



Annual Report - Short-term Power Market in India, 2009



Contents

S.No	Contents	Page No
	Cover page	1
	Contents	2
	Abbreviations	3
	Executive Summary	5
1	Yearly trends in short-term transactions of electricity (2007 to 2009)	6
1.1	Volume of short-term transactions of electricity	7
1.2	Price of short-term transactions of electricity	8
2	Monthly trends in short-term transactions of electricity (Jan-Dec 09)	9
2.1	Volume of short-term transactions of electricity	10
2.2	Price of short-term transactions of electricity	13
3	Daily trends in short-term transactions of electricity (Jan to Dec 09)	15
3.1	Volume of short-term transactions of electricity	15
3.2	Price of short-term transactions of electricity	16
4	Emergence of open access industrial sector consumers on power exchanges	19
5	Major Sellers and Buyers of Electricity through Licensed Traders and Power Exchanges	19
6	Effect of congestion on Volume Transacted through Power Exchanges	22
7	Comparison of short term prices with Tariffs of long term sources of power for various distribution companies	22
8	Annexure-I: List of Trading Licensees as on 31.12.2009	28
9	Annexure-II: Historic Volatility Calculation	29
10	Annexure-III: Herfindahl-Hirschman Index (HHI) Calculation	30

Abbreviations

Abbreviation	Expanded Version
APCPDCL	Central Power Distribution Company of Andhra Pradesh Limited
APPCC	Andhra Pradesh Power Coordination Committee
BALCO	Bharat Aluminium Company Limited
BESCOM	Bangalore Electricity Supply Company Limited
BU	Billion units (billion kWh)
BYPL	BSES Yamuna Power Limited
CCGT	Combined Cycle Gas Turbine
DISCOMS	Distribution Companies
GMR	GMR Energy Trading Limited
GPS	Gas Power Station
GUVNL	Gujarat Urja Vikas Nigam Limited
HHI	Herfindahl-Hirschman Index
HPPC	Haryana Power Procurement Centre
HPSEB	Himachal Pradesh State Electricity Board
IEX	Indian Energy Exchange Limited
JSW	JSW Power Trading Company Limited
JSWEL	JSW Energy Limited
JVVNL	Jaipur Vidyut Vitaran Nigam Limited
KISPL	Knowledge Infrastructure & Systems Private Limited
KSEB	Kerala State Electricity Board
kWh	Kilo Watt Hour
Ltd	Limited
MSEDCL	Maharashtra State Electricity Distribution Company Limited
MW	Mega Watts
MUs	Million Units
NBVL	Nav Bharat Ventures Limited
NEEPCO	North Eastern Electric Power Corporation Limited.
NEW Grid	Northern, Eastern, Western and North-Eastern Region Grid
NHDC	NHDC Limited
NHPC	National Hydro-Electric Power Corporation Limited
NLC	Neyveli Lignite Corporation Limited
NTPC	National Thermal Power Corporation Limited
NVVN	NTPC Vidyut Vyapar Nigam Limited
PSEB	Punjab State Electricity Board
PTC	PTC India Limited
PX/PXs/Pxes	Power Exchange/Power Exchanges
PXIL	Power Exchange India Limited
R Infra	Reliance Infrastructure Limited
RPPC	Rajasthan Power Procurement Centre

RTC	Round The Clock
SJVNL	Sutlej Jal Vidyut Nigam Limited
SR Grid	Southern Region Grid
ST	Stage
STPS	Super Thermal Power Station
THDC	Tehri Hydro Development Corporation Limited
TNEB	Tamil Nadu Electricity Board
TPS	Thermal Power Station
TPTL	Tata Power Trading Company Limited
UI	Unscheduled Interchange
UMPP	Ultra Mega Power Project
UPPCL	Uttar Pradesh Power Corporation Limited
WBSEDCL	West Bengal State Electricity Distribution Company Limited

Executive Summary

An analysis on short-term transactions of electricity in India has been made in the report on short-term power market¹ 2009. Here, the “short-term transactions of electricity” means the contracts of less than one year period for electricity transacted through Inter-State Trading Licensees and directly by the Distribution Licensees, Power Exchanges (Indian Energy Exchange Ltd (IEX) and Power Exchange India Ltd (PXIL)), and Unscheduled Interchange (UI). The analysis includes (i) Years/Monthly/Daily trends in short-term transactions of electricity; (ii) Emergence of open access industrial sector consumers on power exchanges; (iii) Major Sellers and Buyers of Electricity through Licensed Traders and Power Exchanges; (iv) Effect of congestion on Volume Transacted through Power Exchanges; and (v) Comparison of short-term prices with tariffs of long-term sources of power for various distribution companies.

The year 2009 witnessed further consolidation of the short-term power market in India. The short term power market not only grew in absolute size in volume terms, but its share as a percentage of total electricity generation in the country also grew noticeably. On price front, although the year witnessed highest ever prices for electricity transacted through power exchanges and trading licensees, especially in the months of April and August 2009; overall the weighted average price of electricity transacted through short term market in the year 2009 was lower as compared to the price in the year 2008. Salient features of the year are listed below and are discussed in details in subsequent sections.

- Of the total electricity generation in India in 2009, the short-term power market comprises only 8 per cent. The balance 92 percent of generation is being procured mainly by distribution companies through long-term contracts.
- In volume terms (kWh) the size of the short term market in India, excluding UI and direct bilateral sale between distribution companies, was about 30.6 billion kWh (units) in the year 2009. As compared to the volume of electricity transacted through short term market in the year 2008, this was about 20.3 percent higher.

¹ Although unscheduled interchange (UI) is not a market mechanism, electricity transacted under UI 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 2009, the volume of UI was about 24.43 billion kWh and that of between distribution companies was about 5.61 billion kWh.

- In monetary terms the size of this (30.6 billion units) short term market was about Rs.19217 crore in the year 2009². About Rs. 3320 crore of which was the value of electricity transacted through power exchanges, and the balance of about Rs.15897 crore was the value of electricity traded through trading licensees.
- Rising share of the short term market, witnessed in the year 2008 also continued in the year 2009. The share of short term market in total electricity generation in the country further increased to a level of 4.08 percent during the year 2009. In the years 2007 and 2008, the share of short term electricity transactions as a percentage of total electricity generation in the country was 2.93 and 3.28 percent, respectively.
- 50% of the volume of electricity in the two power exchanges has been transacted at the price less than Rs.5/kWh.
- The weighted average price of electricity transacted through power exchanges was Rs. 5.73 per kWh and through trading licensees was Rs. 6.41 per kWh in the year 2009. The corresponding values for the year 2008 were Rs. 7.57 per kWh and Rs. 7.04 per kWh, respectively.
- The year 2009 witnessed for the first time, the beginning of the process of procurement of power by the industrial sector consumers through power exchanges, although such beginning has been made only at the Indian Energy Exchange Limited (IEX).
- The year also witnessed constraints on the volume of electricity that could be transacted through power exchanges, mainly due to transmission congestion. During the year 2009, the actual volume transacted could have been about 17 percent higher, had there been no congestion prevalent in the system.

1. Yearly trends in short-term transactions of electricity (2007 to 2009)

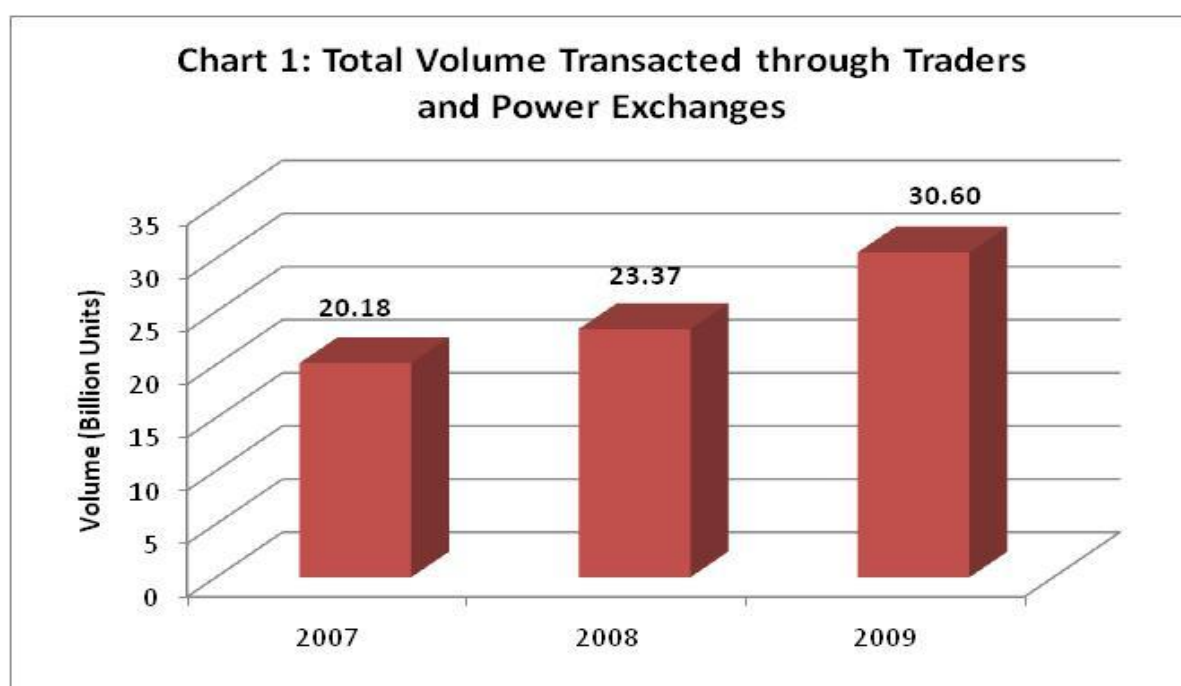
The analysis on yearly trends in short-term transactions includes the electricity transacted through trading licensees and power exchanges only and it does not include the electricity transacted through UI and directly between distribution companies. Inter-state trading licensees have been undertaking trading in electricity since the year 2004 and the power exchanges are in operation since the year 2008. The IEX and PXI are in operation since June 2008 and October 2008 respectively. As of end December 2009, there were 38 inter-state trading licensees (list is enclosed at Annexure-I) and two power exchanges.

