Introduction to Energy Exchange

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In this presentation

-Status Update on CBT

- Introduction to IEX

- Market snapshot

CROSS BORDER TRADE

GoI issues guidelines on

Cross Border trade through Exchange

- GoI has issued '*Guidelines on Cross Border Trade of Electricity*' on 5th Dec 2016.
- As per the Guidelines, ***TRADE THROUGH INDIAN POWER EXCHANGES*:**

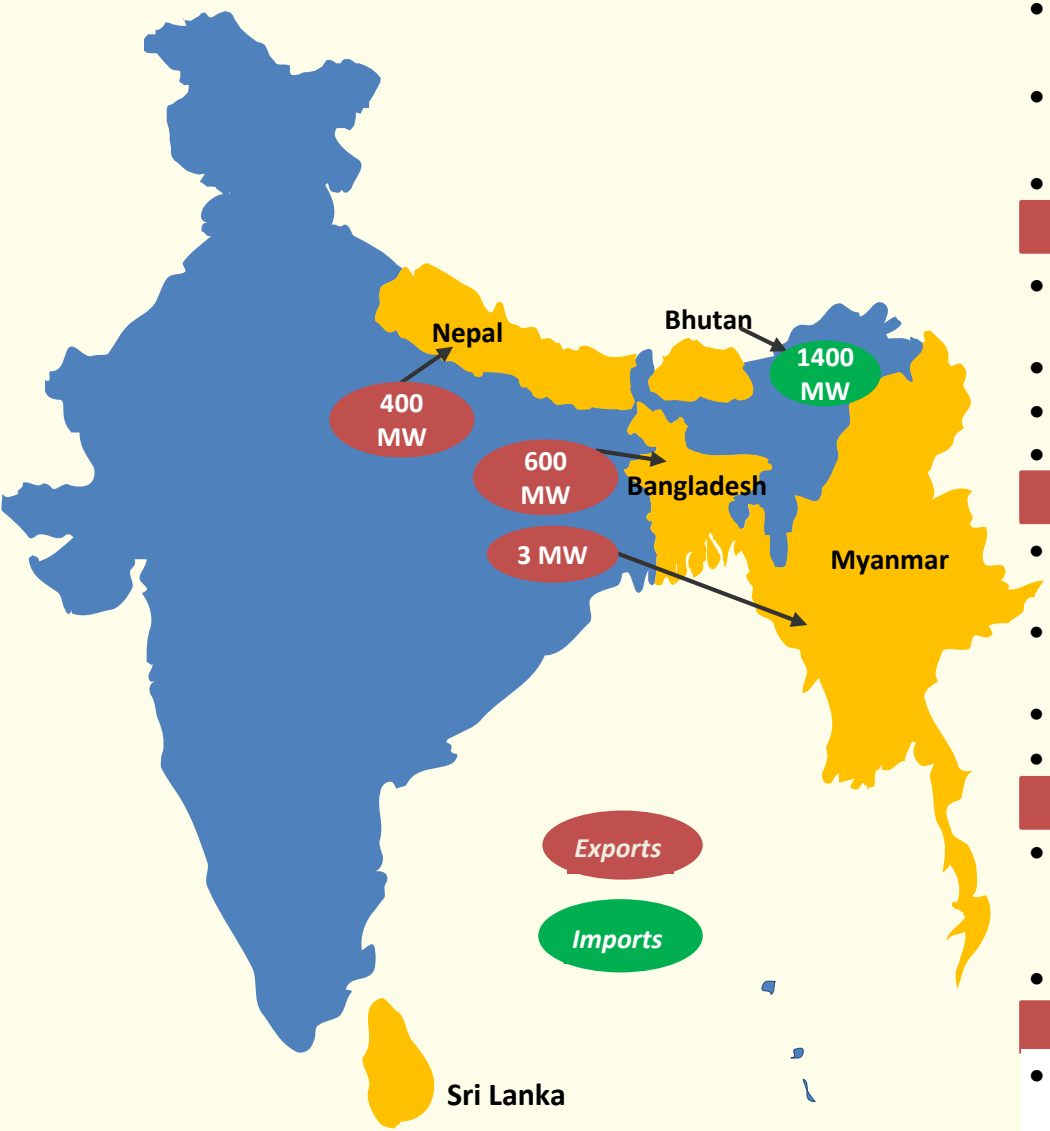
"7.1 Any Participating entity, with approval from the Designated Authority under para 5.2.1, after complying with the relevant regulations of CERC, **shall be eligible for cross border trade of electricity through Indian Power Exchanges under the categories of Term Ahead Contracts, Intra Day Contracts/ Contingency Contracts** as defined in the Power Market Regulations of CERC. Provided that other entities shall be eligible to participate in the Indian Power Exchanges through the eligible licensees under the aforesaid Regulations of CERC.

7.2 Further, the quantum of electricity that can be traded under cross border trade for electricity in Indian Power Exchanges shall be prescribed from time to time by the Designated Authority.

7.3 Cross border trade of electricity can be extended to other categories of contracts based on review by Ministry of Power in consultation with CERC."

- **Trade through Day Ahead Market has not been allowed yet**

Today: India trades ~2500 MW / ~13BUs with its neighboring countries in S Asia (Nepal, Bangladesh, Bhutan)



Bhutan

- Power surplus: Primarily hydro power; India purchases all surplus as per the **2006 Inter-Governmental Treaty**
- **Total imports of ~1500 MW or 5.6 BU**s; existing **1500 MW transmission capacity**
- **Seasonal generation**, concentrated in **May-Sept.** period

Bangladesh

- Power deficit: Peak demand of ~13 GW and capacity of ~12 GW however, effective capacity of ~9GW (lack of gas)
- **India exports 600 MW or 5.3 BUs**, to meet B'desh's deficit
- **600 MW** transmission capacity**; expected to double** in 5 years
- **Power deficit situation to continue for next 10 years**

Nepal

- Power Deficit: Instances of blackouts during dry seasons; expected to be surplus during monsoon in 5 years
- India financed hydro projects currently stuck owing to land-acquisition challenges
- **India exports 400MW** or 1.8 BUs
- Transmission capacity to be **expanded to 1000 MW** (400 MW now)

Myanmar

- Power surplus: Internal demand is low due to **poor grid connectivity within Myanmar** – only 35% households connected to their main grid
- **India exports 3 MW** or 0.03 BUs; no inter-regional transmission

Sri Lanka

- Power sufficient, though costs are high due to expensive oil imports
- **No power trade currently** given **lack of transmission capacity**;
- 500 MW transmission capacity to come up by ~2030

Cross Border trade through Exchange

- Globally, countries have harnessed the resources by integration of power markets to harness greater system reliability, optimization of investments and optimum utilization of resources across border.

- Most **countries achieved efficient utilization of cross border transmission capacity and linking of the electricity markets of the neighboring companies through the Day Ahead Markets.**

- **European Union (EU) established a single electricity market through Day Ahead Market across 28 countries. Similarly, South African Power pool (SAPP) integrated 12 countries to form a common market offering Day-ahead contracts.**

- In the recent cross border trade guidelines issues by MoP, **only bilateral contracts (TAM) through Exchanges are allowed.**

- In FY 16-17, in Day Ahead Market, sale bids of 77 BUs were received against purchase bids of 48 BUs. The market had a surplus of about 30 BUs in the year ie. 80 MUs/Day which is equivalent to about 3400 MW on an average day.

- Cross Border transactions is expected to be much less compared to the surplus power in DAM. Therefore allowing cross border transaction cannot have any adverse impact on Indian markets.

Why harness the Power Exchange markets for regional trade?

- **Better resource optimization**
  - Can use the inherent margins in transmission to transact power
- **Management of daily demand variations**
  - Daily demand variations and Peak requirements can be managed optimally through Day-Ahead Transactions.
- **Competitive, transparent and neutral market**
- **Liquid, diversified market**
- **Standardized contracts, competitive prices** through market determined prices (no need for negotiations)

INDIAN ENERGY EXCHANGE

Understanding the Exchange

A Neutral Platform

- Provides the necessary **electronic trading platform** and associated infrastructure to facilitate buying and selling of electricity by the participants.
- The Exchange in **no way influences the price determination process**, which is dependent on the offers and bids placed by the market participants i.e., the sellers and buyers.
- **Participating members cannot have more than 5% stake in the Exchange**

Voluntary Participation

- In India, the participation in any of the markets – bilateral or the Power Exchanges is purely voluntary.

Competition and Anonymity is maintained

- Trading on Exchanges is a **non-cooperative game**. Both the sellers and the buyers place bids on the electronic platform **independent of each other** and compete in the market.

Understanding the Exchange

Regulatory Oversight

- In India, Power Exchange is **under the Regulatory oversight of CERC.**

Risk Mitigation

- The exchange **acts as the counterparty in the trade** and absolves the participants of any risk of payment defaults.

Standardized Contracts

- The contracts traded on the Power Exchange are standardized contracts, **terms and conditions of which are well known upfront to all the market players.**

Operates on inherent transmission margins

- Delivery of the trades discovered on the Power Exchanges is facilitated by the System Operator **utilizing the spare margins available on the transmission system**. These **margins are declared and made public upfront transparently on the websites of the System Operator**.

