1500 |

List of Trading Licensee as on 31.3.2015

| Sr. No. | Name of Trading Licensee | Date of Issue of License | Present Category of License |
|---------|--------------------------------------------------|--------------------------|-----------------------------|
| 1 | Tata Power Trading Company Ltd | 09.06.2004 | I |
| 2 | Adani Enterprises Ltd | 09.06.2004 | I |
| 3 | PTC India Ltd | 30.06.2004 | I |
| 4 | Reliance Energy Trading (P) Ltd | 30.06.2004 | I |
| 5 | NTPC Vidyut Vyapar Nigam Ltd | 23.07.2004 | I |
| 6 | National Energy Trading & Services Ltd | 23.07.2004 | I |
| 7 | Karam Chand Thapar & Bros Ltd | 27.01.2005 | I |
| 8 | JSW Power Trading Company Ltd. | 25.04.2006 | I |
| 9 | GMR Energy Trading Ltd | 14.10.2008 | I |
| 10 | Global Energy (P) Ltd. | 28.11.2008 | I |
| 11 | Knowledge Infrastructure Systems (P) Ltd | 18.12.2008 | I |
| 12 | Shree Cement Ltd | 16.03.2010 | I |
| 13 | Jai Prakash Associates Ltd | 23.03.2011 | I |
| 14 | SN Power Markets (P) Ltd. | 21.05.2012 | I |
| 15 | Pan India Network Infravest Ltd | 18.11.2013 | I |
| 16 | IL&FS Energy Development Company Ltd | 04.09.2014 | I |
| 17 | Essar Electric Power Development Corporation Ltd | 14.12.2005 | II |
| 18 | RPG Power Trading Company Ltd | 23.09.2008 | II |
| 19 | Mittal Processors (P) Ltd | 12.02.2009 | II |
| 20 | Manikaran Power Ltd | 29.06.2012 | II |
| 21 | Instinct Infra & Power Ltd | 07.09.2005 | III |
| 22 | Indrajit Power Technology (P) Ltd | 16.05.2008 | III |
| 23 | PCM Power Trading Corporation Ltd | 01.09.2010 | III |
| 24 | My Home Power (P) Ltd | 26.04.2011 | III |
| 25 | DLF Energy (P) Ltd | 07.03.2012 | III |
| 26 | Arunachal Pradesh Power Corporation (P) Ltd. | 11.09.2012 | III |
| 27 | Solar Energy Corporation of India | 01.04.2014 | III |
| 28 | Rajasthan Renewable Energy Corporation Ltd | 03.06.2014 | III |
| 29 | Jai International (P) Ltd. | 18.07.2014 | III |
| 30 | IPCL Power Trading (P) Ltd | 10.02.2015 | III |
| 31 | Suryachakar Power (P) Corporation Ltd | 22.02.2006 | IV |
| 32 | Visa Power Ltd | 28.06.2007 | IV |
| 33 | Pune Power Development (P) Ltd | 21.08.2007 | IV |
| 34 | Greenko Energies (P) Ltd | 22.01.2008 | IV |
| 35 | Vandana Vidyut Ltd | 03.04.2008 | IV |
| 36 | Audhunic Alloys & Power Ltd | 26.06.2008 | IV |
| 37 | Indiabulls Power Trading Ltd | 12.09.2008 | IV |

| | | | |
|----|-------------------------------------------|------------|----|
| 38 | Ambitious Power Trading Company Ltd | 16.09.2008 | IV |
| 39 | Shyam Indus Power Solutions (P) Ltd | 11.11.2008 | IV |
| 40 | Customised Energy Solutions India (P) Ltd | 08.06.2011 | IV |
| 41 | Gemac Engineering Services (P) Ltd. | 21.06.2012 | IV |
| 42 | Green Fields Power Services (P) Ltd | 08.02.2013 | IV |
| 43 | HMM Infra Ltd | 11.03.2013 | IV |
| 44 | Newfields Advertising (P) Ltd | 30.04.2013 | IV |
| 45 | Vedprakash Power (P) Ltd | 19.08.2013 | IV |
| 46 | Parshavnath Power Projects (P) Ltd | 19.05.2014 | IV |
| 47 | Provestment Services Ltd | 27.01.2015 | IV |

Historic Volatility Calculation

Volatility = Standard deviation of daily prices returns.

Historical Volatility Formula:

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

where

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

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

Herfindahl-Hirschman Index (HHI) Calculation

Formula for computing the HHI is as under:

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

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 one, where N is the number of firms in the market. Equivalently, if percents are used as whole numbers, as in 75 instead of 0.75, the index can range up to 100^2 or 10,000.

- A HHI index below 0.01 (or 100) indicates a highly competitive index.
- A HHI index below 0.15 (or 1,500) indicates an unconcentrated index.
- A HHI index between 0.15 to 0.25 (or 1,500 to 2,500) indicates moderate concentration.
- A HHI index 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 one, the normalized Herfindahl index ranges from 0 to 1.