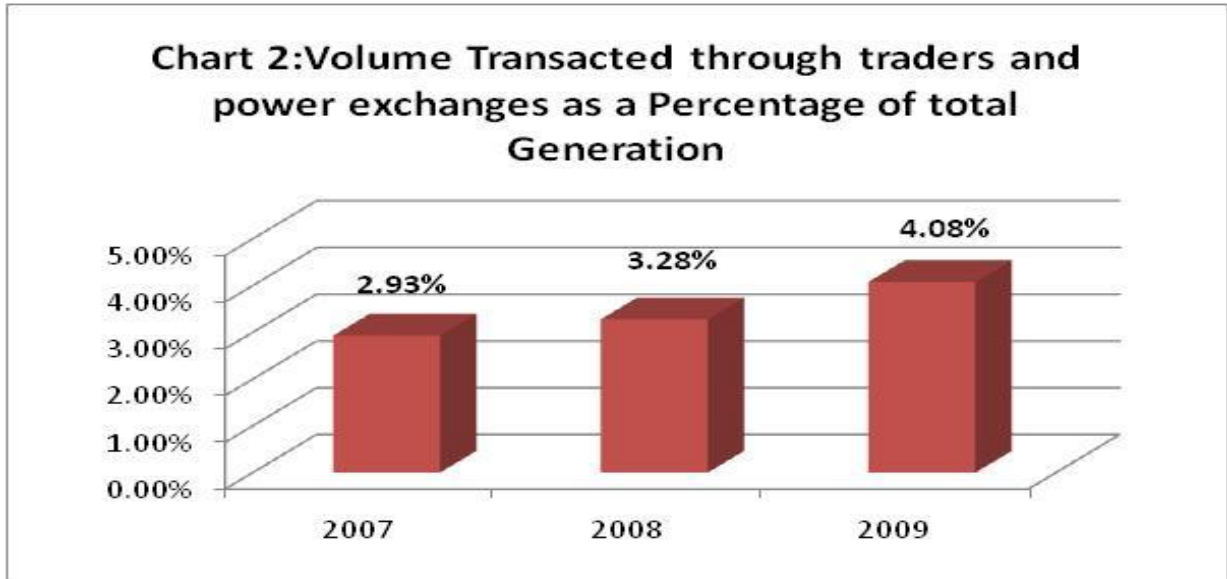
² *Excluding transactions pertaining to power procured from Bhutan, and banking transactions.*

1.1. Volume of short-term transactions of electricity

The volume of electricity transacted through inter-state trading licensees and power exchanges has been increased from 20.18 BUs in 2007 to 30.60 BUs in 2009. The share of electricity transacted through trading licensees and power exchanges in volume terms as a percentage of total electricity generation too increased from 2.93% to 4.08% during the period. Table-1 & Chart-1 show details of volume of electricity transacted through trading licensees and power exchanges for the period from 2007 to 2009. Chart-2 depicts volume of electricity transacted through trading licensees and power exchanges as a percentage of the total generation for the period from 2007 to 2009.

Year	Electricity Transacted through trading Licensees (BUs)	Electricity Transacted through IEX (BUs)	Electricity Transacted through PXI (BUs)	Total (BUs)	Total Electricity Generation (BUs)	Electricity Traded as % to Total Generation
	1	2	3	4 (1+2+3)	5	6 (4/5)
2007	20.18			20.18	689	2.93%
2008	21.63	1.72	0.015	23.37	712	3.28%
2009	24.81	5.07	0.72	30.60	750	4.08%



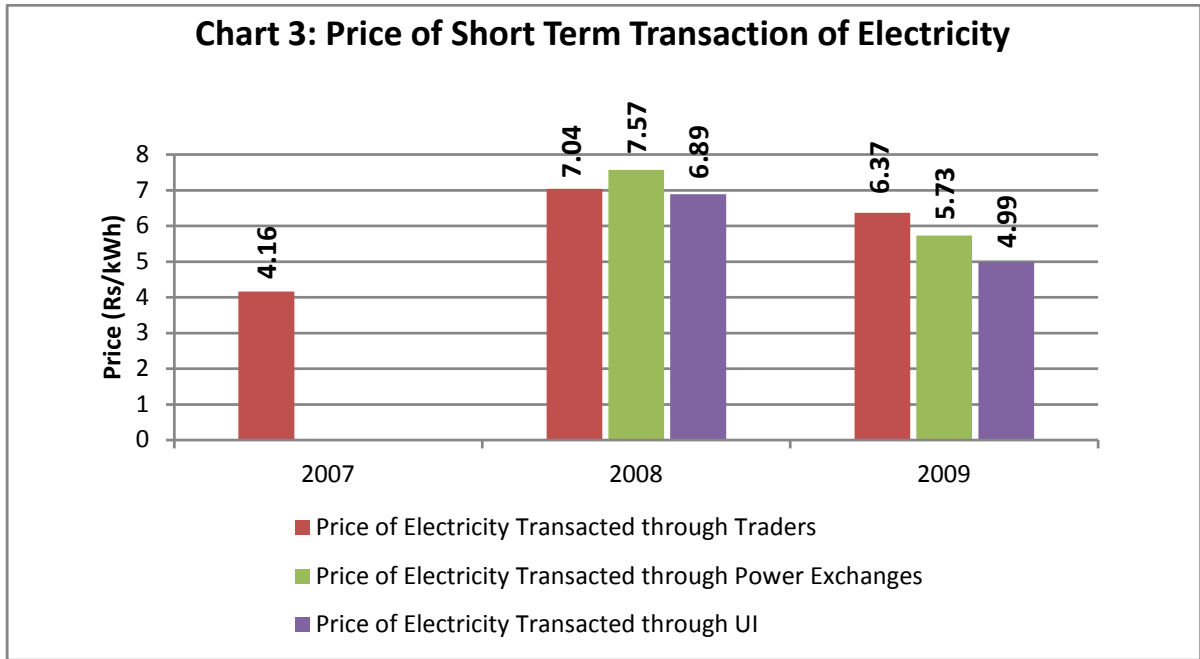


1.2. Price of short-term transactions of electricity

The price of electricity transacted through trading licensees, Power Exchanges, and UI is shown in Table-2 and Chart-3. The weighted average price of electricity transacted through trading licensees has increased from Rs.4.16/kWh in 2007 to Rs.7.04/kWh in 2008, but came down to Rs. 6.41/kWh in 2009. The weighted average price of electricity transacted through the two power exchanges that started their operations in 2008, was Rs. 7.57/kWh during 2008. The same was Rs. 5.73/kWh in 2009. The UI prices in 2008 and 2009 were Rs.6.89/kWh and Rs.4.99/kWh, respectively. It is thus seen that the price of electricity in the short term market in the year 2009 were on the lower side as compared to price prevalent in the year 2008. They were about 9.5 percent lower for electricity transacted through licensed traders, about 24.3 percent lower for electricity transacted through power exchanges and about 27.6 percent lower in the case of UI as compared to 2008 prices.

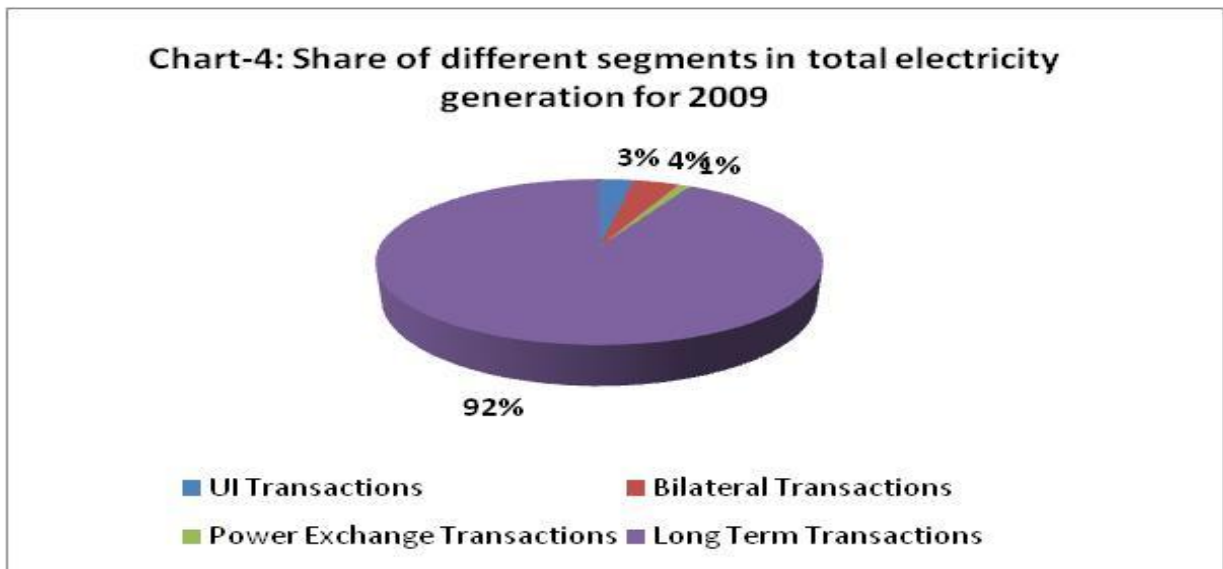
Year	Price of Electricity transacted through Trading Licensees (Rs/kWh)	Price of Electricity transacted through Power Exchanges (Rs/kWh)	Price of Electricity transacted through UI (Rs/kWh)
2007	4.16		
2008	7.04	7.57 *	6.89*
2009	6.41	5.73	4.99