Exchange: A Competitive 'Market'

- Exchanges provide a **transparent, competitive and efficient platform** for transactions in any market – Stock or commodity. Same is true for power sector.
- The concept of Exchanges in Power Sector was initially **introduced in 1990-91 in Europe.**
- **Now, worldwide Power Exchanges are operating in almost 40 countries**.
- Power Exchanges are **most preferred option for sale and purchase of Power**.
- In India, **after Electricity Act, 2003 market framework for Exchange operations was put in place.**
- Exchanges in India started operations from 2008.

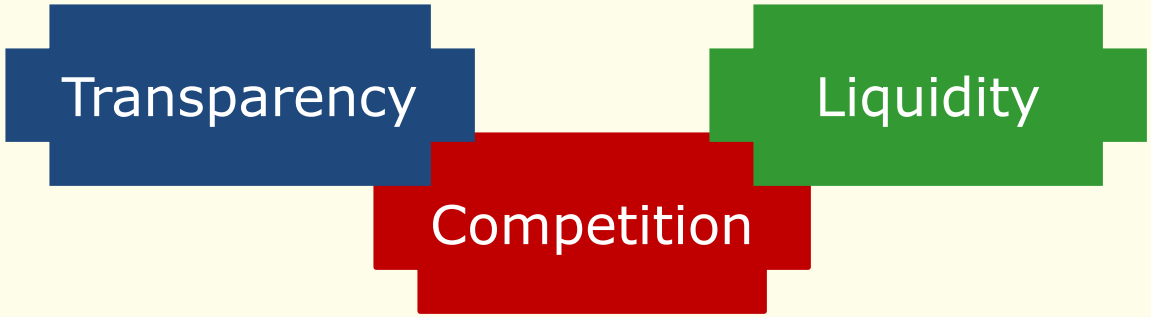
Company Snapshot

96% Market Share **~ 5000 MW** average daily trade

5800+ Participants

3800+ Industries **70+** Commercial **50+** Discoms

400+ Conventional Generators **1500+** RE Participants



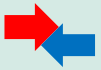
IEX Market Segments

Day-Ahead Market
since June,08

- *Delivery for next day*
- *Price discovery: Closed , Double-sided Auction*

Intraday Market & Day-Ahead Contingency
Round the clock since Jul'15

- *Intraday: For Delivery within the same day*
- *Day Ahead Contingency: Another window for next day*
- *Gate closure : 3 hours*



Term-Ahead Contracts
since Sep,09

- *For delivery up to 11 days*
  - *Daily contracts*
  - *Weekly Contracts*

Renewable Energy Certificates
since Feb,11

- ***Green Attributes as Certificates***
- ***Sellers :*** *RE generators not under feed in tariffs*
- ***Buyers:*** *Obligated entities; 1MWh equivalent to 1 REC*

Energy Saving Certificates

Expected soon

Auction

Continuous

Trading Mechanism

Understanding exchange mechanism

Key Functions

Trading

- ✓ Bid accumulation
- ✓ Calculation of Provisional result
- ✓ Publishing provisional results
- ✓ Calculation of Final result (with technical constraints)
- ✓ Publishing final results
- ✓ Publishing Daily Obligation reports

Surveillance

- ✓ Round the clock
- ✓ Checking of Collateral
- ✓ Checking of Permissible Quantity as per NoC & Margins
- ✓ Deviation from Bidding Pattern
- ✓ Daily MIS reporting
- ✓ Real time support to members

Clearing

- ✓ Pre-Trade Margin Check
- ✓ Post Trade Margin Call
- ✓ Daily Obligation settlement
  - ✓ Pay In
  - ✓ Pay Outs
- ✓ Risk Management
- ✓ Bank Reconciliation of Settlements Accounts
- ✓ Daily NLDC/SLDC charges Payment

Delivery

- ✓ Update NoC
- ✓ Calculation of transmission capacity requirement between various points based on market clearing volume
- ✓ Interaction with NLDC for transmission capacity availability
- ✓ Market splitting in case of transmission congestion
- ✓ Delivery schedule for every portfolio
- ✓ Scheduling with SLDCs
- ✓ Member communication for schedule and trade related reports
- ✓ Monthly and weekly reporting to various organizations such as CERC & S/O
- ✓ Monthly REA data verification
- ✓ Real Time Congestion Management

- ✓ Over 3 Lakh contracts traded
- ✓ All activities performed for 1200-1500 portfolio daily
- ✓ Precision and adherence to timelines

Features of Day Ahead Market

A closed double-sided anonymous auction for **each 15-min time block** for the following day

The intersection between the aggregated sale and purchase curves defines the market clearing price (MCP)

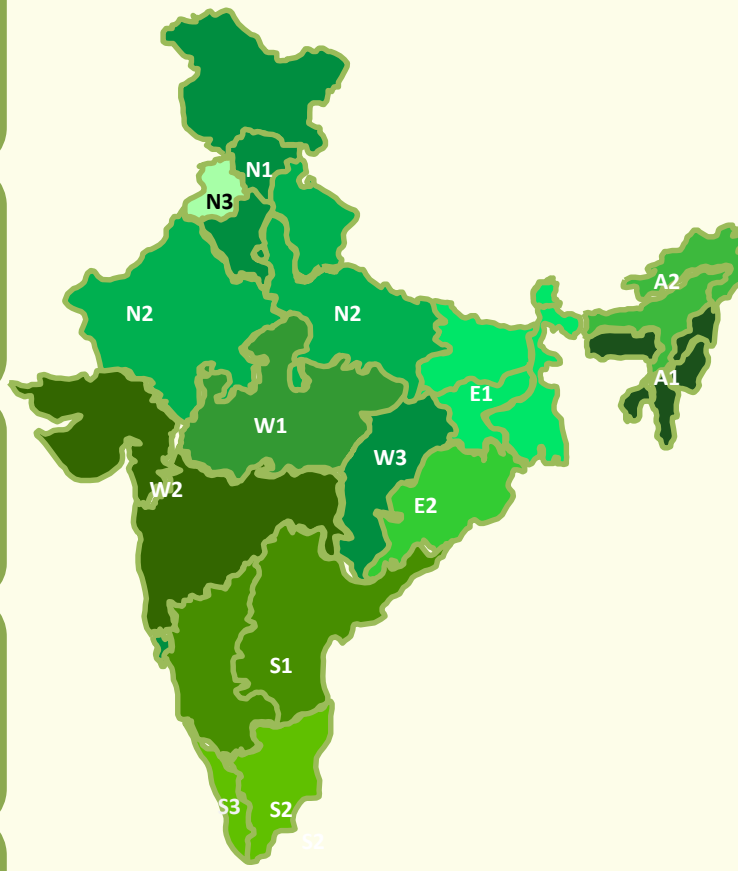
13 Bid area defined

Congestion Management through market splitting and determining Area Clearing Price (ACP) specific to an area

Bid types: Portfolio Orders or Block Orders

Minimum bid=Re.1 for 0.1MWh

Minimum Price & Volume Step = 0.1p * 0.1 MWh



13 Bid Areas

DAM trading process

Bidding

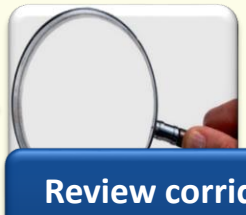
10:00 am to 12:00 pm

Bids for 15- min each or block bids can be placed

Matching

12:00 pm to 1:00 pm

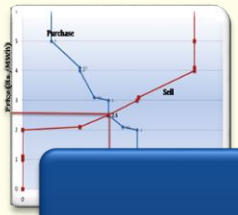
MCP &MCV calculated



Review corridor and funds availability

1:00 pm to 2:00 pm

Corridor availability from NLDC and funds verified from bank



Result

3:00 pm

Final ACV and ACP calculated. Market splitting if congestion

Confirmation

5:30 pm

Collective transaction confirmation by NLDC and Pay In

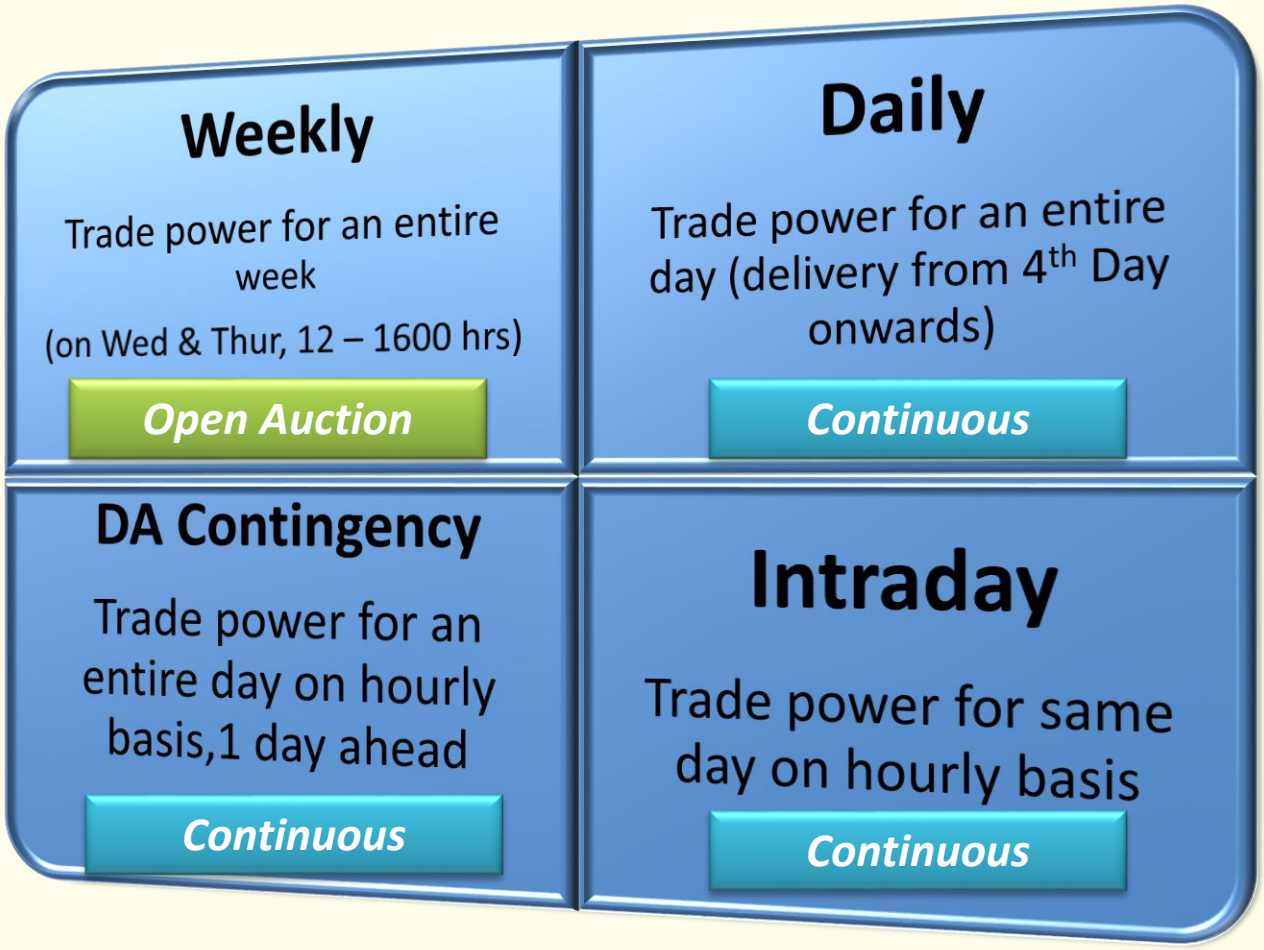
Scheduling

6:00 pm

Final Schedule sent to RLDC for incorporation

Term Ahead Market

TAM Market Segments



BID MATCHING

Open/Closed Auction

- Orders accumulated during call phase (no matching)
- Orders matched after call period
- Orders are used for calculation common price i.e. Equilibrium Price.
- All successful orders matched at Equilibrium Price.

Continuous Trading

- Price-time priority based continuous matching
- The highest Buy order & lowest Sell order gets the priority
- If the prices are same then priority is given to the time of the order received.

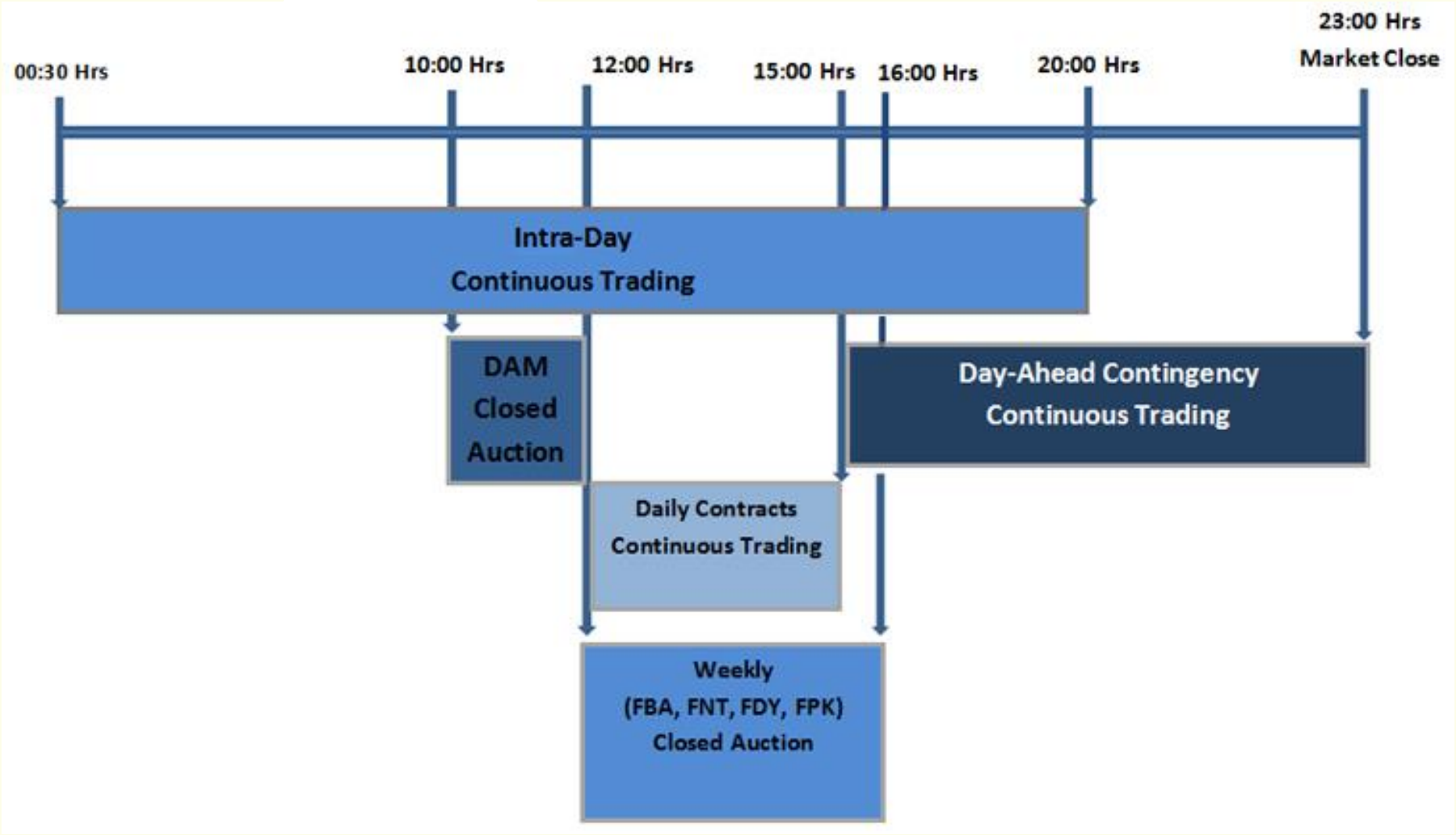
TAM Contract Characteristics

TERM AHEAD MARKET

Contract Characteristic	Day Ahead Market	Intraday Contracts	Day Ahead Contingency	Daily Contracts	Weekly Contracts
Delivery	Next day	0400-2400 Hrs same day	For next day	From 4th day to next 7 days	For next week
Auction Type	**Closed Auction**	**Continuous trading**	**Continuous trading**	**Continuous trading**	**Open Auction**
Contracts	**15 min**	Hourly	Hourly	Block of Hours (Fixed)	Block of Hours (Fixed)
Trade Availability	All Days	All days; 0030 - 2000	All Days; 1500-2300	All Days; 1200-1500	Wed & Thurs; 1200-1600
Financial Settlement	Pay-In- D-1; Pay Out – D+1	Pay in: T+1 Pay out: T+1	Pay in: T+1 Pay out: T+2	Pay-In- D-1; Pay Out – D+1	Pay-In- D-1; Pay Out – D+1