**= weighted average of prices during the period August to december 2008. The Indian Energy Exchange started functioning in June 2008 and The Power Exchange of India started functioning in October 2008.*



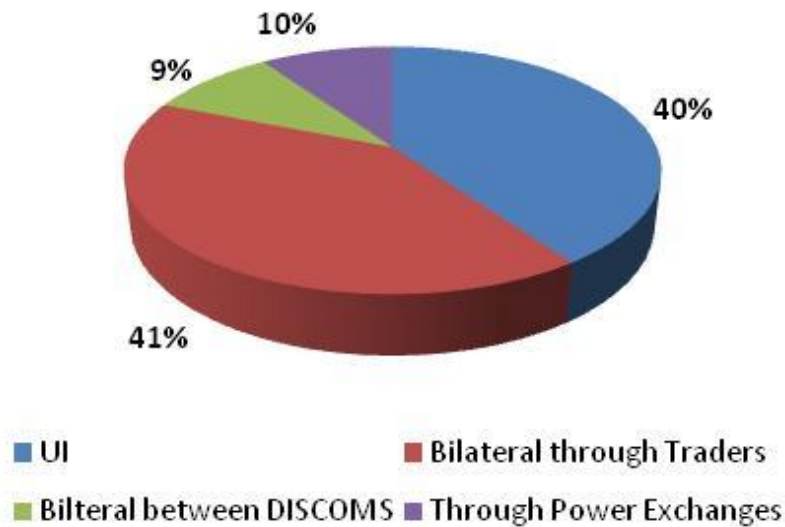
2. Monthly trends in short-term transactions of electricity (Jan-Dec 09)

During 2009, the share of the total short term transactions in volume terms, including UI and bilateral transactions between distribution companies, as a percentage of total electricity generation in the country was about 8 percent (Chart-4).



The share of different segments within the total short term transaction for the year 2009 has been shown in the Chart-5 below.

Chart-5: Share of Different Segments in Short Term Transactions in 2009



2.1. Volume of short-term transactions of electricity

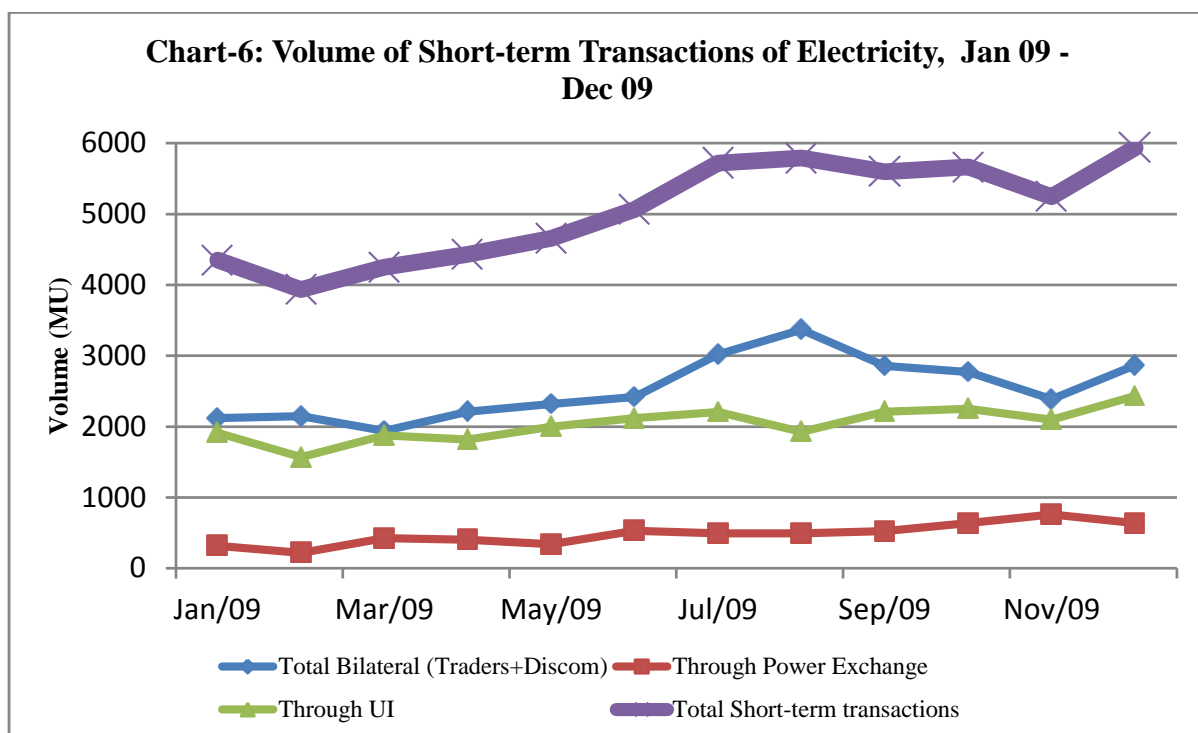
The volume of short-term transactions of electricity during different months of the year 2009 with respect to different segments of transaction is shown in Table-3 and Chart-6.

Table-3: VOLUME OF SHORT-TERM TRANSACTIONS OF ELECTRICITY (MUs)							
Period	Bilateral through Traders	Bilateral Direct	Total Bilateral transactions	Power Exchange transactions	UI transactions	Total Short-term transactions	Total Electricity Generation
Jan-09	1715.29	406.08	2121.37	316.43	1911.39	4349.19	61193.77
Feb-09	1677.94	471.00	2148.94	217.57	1569.11	3935.62	57121.74
Mar-09	1696.50	245.18	1941.68	428.61	1878.26	4248.55	64841.89
Apr-09	1794.80	415.54	2210.34	406.07	1815.66	4432.07	62486.24
May-09	2070.01	247.29	2317.30	341.70	1997.38	4656.38	63465.58
Jun-09	1843.61	573.90	2417.51	529.49	2118.63	5065.63	62645.64
Jul-09	2402.76	618.07	3020.83	495.16	2204.68	5720.67	62935.51
Aug-09	2761.13	607.92	3369.05	493.51	1926.73	5789.28	65563.07
Sep-09	2518.69	338.88	2857.57	527.22	2210.49	5595.28	63188.40
Oct-09	2210.72	560.99	2771.71	639.02	2251.41	5662.15	64896.26
Nov-09	1941.68	444.59	2386.27	758.82	2098.48	5243.57	59402.72
Dec-09	2178.58	685.46	2864.03	640.09	2430.84	5934.97	63417.34
Compounded monthly growth rate (%)	2.01	4.46	2.53	6.05	2.02	2.62	0.32

It is observed from the above table (Table-3) that the volume of short-term transactions of electricity has grown steadily over the months at the compounded monthly rate of 2.62 %.

Volume of transactions through power exchanges has shown a healthy growth and has grown at the monthly compounded rate of 6.05 percent. It is also observed from the table that total volume of electricity transacted through traders in 2009 was comparable with the volume of electricity transacted through UI in 2009. However, the monthly compounded growth rate in UI at 2.02 percent is very marginally higher than the monthly compounded growth rate in volume of electricity transacted through trading licenses, which has grown at monthly compounded rate of 2.01 percent. Whereas the monthly compounded growth rate in volume of electricity traded through trading licensees has been modest as compared to monthly compounded growth rate in volume transacted through power exchanges during the year 2009, in absolute terms, as can be seen from the data in Table-1, the volume of transactions through trading licensees has shown a growth of 14.7 percent in 2009 over 2008.

It is observed from the chart below (Chart-6) that there is a cyclical trend in the total volume of short-term transactions of electricity. It is also observed from the chart that there is no constant increase/decrease in the volume of all segments of the short-term transactions of electricity. This trend may have emerged due to demand and supply of electricity which vary from season to season. However, a rising trend in the volume of total short term transactions as well as in the volumes of all segments of the short term transactions, albeit with differing growth rates, is clearly discernable from the Chart-6.



The volume of short-term transactions of electricity as % of total electricity generation is varying between 6.55% and 9.36% during the period (Table-4).