T = Trade D = Delivery

DAM and TAM Trading Timeline



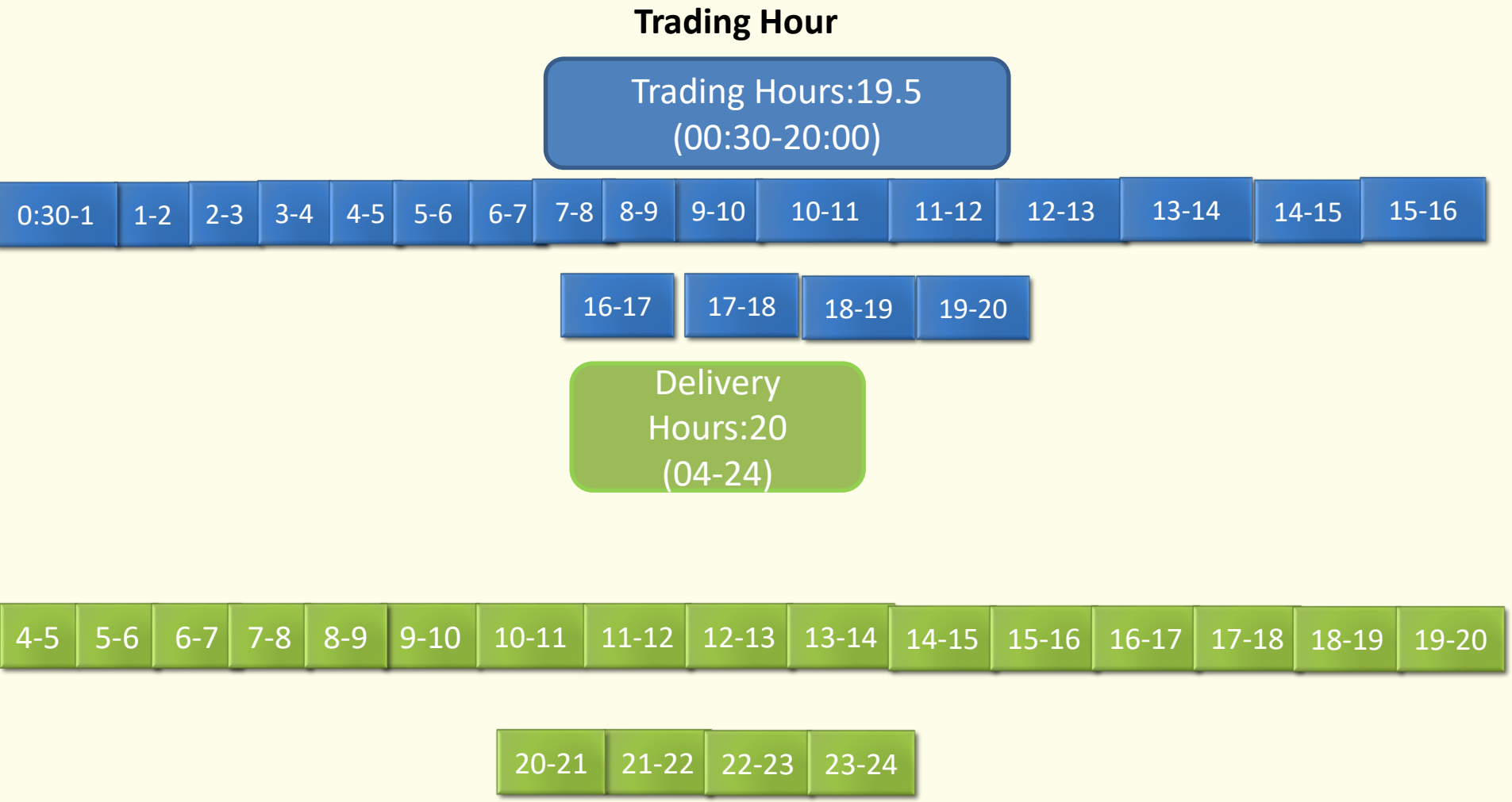
Types of Contracts

- Weekly and Daily
  - FBA -- Firm Base – 24 Hrs
  - FNT -- Firm Night – 8 Hrs (0-7 & 23-24)
  - FDY -- Firm Day – 11Hrs (7-18)
  - FPK -- Firm Peak – 5 Hrs (18-23)

- Day Ahead Contingency and Intra-Day
  - Hourly (DAC-24 hrs & Intraday-04-24)

Region Specific Contracts

Trading of Intra-day Contracts



Contracts available for delivery on the same day

Trading of Weekly & Daily Contracts

Weekly

Daily

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Bidding and Price Discovery Mechanism

Open/Closed Auction

- Orders accumulated during call phase (no matching)
- Orders matched after call period
- Orders are used for calculation common price i.e. Equilibrium Price.
- All successful orders matched at Equilibrium Price.

Continuous Trading

- Price-time priority based continuous matching
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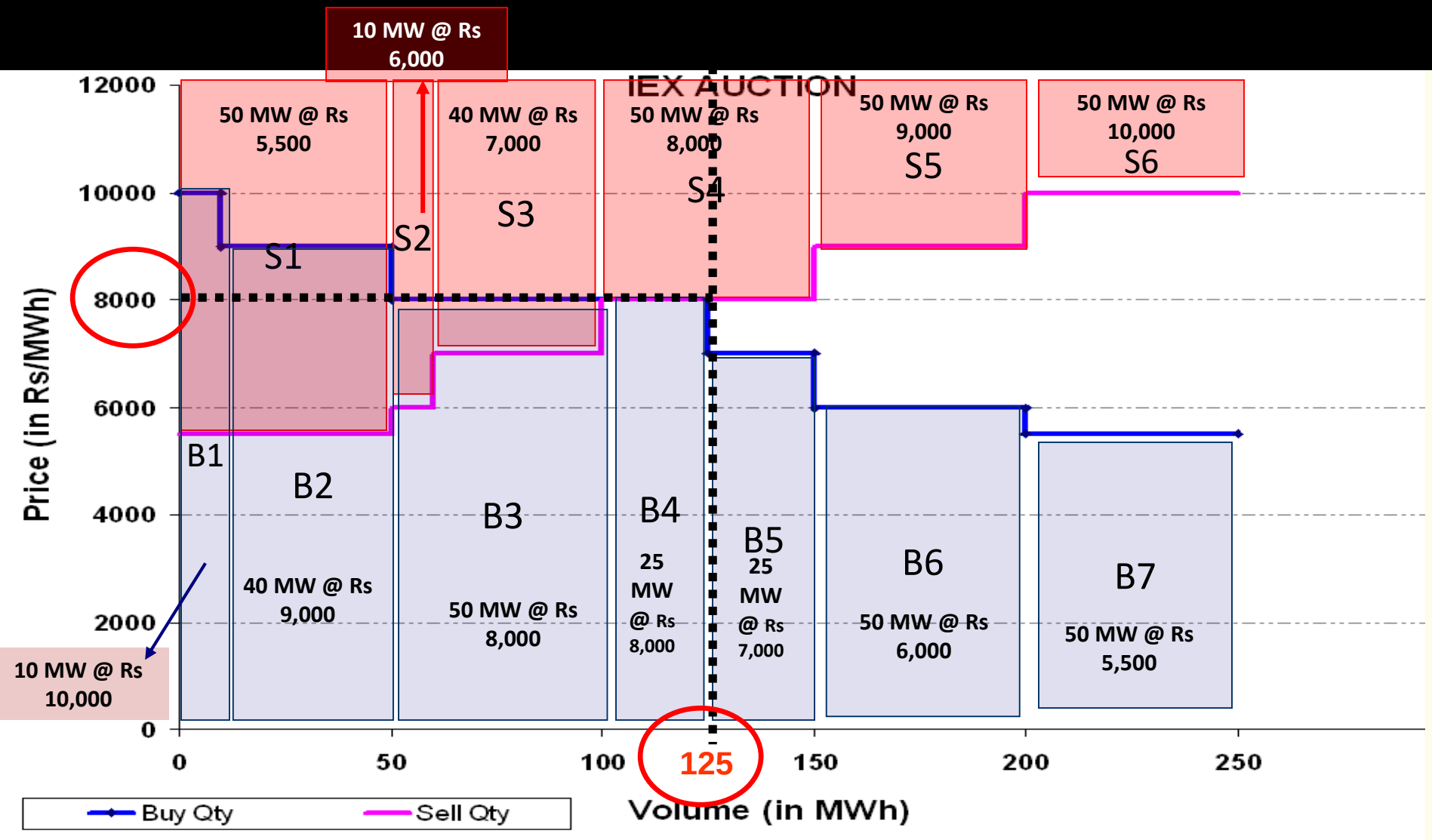
MCP :Rs 8000/MWh Volume: 125 MW



Continuous Trading

TWS Screen

Pending Buy Order

Buy 10 MW @ Rs 4500/MWh

Pending Sell Order

Sell 15 MW @ RS 5500/MWh

Trading Engine

Buy 10 MW @ RS 4500/MWh

Sell 15 MW @ RS 5500/MWh

Buy 10 MW @ Rs 4500/MWh

Sell 15 MW @ Rs 5500/MWh

TWS Screen

Pending Buy Order

Buy 10 MW @ RS 5000/MWh

Buy 10 MW @ RS 4500/MWh

Pending Sell Order

Sell 15 MW @ Rs 5500/MWh

Trading Engine

Buy 10 MW @ RS 5000/MWh

Buy 10 MW @ 5000/MWh

TWS Screen

Pending Buy Order

Buy 10 MW @ RS 4500/MWH

Buy 10 MW @ 4500

Pending Sell Order

Sell 5 MW @ Rs 5000/MWh

Trading Engine

Sell 15 MW @ Rs 5000/MWh

Trade 10 MW @ RS 5000/MWh

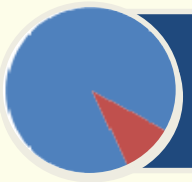
Bid Modified

Sell 15 MW @ RS 5000/MWh

Market Place Functionality (TAM)

MARKET SNAPSHOT

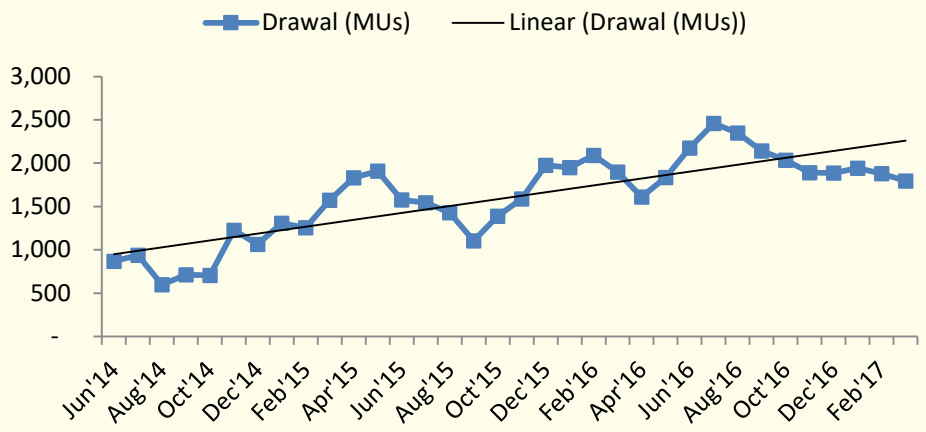
Key statistics: Electricity & REC Market