Period	Short-term transactions as % of total generation
Jan-09	7.11%
Feb-09	6.89%
Mar-09	6.55%
Apr-09	7.09%
May-09	7.34%
Jun-09	8.09%
Jul-09	9.09%
Aug-09	8.83%
Sep-09	8.85%
Oct-09	8.72%
Nov-09	8.83%
Dec-09	9.36%

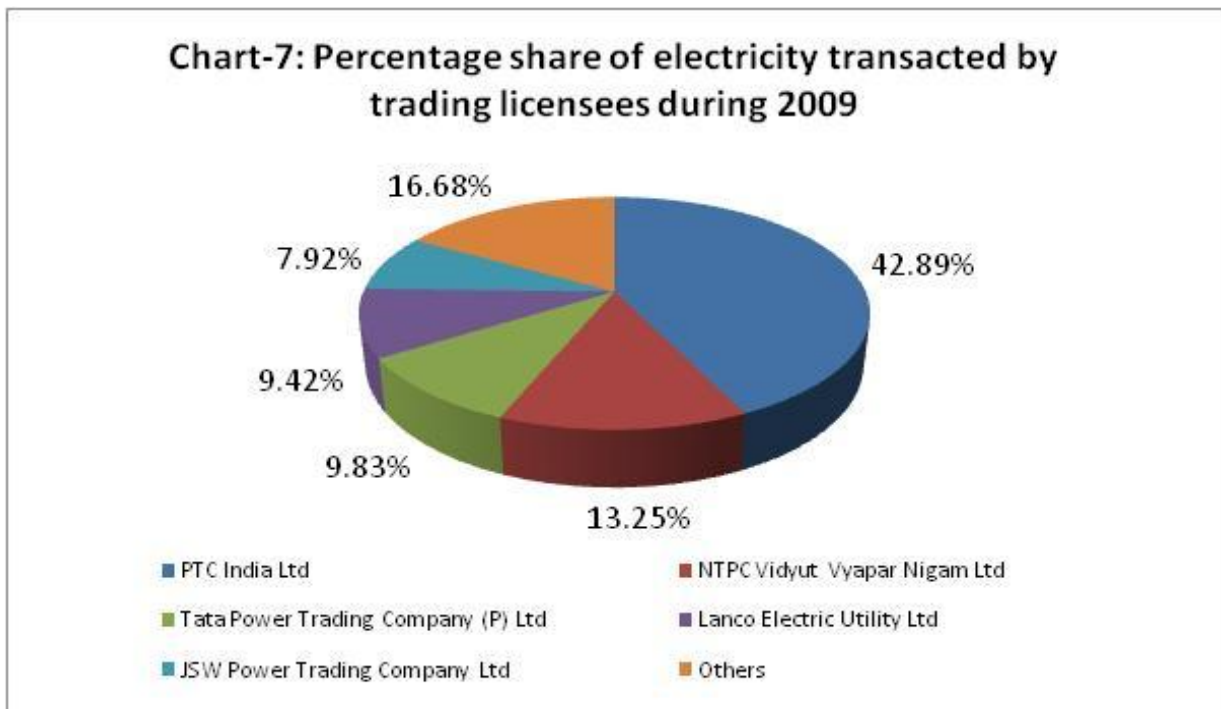
Of the bilateral, the volume of electricity transacted through trading licensees is analysed using the Herfindahl-Hirschman Index (HHI) for measuring the competition among the trading licensees (Table-5). Increases in the HHI generally indicate a decrease in competition and an increase of market power, whereas decreases indicate the opposite. A HHI between 0.10 to 0.18 indicates moderate concentration and a HHI above 0.18 indicates high concentration. The HHI computed for volume of electricity transacted by trading licensees during 2009 is 0.23 which shows high concentration/market power among the trading licensees.

S.No	Name of the Trading Licensee	Share of Electricity traded by Licensees	Herfindahl-Herschman Index (HHI)
1	PTC India Ltd	42.89%	0.18
2	NTPC Vidyut Vyapar Nigam Ltd	13.25%	0.02
3	Tata Power Trading Company (P) Ltd	9.83%	0.01
4	Lanco Electric Utility Ltd	9.42%	0.01
5	JSW Power Trading Company Ltd	7.92%	0.01
6	Reliance Energy Trading (P) Ltd	7.36%	0.01
7	Adani Enterprises Ltd	3.69%	0.00
8	GMR Energy Trading Ltd	2.32%	0.00
9	Knowledge Infrastructure & Systems Ltd	1.50%	0.00
10	Pune Power Development Pvt. Ltd.	0.64%	0.00
11	RPG Power Trading Company Ltd	0.49%	0.00
12	Mittal Processes Private Ltd	0.40%	0.00
13	Instinct Advertisement & Marketing Ltd	0.25%	0.00
14	Vinergy International Private Ltd	0.03%	0.00
	Total	100.00%	0.23
	Top 5 trading licensees	83.32%	

Note: Percentage Share in total volume traded by licensees computed based on the volume which includes the volume traded by trading licensees through power exchanges also.

Source: Information submitted by trading licensees

The percentage share of electricity transacted by major trading licensee in the total volume of electricity transacted by all the licensees is shown in Chart-7.

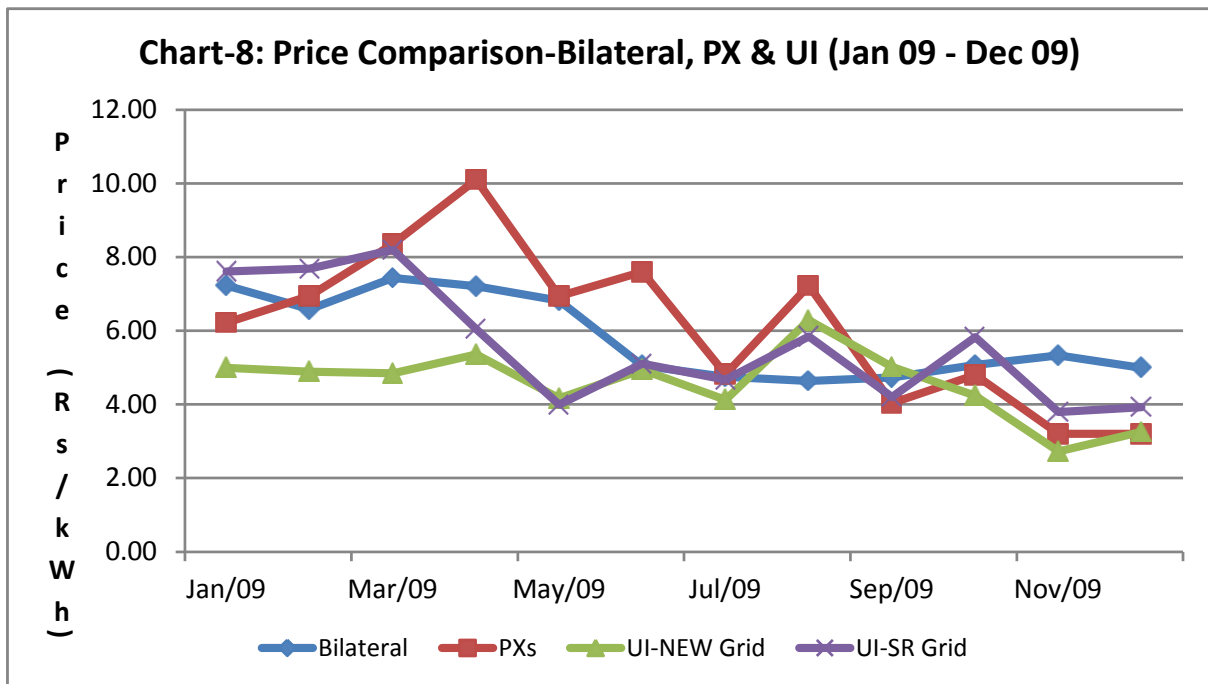


2.2. Price of short-term transactions of electricity

The trends in price of short-term transactions of electricity are shown in Table-6 and Chart 8 & 9. The price analysis is mainly based on the average price of UI and the weighted average price of other short-term transactions of electricity. The price of bilateral transactions represents the price of electricity transacted through trading licensees. The trends in price of electricity transacted through trading licensees are studied separately for total transactions as well as the transactions undertaken Round the clock (RTC), during Peak, and during Off-peak periods.

Period	Bilateral through Traders				Power Exchange		UI	
	RTC	Peak	Off-peak	Total	IEX	PXIL	NEW Grid	SR Grid
Jan-09	7.43	8.55	6.78	7.23	6.16	6.86	4.99	7.61
Feb-09	6.89	8.16	6.19	6.58	6.85	7.42	4.89	7.68

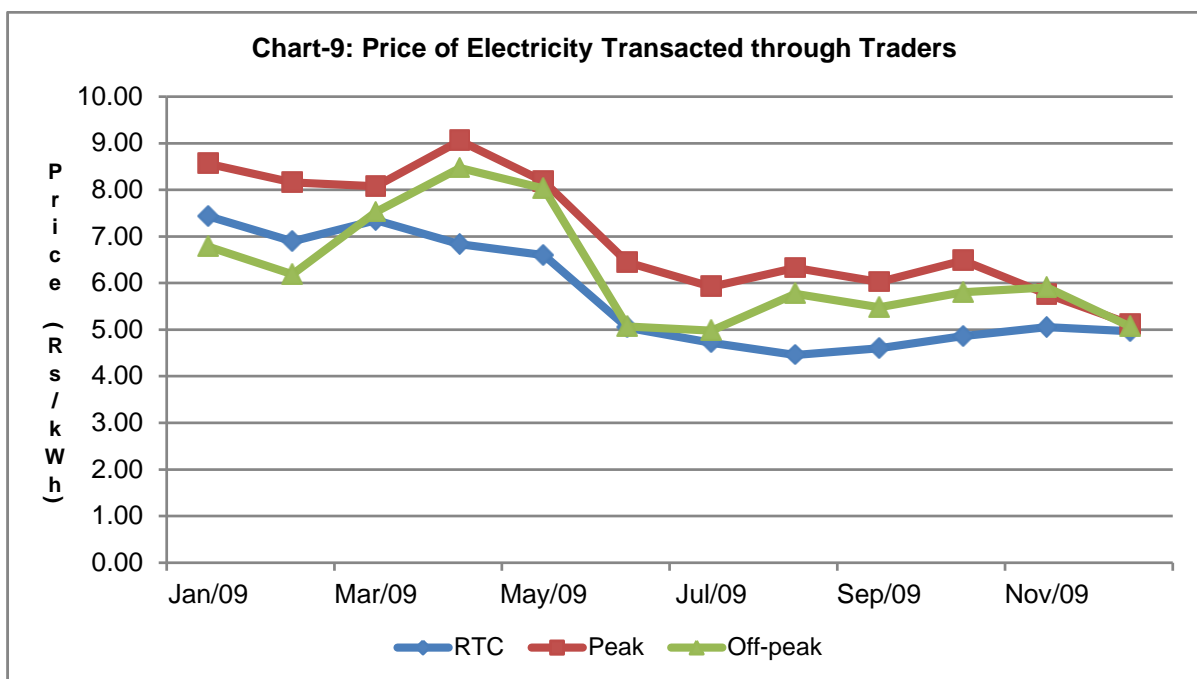
Mar-09	7.35	8.08	7.53	7.43	8.33	8.54	4.85	8.20
Apr-09	6.83	9.05	8.47	7.21	10.10	10.18	5.36	6.04
May-09	6.60	8.18	8.03	6.82	6.84	8.74	4.17	3.99
Jun-09	5.04	6.44	5.07	5.05	7.39	9.60	4.94	5.10
Jul-09	4.72	5.92	4.98	4.75	4.81	4.85	4.12	4.67
Aug-09	4.46	6.32	5.77	4.64	7.40	6.15	6.29	5.85
Sep-09	4.60	6.02	5.48	4.73	4.00	4.32	5.02	4.20
Oct-09	4.86	6.48	5.80	5.07	4.73	5.18	4.24	5.83
Nov-09	5.05	5.76	5.91	5.33	3.16	3.39	2.72	3.79
Dec-09	4.96	5.12	5.06	4.99	3.22	3.07	3.26	3.92