	ELECTRICITY	REC
 Market Share (FY16-17)	95%	63%
 State Utilities	29 States I 5 UTs	17 States I 5 UTs
 Generators	399	899
 Industrial Consumers	3904	2,486
 Average Daily Volume	>100,000 MWh *Highest : 172,447 MWh*	**>1 Crore RECs** **Highest: 12,87,814 RECs**

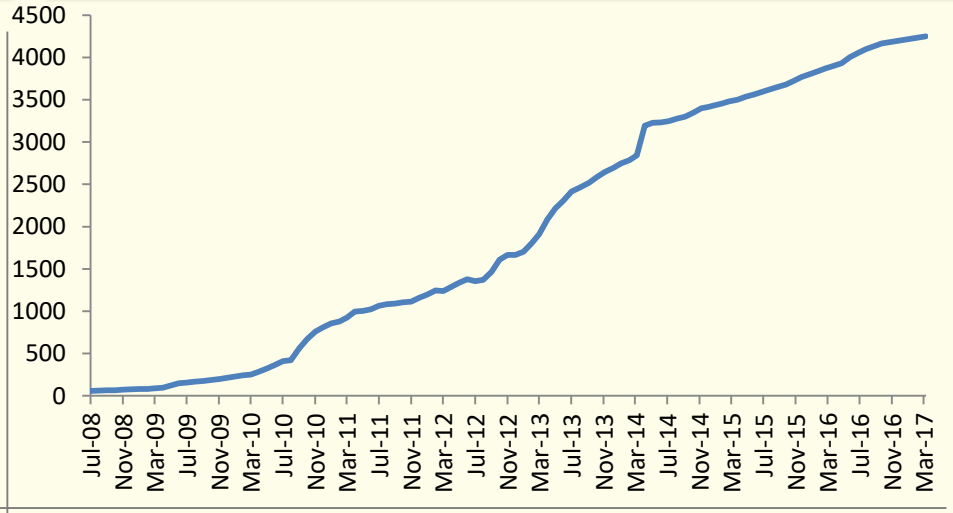
IEX Data as on 31 AUG, 2017

Strong and Growing Base of Participants

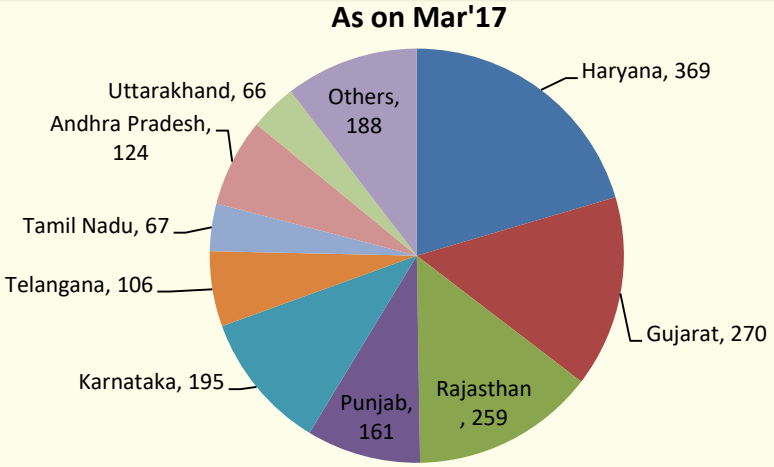
Open Access Volumes have shown rapid growth



Average registered participants has been growing

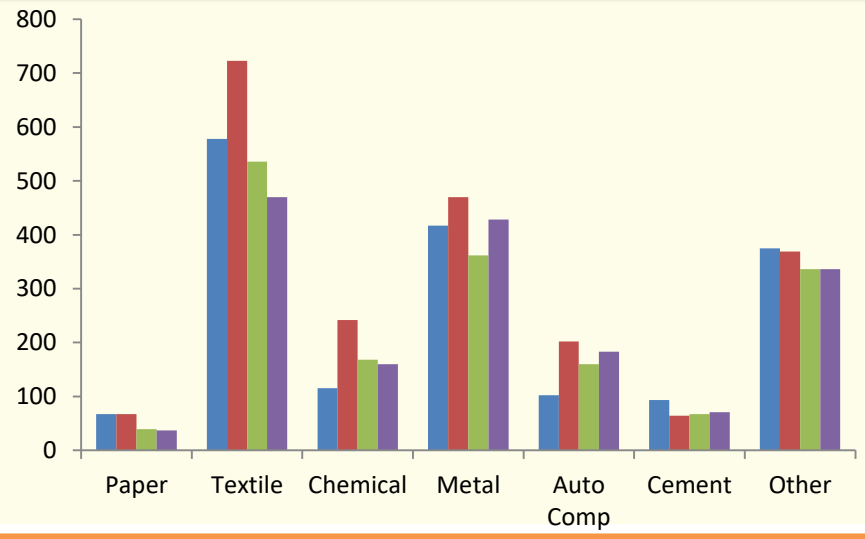


Open Access Consumers Present Across States



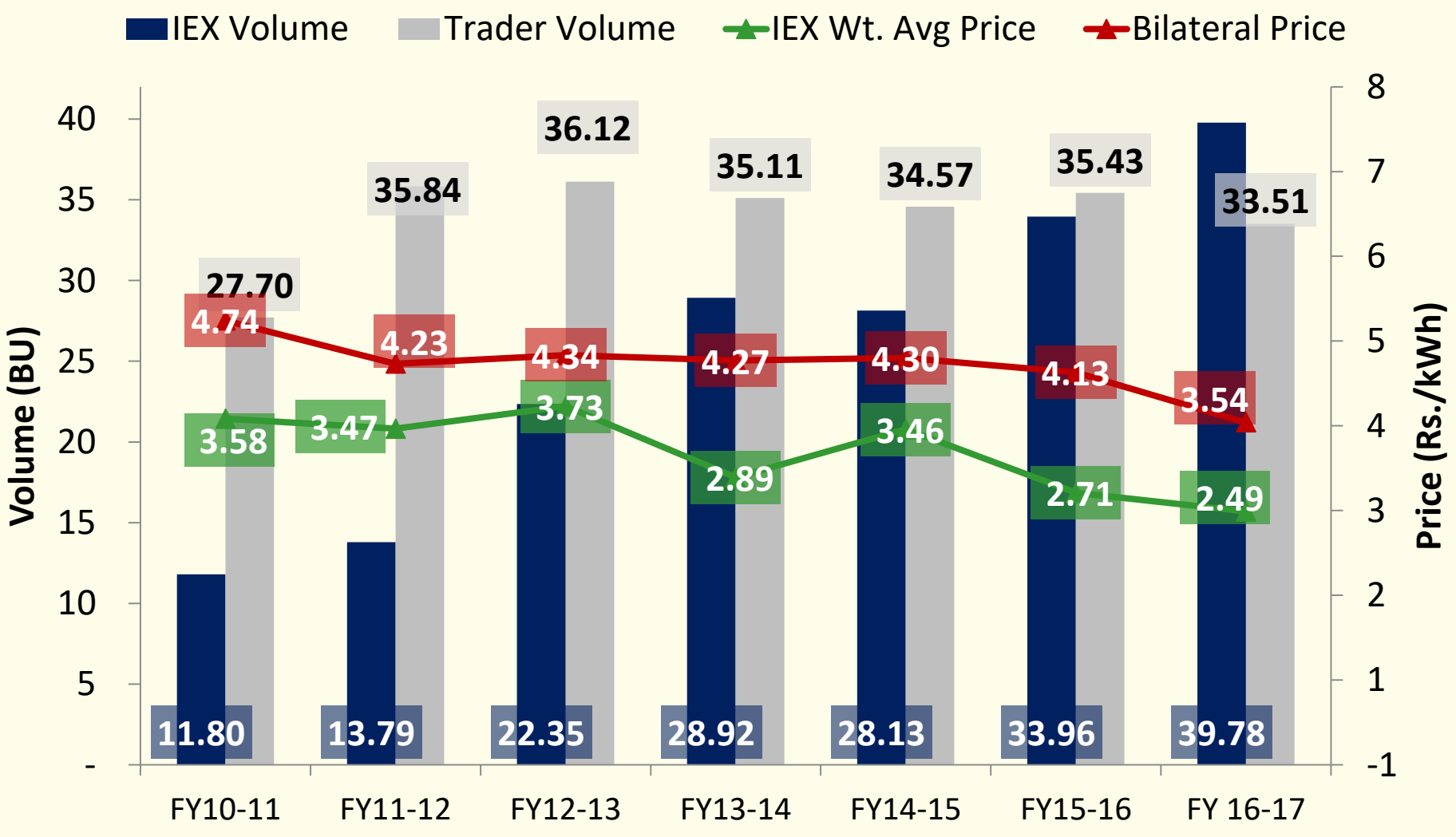
Total Open Access Consumers: 1,805 (as on Mar'17)

And Spread Across Industries (recent years)



Open Access volumes and participation has shown significant growth over the years

Price and Volume: Bilateral vs. IEX DAM

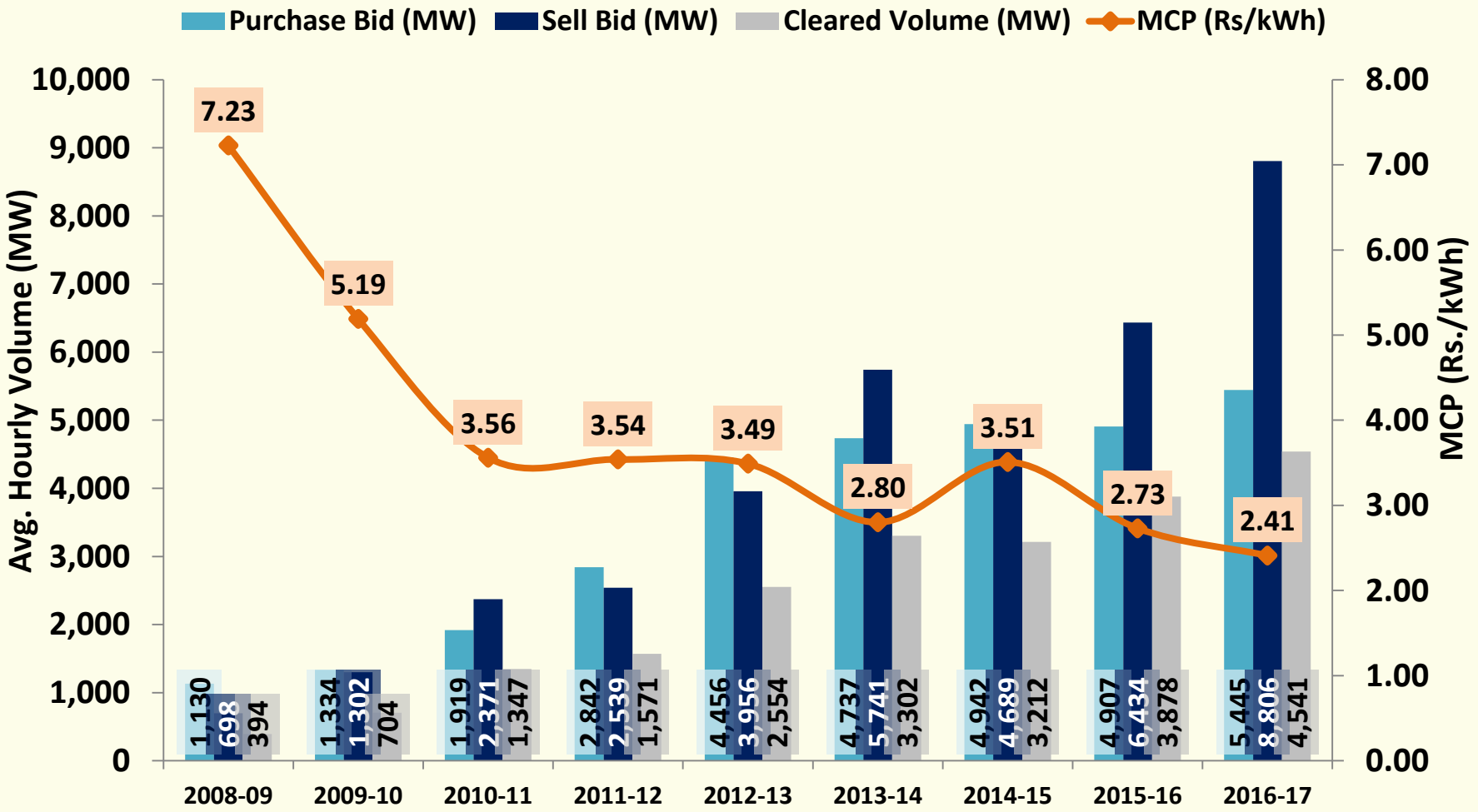


Prices at the Exchange always remained lower than Bilateral Contracts

Source: CERC MMC Reports, Data as on 31st Mar' 2017

High Liquidity in Volume at IEX

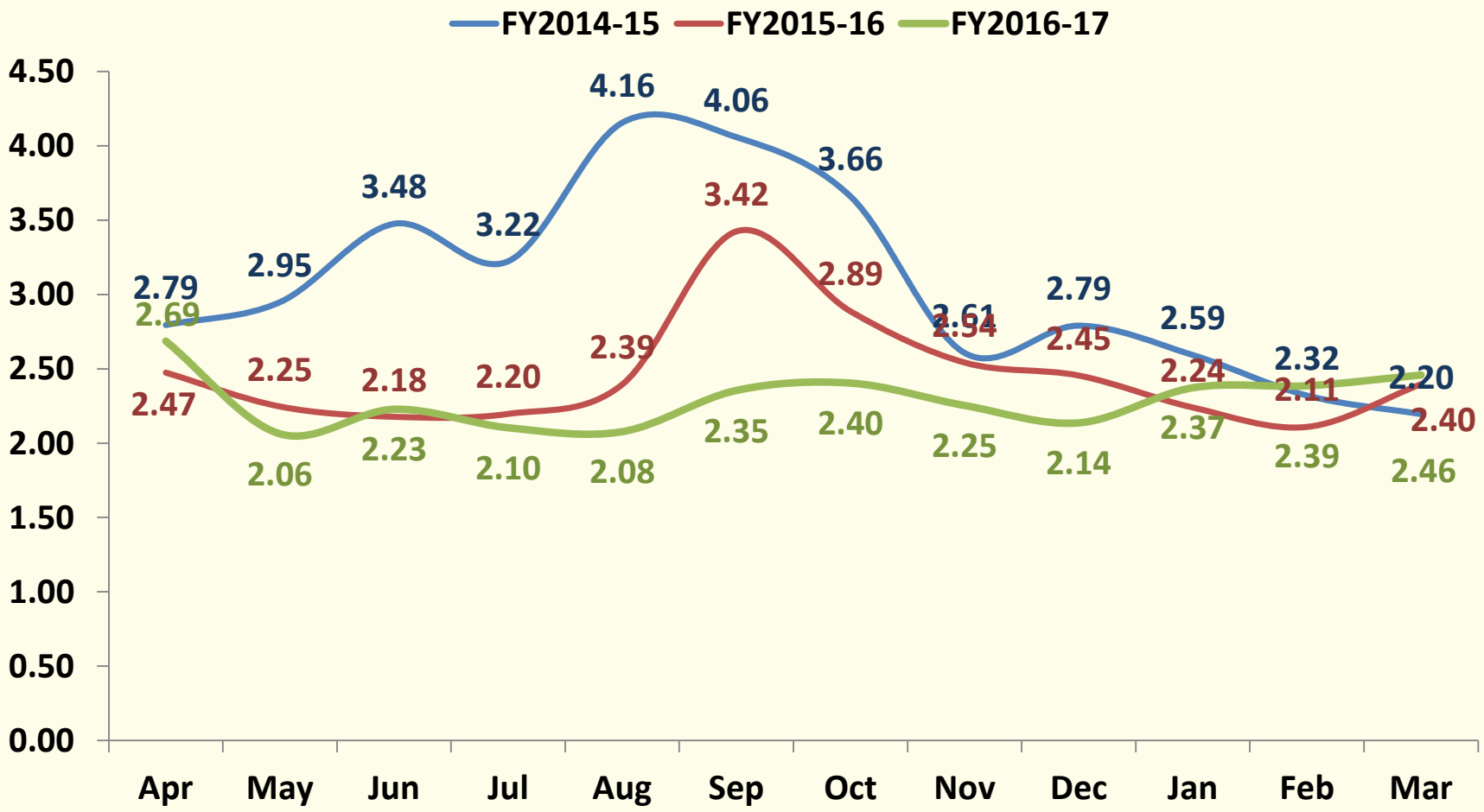
(Avg. Hourly Volume in MW)