It is observed from the above Chart that the price of electricity transacted through power exchanges was relatively high when compared with the price of electricity transacted through trading licensees and UI during the period April – August 2009. It is also seen that the price of all the short-term transactions were relatively higher during the same period as compared to the price during other months. It is pertinent to note that the period of higher relative price (April–August 2009) was also the period of relatively higher overall demand for electricity, first in April/May 2009 due to general elections and then during June–August 2009 due to delay in monsoon and/or due to lesser than normal monsoon rains in some parts of the country. September and October were months when, for much of the time (September 11– October 25), there was a cap imposed on the price of inter-State day ahead transactions of power on power exchanges and through bilateral markets. The cap not only kept the price of power transacted through power exchanges low, it also brought the weighted average price of power transacted

through power exchanges, lower than the weighted average price of power transacted through traders as well as the average price of power through UI (especially Southern Grid average UI prices). The last two months of 2009, witnessed relatively lower demand for power and that got reflected in relatively lower weighted average/average price of power through short term transactions, including UI. It is also observed that, while there was divergence of prices of power transacted through different short term segments in the first six to nine months when the demand for power was relatively high; there was convergence of prices of power transacted through different short term segments in the last quarter of the year, mainly because the demand for power during this period was relatively low.

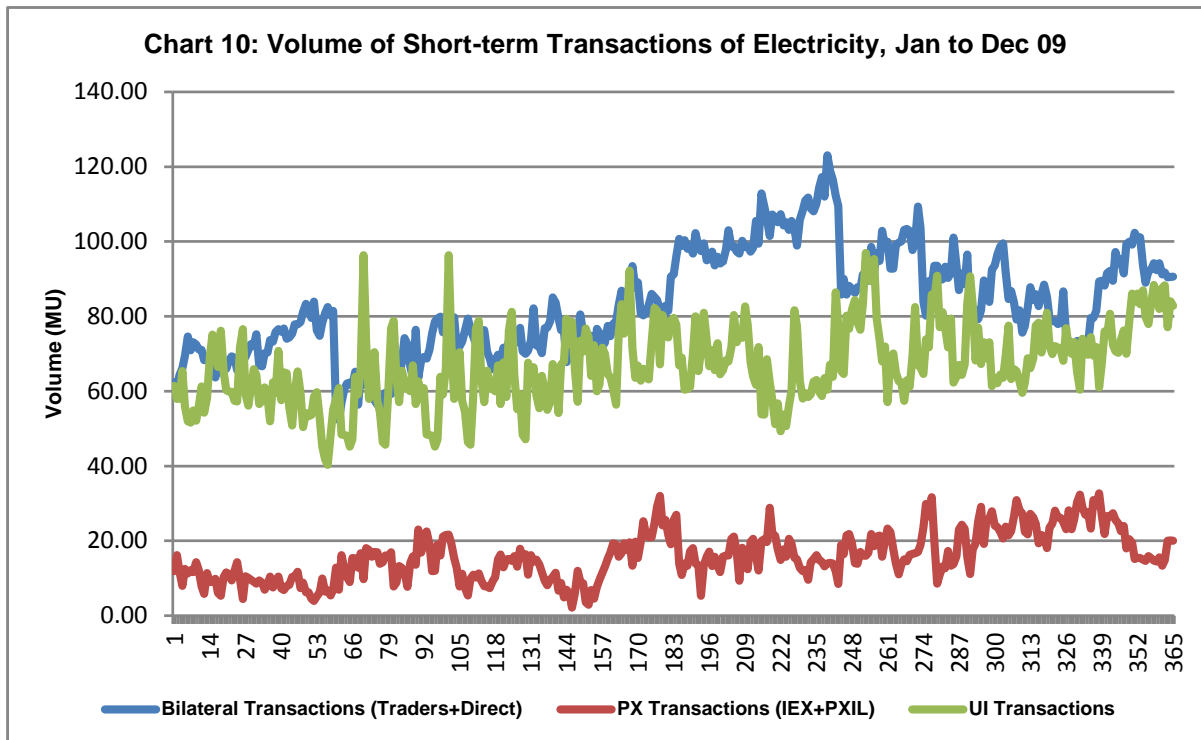
The trends in price of electricity transacted by trading licensees during RTC, Peak and Off-peak periods are shown in Chart-9. The price of electricity transacted during peak RTC and Off-peak periods shows a declining trend and converged perfectly by December 2009.



3. Daily trends in short-term transactions of electricity (Jan to Dec 09)

3.1. Volume of Short-term transactions of Electricity

Trends in daily volume of short-term transactions are shown in Chart 10. It is observed from the chart that there is an increasing trend in the volume of electricity transacted through bilateral, through power exchanges and through UI during the year 2009.