Data as on 31st Mar' 2017

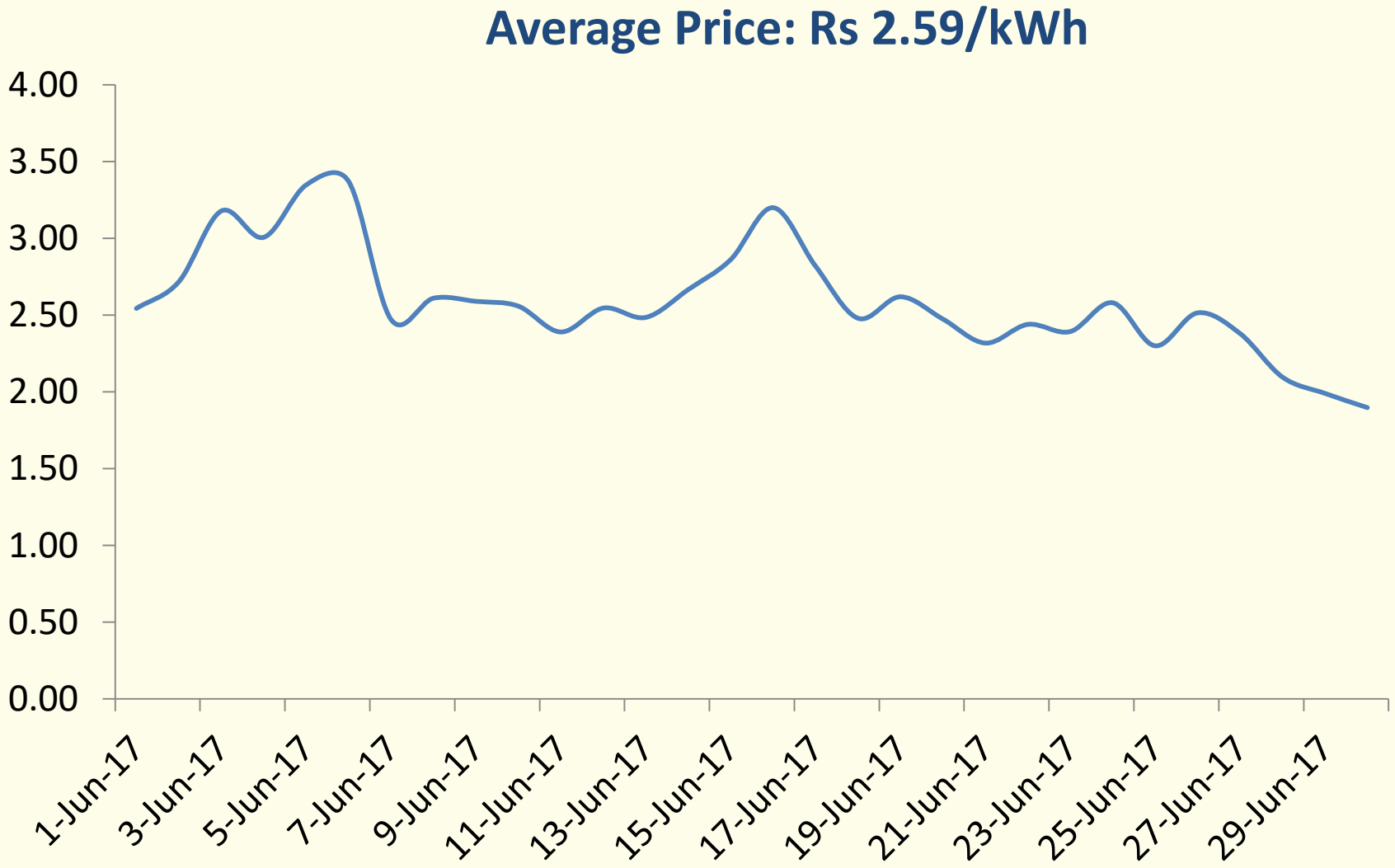
Monthly Price Trend

FY 14-15 Avg. RTC Price: Rs 3.23/kWh
FY 15-16 Avg. RTC Price: Rs 2.77/kWh
FY 16-17 Avg. RTC Price: Rs 2.58/kWh

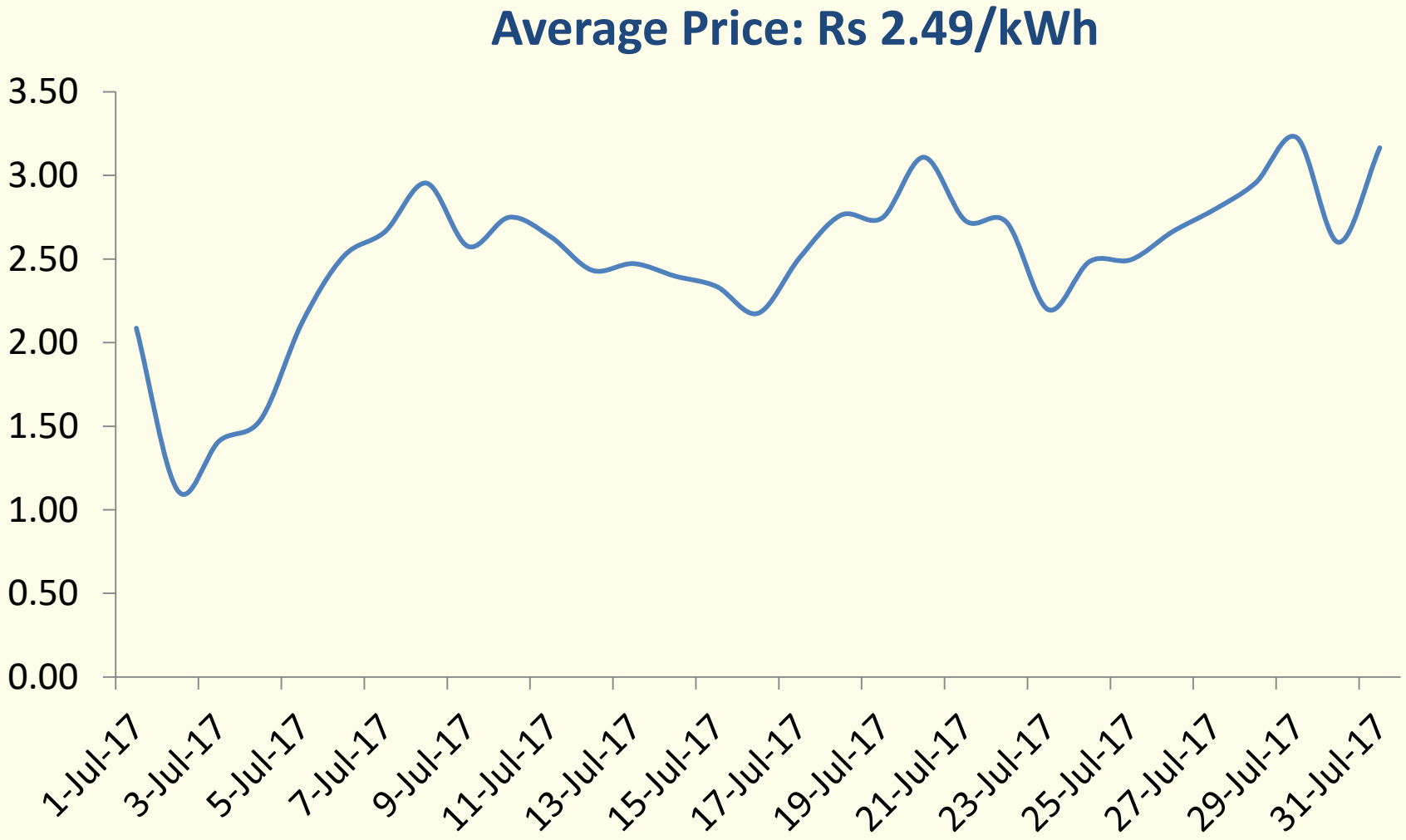


Data as on 31st Mar' 2017

Daily Average Price Trend (June 2017)



Daily Average Price Trend (July 2017)



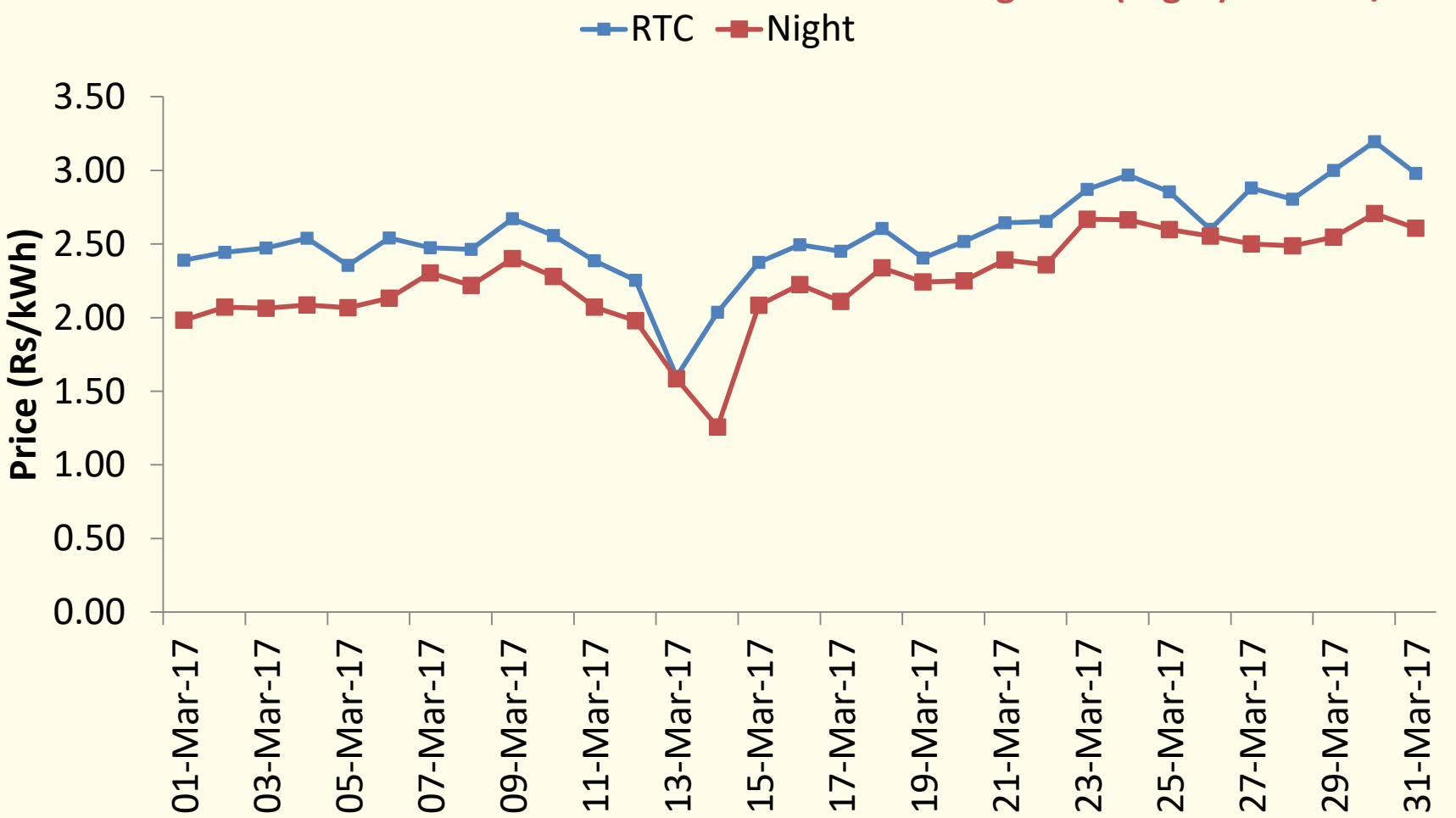
Daily Average Volume & Price for the month

Mar 2017

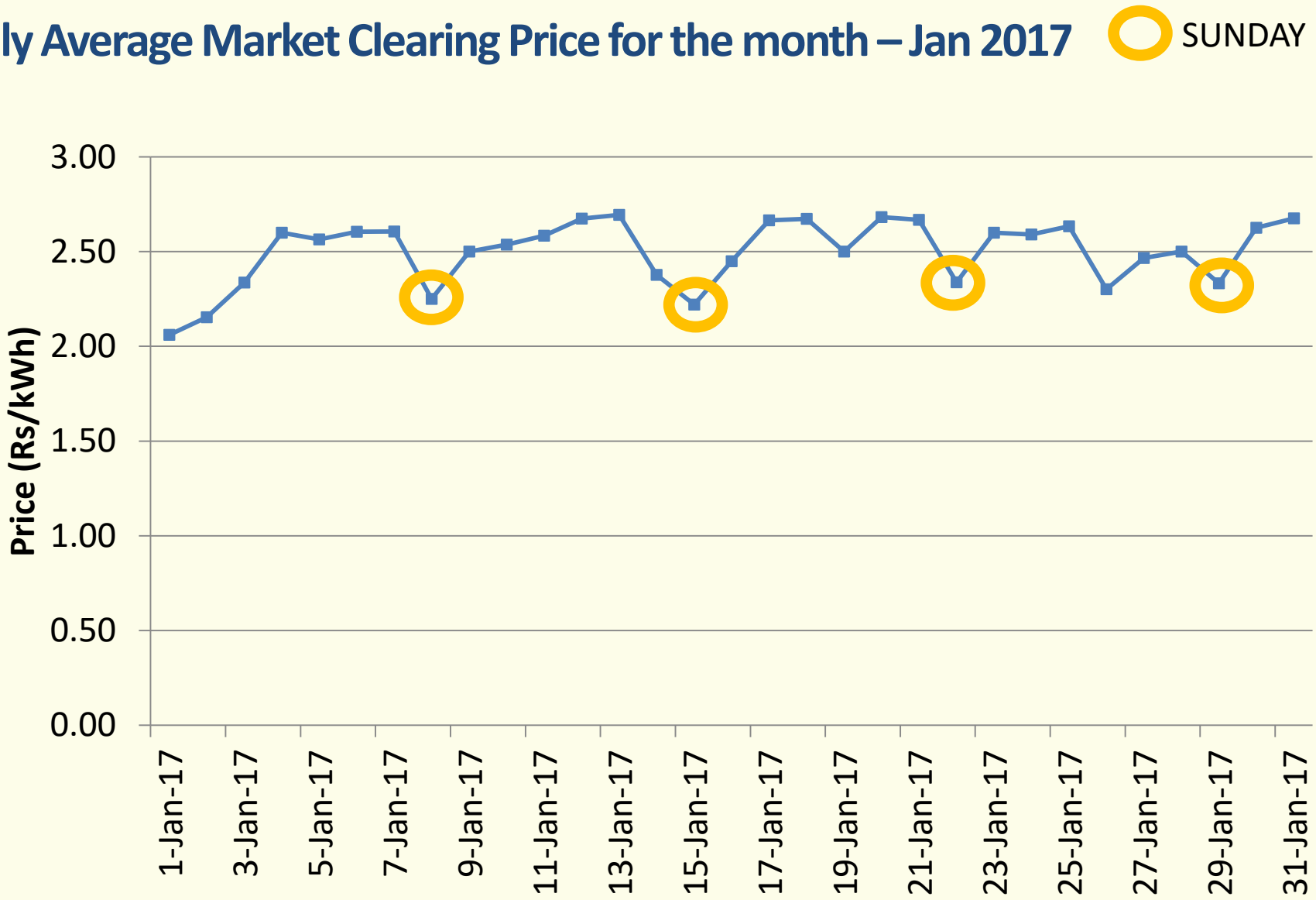
Avg Daily Volume: 113 MU

Avg MCP (RTC): 2.56 Rs/kWh

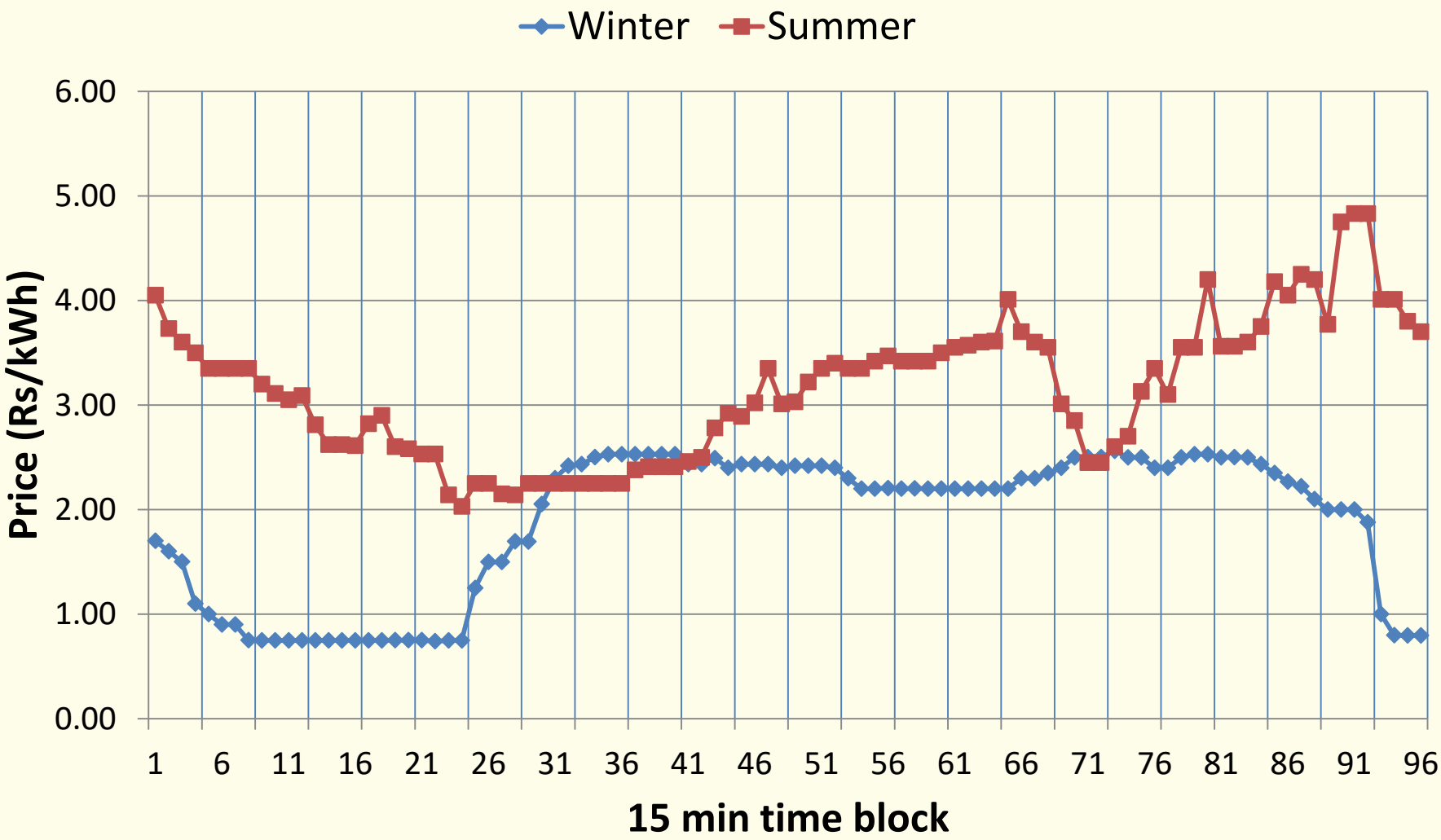
Avg MCP (Night): 2.25 Rs/kWh)



Daily Average Market Clearing Price for the month – Jan 2017



Price Comparison of a typical day



Winter: 18/12/2016 | Summer: 15/04/2017

TAM: Performance so far

Weekly	Day-ahead Contingency
2,886,140 MWh	761,976 MWh

Total Volume traded
5,164 MUs

Intraday	Daily
10,54,961 MWh	4,61,242 MWh

TAM Monthly Snapshot – AUG'17

Contracts	Total Volume (MWh)	Max Price (Rs./kWh)	Min Price (Rs./kWh)
Weekly			
Intraday	26,548	8.00	1.0
Day-Ahead Contingency	19,196	7.50	1.90
Daily	70,568	3.50	3.50

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