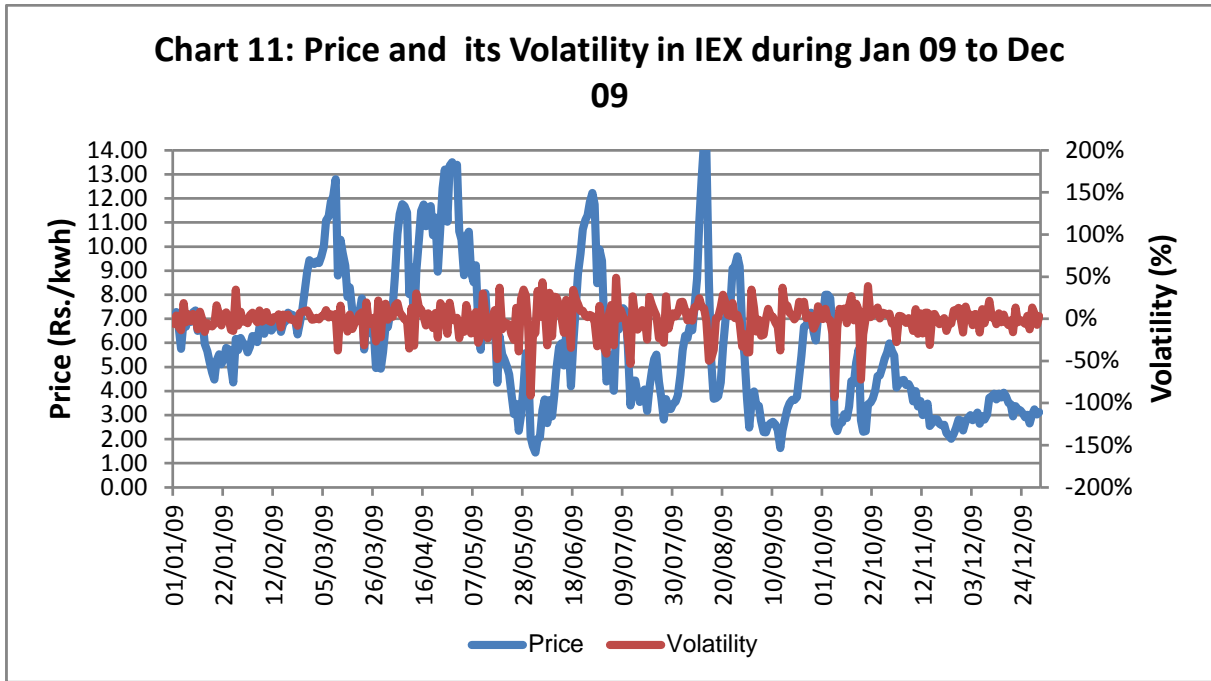


3.2 Price of Short-term transactions of Electricity

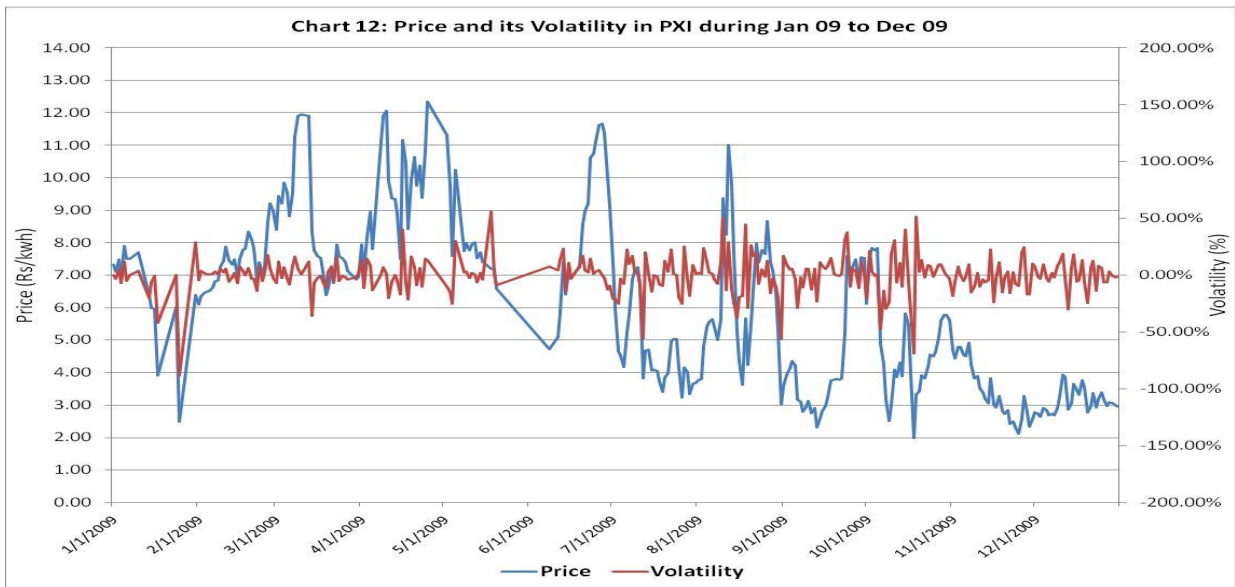
Trends in daily price of short-term transactions are shown for transactions of power exchanges and UI.

3.2.1 Trends in price of electricity transacted through Power Exchanges

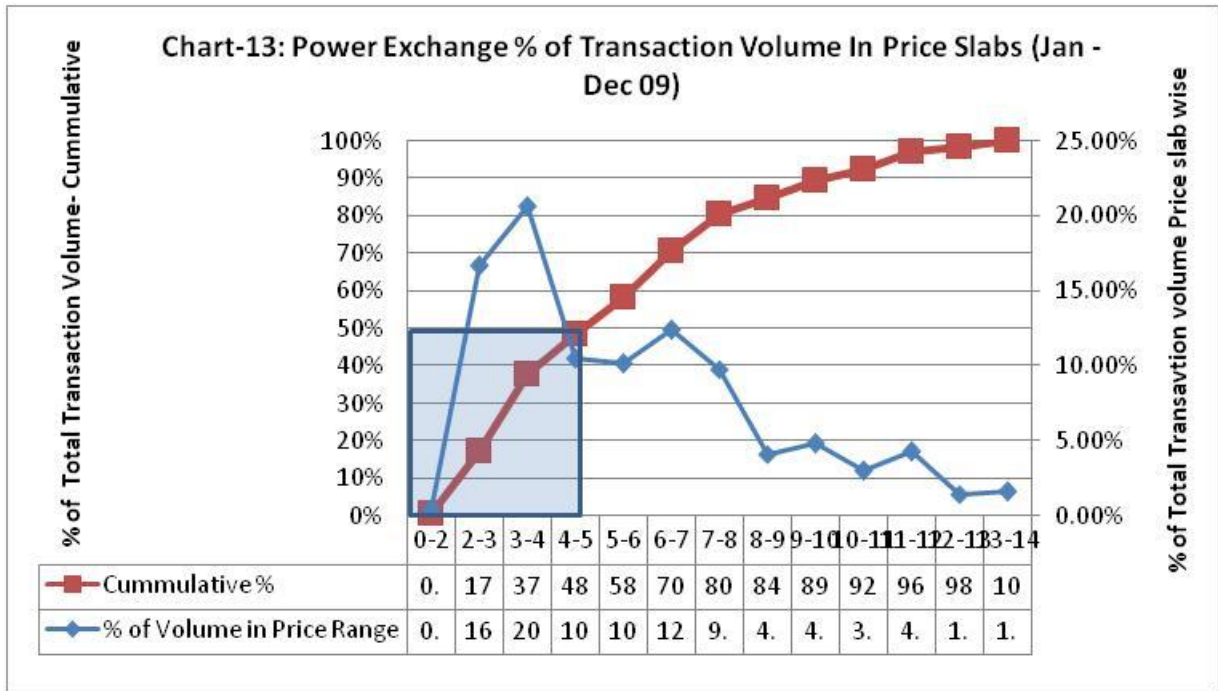
The weighted average price of electricity transacted through IEX and its volatility is shown in Chart-11. Volatility in the Price of electricity transacted through IEX has been computed using daily data for the year 2009 and it was 18%. (See Annexure-II for historic volatility formula).



The weighted average price of electricity transacted through PXI and its volatility is shown in Chart 12. Volatility in the Price of electricity transacted through PXI has been computed using daily data for the year 2009 and it was 16%.

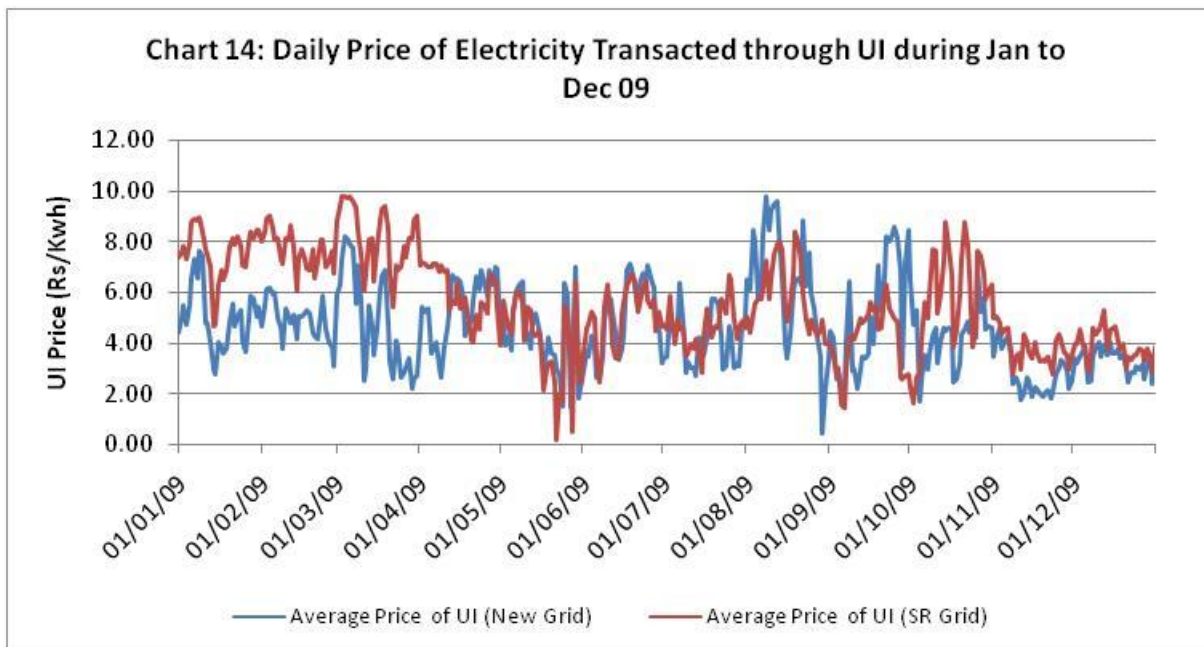


Cumulative volume and price of two power exchanges in 2009 is depicted in the following chart (Chart-13). The chart shows that 50% of the volume of electricity in the two power exchanges has been transacted at the price less than Rs.5/kWh.



3.2.2 Trends in price of electricity transacted through UI

Trends in daily price of electricity transacted through UI, i.e. in the New Grid and SR Grid, are shown in Chart14.



It is observed from the above chart that there was divergence in the price of UI in the NEW Grid and SR Grid in the initial four months and that there was convergence in the price of UI in the rest of the months. It is also observed that there was a falling trend in the price of UI during the year 2009.

4. Emergence of open access industrial sector consumers on power exchanges

One significant development during the year is the beginning of the process of procurement of power by the industrial sector consumers through power exchanges. Although such beginning has been made only at the Indian Energy Exchange Limited (IEX), it is observed that, as of end December 2009, more than twenty industrial sector consumers were procuring part of their power requirements through IEX. These consumers were mostly located in Punjab, Rajasthan, and Tamil Nadu and were having units engaged in manufacture of textile, including yarn, auto ancillary products, cement, steel and chemicals. During the year, these industrial sector consumers procured a total of about 154.4 million kWh of electricity through the power exchange at a weighted average price of Rs. 2.51 per kWh.

5. Major Sellers and Buyers of Electricity through Licensed Traders and Power Exchanges

Table 7 and Table 8 below show top 10 sellers and buyers of electricity through trading licensees. Table 9 and Table 10 show the same data with respect to power exchanges. It is seen that dominant sellers at both, the power exchanges and through licensed traders, are a mixed group comprising of independent power producers, distribution companies, state government agencies/bodies, and captive power plants. The major buyers through trading licensees and at power exchanges are mostly Northern and Southern region distribution companies and state electricity boards from Rajasthan, Haryana, Punjab, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, and Karnataka. In the State of Maharashtra, the state owned electricity distribution company – MSEDCL and a private sector distribution company – Reliance Infrastructure Limited, are major buyers through power exchanges as well as through trading licensees.

Table-7: Major Sellers of Electricity through Trading Licensees			
S.No	Seller	Volume Sold (MUs)	Approximate Percentage of Total Volume transacted Through Trading Licensees
1	Jindal Power Limited (Chhattisgarh)	2987	12.90%
2	Govt. of Himachal Pradesh	2845	12.30%
3	JSW Energy Limited, Karnataka	2328	10.10%
4	State Power Development Corporation (J&K)	1160	5.00%
5	Nav Bharat Ventures Limited (NBVL) - AP & Orissa	1151	5.00%
6	West Bengal State DISCOM	988	4.30%
7	Chhattisgarh State Power Distribution Company Limited	844	3.70%
8	Chhattisgarh State Power Trading Corporation Limited	653	2.70%
9	Gujarat Urja Vikas Nigam Limited (GUVNL), Gujarat	609	2.40%
10	Bharat Aluminium Company Limited (BALCO), Chhattisgarh	542	2.30%

Note: Volume sold by major sellers and total volume transacted through trading licensees do not include the volume through banking arrangement

Table-8: Major Buyers of Electricity through Licensed Traders			
S.No	Seller	Volume Bought (MUs)	Approximate Percentage of Total Volume transacted Through Trading Licensees
1	Haryana Power Procurement Centre (HPPC), Haryana	3059	13.20%
2	Rajasthan Power Procurement Centre (RPPC), Rajasthan	2629	11.40%
3	Punjab State Electricity Board (PSEB), Punjab	2440	10.60%
4	Jaipur Vidyut Vitaran Nigam Limited (JVVNL), Rajasthan	2363	10.20%
5	Andhra Pradesh Power Coordination Committee (APPCC), Andhra Pradesh	1932	8.40%
6	Maharashtra State Electricity Distribution Company Limited (MSEDCL), Maharashtra	1411	6.10%
7	Tamil Nadu Electricity Board (TNEB), Tamil Nadu	1360	5.90%
8	Reliance Infrastructure Limited (RInfra), Maharashtra	1229	5.30%
9	Himachal Pradesh State Electricity Board (HPSEB), Himachal Pradesh	904	3.90%
10	BESCOM, Karnataka	856	3.70%

Note: Volume bought by major buyers and total volume transacted through trading licensees do not include the volume through banking arrangement

Table-9: Major Sellers of Electricity through Power Exchanges			
S.No	Seller	Sale Volume (MUs)	Percentage of the Total volume Transacted
1	Gujarat Urja Vikas Nigam Limited, Gujarat	705	12.20%
2	JSWEL- JSW Energy Limited, Karnataka	636	11.00%
3	Chhattisgarh State Electricity Board/Chhattisgarh State Electricity Distribution Company Limited, Chhattisgarh	586	10.10%
4	Jindal Power Limited (Chhattisgarh)	505	8.70%
5	West Bengal State Electricity Distribution Company Limited, West Bengal	322	5.60%
6	Sikkim Government.	214	3.70%
7	BSES Yamuna Power Limited (BYPL), Delhi	181	3.10%
8	Haryana Power Purchase Centre (HPPC), Haryana	163	2.80%
9	Himachal Pradesh State Electricity Board (HPSEB), Himachal Pradesh	140	2.40%
10	Bharat Aluminium Company Limited, Chhattisgarh	129.3	2.20%
Note: Total Volume through Power Exchanges was About 5.793 billion units			

Table-10: Major Buyers of Electricity through Power Exchanges			
S.No	Seller	Buy Volume (MUs)	Percentage of the Total volume Transacted
1	Jaipur Vidyut Vitaran Nigam Limited (JVVNL), Rajasthan	1613	27.80%
2	Central Power Distribution Company of Andhra Pradesh (APCPDCL)	739	12.80%
3	Tamil Nadu Electricity Board (TNEB)	513	8.90%
4	Tamil Nadu	448	7.70%
5	Uttar Pradesh Power Corporation Limited (UPPCL), Uttar Pradesh	362	6.20%
6	Maharashtra State Electricity Distribution Company Limited (MSEDCL), Maharashtra	349	6.00%
7	Kerala State Electricity Board (KSEB), Kerala	282	4.90%
8	Haryana Power Purchase Centre (HPPC), Haryana	275	4.70%
9	Reliance Infra/Reliance Energy	251	4.30%
10	Administration of Dadra, Nagar & Haveli	174	3.00%
Note: Total Volume through Power Exchanges was About 5.793 billion units			

6. Effect of congestion on Volume Transacted through Power Exchanges

The volume of electricity transacted/sold through power exchanges is sometimes constrained due to transmission congestion. During the year 2009, whereas the value of unconstrained cleared volume on the two power exchanges was of the order of 6.78 billion kWh, the actual volume transacted was about 5.79 billion kWh, indicating that the actual transacted volume could have been about 17 percent higher had there been no congestion present in the system.

7. Comparison of short term prices with Tariffs of long term sources of power for various distribution companies

It is seen that short term market, including UI, power transacted through licensed traders, and power transacted through power exchanges met about 8 percent of the power requirement of the distribution companies in the year 2009. The balance i.e., about 92 percent of the power requirement of the distribution companies in the country was met from power procured under long term contracts from state and central government owned power generating companies and independent power producers. The central government power generating companies in 2009, accounted for about 42.4 percent of the total power generation in the country. From the data presented earlier, it is seen that during the year 2009, the weighted average cost of electricity procured through different segments of short term power market was as follows:

Description	Price (Rs/kWh)
Weighted average price of power procured through Power exchanges	5.73
Weighted average price of power procured through Traders	6.41
Weighted average price of power procured through Traders and Power exchanges	6.28
Average price of power through UI	4.99
Combined weighted average price of electricity procured UI, traders, and power exchanges	5.71

The distribution companies thus paid about Rs. 6.28 for procuring one unit of electricity through short term market, if UI is excluded and about Rs. 5.71 per unit if UI is included.

As against this, the prices paid by distribution companies to procure power from central government owned generating companies (about 42.4 percent of their total requirement) for the year 2008-09 (under long term Power Purchase Agreements) are shown in Table-11 and 12. It is seen that, on an average, the distribution companies paid between Rs. 1.67 and Rs. 2.73 per kWh for procuring power from coal and lignite based stations (Table-11), between Rs. 1.45 and Rs. 3.62 per kWh for procuring power from gas/RLNG based power stations (Table-11), between Rs. 5.46 and Rs. 10.55 per kWh for liquid fuel based power stations (Table-11), and between Rs. 0.56 and Rs. 5.04 per kWh for procuring power from hydro stations (Table-12).

From Table-13, it is also seen that the levelised tariff for power long term available from ultra-mega power projects (UMPP) varies between Rs. 1.19617 per kWh (For UMPP at Sasan, Madhya Pradesh- pit head project) and Rs. 2.33296 per kWh (For UMPP at Krishnapatnam, Andhra Pradesh-imported coal based project). Similarly, from Table-14, it is seen that the levelised long term tariff for power projects bid under Case I or II varies in the range of Rs. 0.81 per kWh to Rs. 4.38 per kWh.

Table-11: Tariff of Thermal Generating Stations of NTPC, NLC and NEEPCO, 2008-09						
Sl. No.	Name of the Generating Station	Installed Capacity as on 31.3.2009	Fixed Charges	Energy Charges as in March 2009	Total	Weighted Average Cost of Generation
	Units	MW	paise/kWh	paise/kWh	paise/kWh	paise/kWh
I. Coal Based thermal generating Stations of NTPC						
A.	Pit head Generation Stations					
1	Rihand STPS St-I	1000	54	140	194	167
2	Rihand STPS St-II	1000	81	147	228	
3	Singrauli STPS	2000	27	105	132	
4	Vindhyachal STPS St-I	1260	38	142	179	
5	Vindhyachal STPS St-II	1000	62	137	199	
6	Vindhyachal STPS St-III	1000	94	137	230	
7	Korba STPS	2100	31	64	95	
8	Ramagundam STPS ST-I&II	2100	35	174	209	
9	Ramagundam STPS ST-III	500	91	115	205	
10	Talcher TPS	460	69	105	174	
11	Talcher STPS ST-I	1000	61	128	189	
12	Talcher STPS ST-II	2000	67	128	195	
13	Sipat STPs-II	1000	100	74	174	
	Sub-Total	16420				
B.	Non-Pit head Generating Stations					
1	FGUTPP TPS St-I	420	53	162	215	273
2	FGUTPP TPS St-II	420	66	164	230	
3	FGUTPP TPS St-III	210	111	165	275	
4	NCTP Dadri	840	60	220	279	
5	Farrakka STPS	1600	50	257	307	
6	Tanda TPS	440	64	249	313	
7	Badarpur TPS	705	49	228	277	
8	Kahalgaon STPS	840	59	216	276	
9	Kahalgaon STPS -III	1000	80	193	273	
10	Simhadri	1000	72	162	234	
	Sub- Total	7475				
	Total Coal	23895				200
II. Lignite Based thermal generating Stations of NLC						
1	TPS-I	600	46	141	182	182
2	TPS-II Stage -I	630	33	134	167	
3	TPS-I Stage - II	840	35	134	169	
4	TPS-I (Expansion)	420	103	129	232	
	Total	2490				
III Gas/ Liquid Fuel Based Stations of NTPC						
A.	Using natural Gas/RLNG as Fuel					
1	Dadri CCGT	830	33	146	179	237
2	Faridabad	431	65	121	186	
3	Anta CCGT	419	32	113	145	
4	Auraiya GPS	663	30	148	178	
5	Gandhar GPS	657	82	280	362	
6	Kawas GPS	656	59	279	338	
	Total	3657				
B.	Using Liquid Fuel (Naphtha/HSD) as Fuel					
1	Dadri CCGT	830	33	684	717	771
2	Faridabad	431	65	550	615	
3	Anta CCGT	419	32	897	929	
4	Auraiya GPS	663	30	1025	1055	
5	Kayamkulam CCGT	360	79	467	546	
6	Kawas GPS	656	59	619	678	
	Total	3359				

IV. Gas /Liquid Fuel Based Stations of NEEPCO						
1	Agartala GPS	84	90	98	189	181
2	Assam GPS	291	118	61	179	
	Total	375				
Notes:						
	1. Normative PLF of 80 % considered for NTPC STATIONS.					
	2. Normative PLF of 75 % considered for NLC STATIONS.					

Table-12: Composite Tariff of Hydro Stations under the purview of CERC				
Generating company	Station	Installed Capacity (MW)	AFC for 2008-09 (Rs.Lakhs)	Composite Tariff (Rs/kWh)
NHPC				
1	Chamera –I	540	19953	1.38
2	Baira siul	180	5271	0.77
3	Loktak	105	5004	1.28
4	Chamera-II	300	34737	2.66
5	Rangit	60	4860	1.59
6	Dhauliganga	280	17638	1.79
7	Teesta-V *	510	36300	1.62
8	Dulhasti*	390	83600	5.04
9	Salal	690	17674	0.66
10	Uri	480	27426	1.22
11	Tanakpur	94	4682	1.19
NHDC				
1	Indira Sagar	1000	47784	2.44
2	Omkareshwar*	520	26327	2.28
THDC				
1	Tehri stage-I*	1000	110826	3.5
SJVNL				
1	Naptha Jhakri	1500	131243	2.16
NEEPCO				
1	Kopili Stg.I	200	5767	0.56
2	Khandong	50	1963	0.81
3	Kopili Stage-II	25	1295	1.72
4	Doyang	75	5850	2.95
5	Ranganadi	405	20341	1.55
(*) Figure provisional as petition for approval of final tariff is yet to be filed by the generating company				

Table-13: Levelised Tariff for Procurement of Electricity through Competitive Bidding Under Case II (UMPPs)

Sr No	Name of the Project	Name of the State	Project awarded to	PPAs with states	Capacity (MW)	Fuel	Levelised Tariff (Rs/KWh)	LOI Issued
1	Mundra UMPP	Gujarat	Tata Power Company Ltd	Gujarat (1805 MW), Maharashtra (760 MW), Punjab (475 MW), Haryana (380 MW) and Rajasthan (380 MW)	3800	Imported Coal	2.26	28.12.2006
2	Sasan UMPP	Madhya Pradesh	Reliance Power Ltd	Madhya Pradesh (1500 MW), Punjab (600 MW), Uttar Pradesh (500 MW), Haryana (450 MW), Delhi (450 MW), Rajasthan (400 MW) and Uttarakhand (100 MW)	4000	Domestic Coal	1.20	01.8.2007
3	Krishnapatnam UMPP	Andhra Pradesh	Reliance Power Ltd	Andhra Pradesh (1600 MW), Karnataka (800 MW), Tamilnadu (800 MW) and Maharashtra (800 MW).	4000	Imported Coal	2.33	30.11.2007
4	Tilaiya UMPP	Jharkhand	Reliance Power Ltd	Jharkhand (1000 MW), Uttar Pradesh (650 MW), Bihar (500 MW), Punjab (450 MW), Gujarat (300 MW), Maharashtra (300 MW), Rajasthan (250 MW), Madhya Pradesh (200 MW), Haryana (200 MW) and Delhi (150 MW).	4000	Domestic Coal	1.77	Feb 2009

Table-14: Status of Case-I and Case-II Bidding in States (adopted tariff)

Sl. No	State	Type	Seller/Project Name	Procurer	Capacity (MW)	Fuel Type	Levelised Tariff (Rs/kWh)*
1	Assam	Case-II	Bordikarai Small Hydro Electric Project	Assam Power Distribution Company Ltd.	4.70	Hydro Electric Project	2.730
			Municipal Solid Waste Based Power Project	Assam Power Distribution Company Ltd.	6.00	Municipal Solid Waste	4.380
2	Chhattisgarh	Case-II	Indiabulls CSEB Bhaiyathan Power Ltd.	Chhattisgarh State Electricity Board	858.00	Coal	0.810
3	Delhi	Case-II	Sasan Power Ltd. (UMPP)	BSES Rajdhani Power Ltd.	196.11	Coal	1.196
		Case-II	Tilaiya Power Ltd. (UMPP)		64.00	Coal	1.770
		Case-II	Sasan Power Ltd. (UMPP)	BSES Yamuna Power Ltd.	122.58	Coal	1.196
		Case-II	Tilaiya Power Ltd. (UMPP)		44.00	Coal	1.770
4	Gujarat	Case-I	Adani Enterprises Ltd.	Gujarat Urja Vikas Nigam Ltd.	1000.00	Coal / Lignite	2.890
			Aryan Coal Beneficiaries Pvt. Ltd.	Gujarat Urja Vikas Nigam Ltd.	200.00	Unspecified	2.250
			Adani Power Pvt. Ltd.	Gujarat Urja Vikas Nigam Ltd.	1000.00		2.350
			Essar Power Ltd.	Gujarat Urja Vikas Nigam Ltd.	1000.00	Imported Coal	2.401
5	Haryana	Case-I	Mundra TPS, Phase-IV, Gujarat (for Adani Power Ltd.)	Haryana Power Purchase Centre	1424.00	Coal	2.940
			Kamalang Thermal Power Project, Orissa (for PTC India Ltd. - GMR Project)	Haryana Power Purchase Centre	300.00	Coal	2.860
		Case-II	Mahatma Gandhi Super Thermal Power Plant, Jhajjar	Haryana Power Purchase Centre	1320.00	Coal	2.996
6	Madhya Pradesh	Case-II	Sasan UMPP	MP Power Trading Company Ltd	1500.00	Coal	1.190
			Jharkhand Integrated Power Ltd. Tilaiya (UMPP) Jharkhand	MP Power Trading Company Ltd	200.00	Coal	1.770
7	Punjab	Case-II	Talwandi Sabo Power Limited	Erstwhile, PSEB	1800 +10%	Coal	2.864

*Rounded off up to three decimal points.

Source: Forum of Regulators.

Annexure-I

List of Trading Licensees as on 31.12.2009			
Sr.No	Name of the Trading Licensee	License issued dated	Present Category of License
1	Lanco Electric Utility Ltd	23.07.2004	I
2	Vinergy International (P) Ltd	12.07.2004	I
3	Tata Power Trading Company (P) Ltd.	09.06.2004	I
4	PTC India Limited	30.06.2004	I
5	DLF Power Ltd	02.11.2004	III
6	Adani Enterprises Ltd	09.06.2004	I
7	Reliance Energy Trading (P) Ltd	30.06.2004	I
8	NTPC Vidyut Vyapar Nigam Ltd	23.07.2004	I
9	Karam Chand Thapar & Bros Ltd	27.01.2005	I
10	Subhash Kabini Power Corporation Ltd	26.05.2005	III
11	Maheshwari Ispat Ltd	19.07.2005	III
12	Special Blasts Ltd	21.07.2005	III
13	Instinct Advertisement & Marketing Ltd	07.09.2005	III
14	Essar Electric Power Development Corporation	14.12.2005	II
15	Suryachakra Power Corporation (P) Ltd	22.02.2006	III
16	JSW Power Trading Company Ltd	25.04.2006	I
17	BGR Energy Systems Ltd	07.12.2006	I
18	Visa Power Ltd	28.06.2007	III
19	Pune Power Development Pvt Ltd	21.08.2007	III
20	Patni Projects Pvt Ltd	23.08.2007	III
21	Ispat Energy Ltd	30.08.2007	III
22	Greenko Energies (P) Ltd	22.01.2008	III
23	Vandana Global Ltd	20.02.2008	II
24	Vandana Vidyut Ltd	03.04.2008	II
25	Indrajit Power Technology (P) Ltd	16.05.2008	II
26	Audhunic Alloys & Power Ltd	26.06.2008	I
27	Indiabulls Power Trading Ltd	12.09.2008	III
28	Indiabulls Power Generation Ltd	12.09.2008	III
29	Chhattisgarh Energy Trading Co (P) Ltd	16.09.2008	II
30	RPG Power Trading company Ltd	23.09.2008	I
31	GMR Energy Trading Ltd	14.10.2008	I
32	Jain Energy Ltd	14.10.2008	II
33	Righill Electrics Limited	11.11.2008	III
34	Shyam Indus Power Solutions (P) Ltd	11.11.2008	III
35	Global Energy Limited,	28.11.2008	I
36	Knowledge Infrastructure Systems (P) Ltd	18.12.2008	I
37	Mittal Processors (P) Ltd	12.02.2009	III
38	Godavari Power & Ispat Ltd	28.04.2009	III

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:

$$\mathbf{HHI} = \sum_{i=1}^{\mathbf{N}} \mathbf{s}_i^2$$

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, the index can range up to 10,000, if percents are used as whole numbers, as in 75 instead of 0.75. The maximum in this case is $100^2 = 10,000$.

- A HHI index below 0.01 (or 100) indicates a highly competitive index.
- A HHI index below 0.1 (or 1,000) indicates an unconcentrated index.
- A HHI index between 0.1 to 0.18 (or 1,000 to 1,800) indicates moderate concentration.
- A HHI index above 0.18 (above 1,800) indicates high concentration.

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