



Implementation of Real Time Market – System Operator Perspective

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Indian Grid...One of the World's Largest



- 1** national synchronous grid
- electricity generation
- 3** electricity consumption
- installed generation capacity
- transmission system
- 4** wind generation
- 5** solar generation
- renewable energy generation
- 6** hydro generation

Source: IEA Key World Energy Statistics 2020

Dimensions

372 GW+
generation capacity

182 GW+
peak demand

> 4 TWh
daily energy met

425,000 ckm+
EHV transmission

88 GW+
renewables

10 +
HVDCs

~ 100 GW
inter-regional capacity

3.2 million km²
area footprint

1.3 Billion+
people served

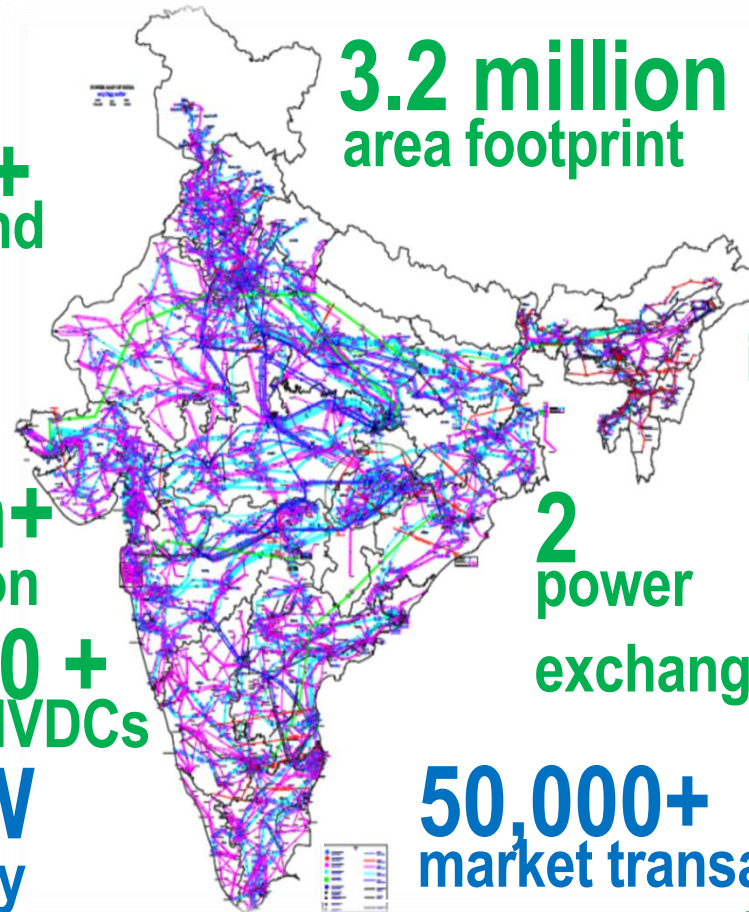
4 GW+
international exchanges

120 TWh+
annual market trades

2
power
exchanges

6000+
market participants

50,000+
market transactions

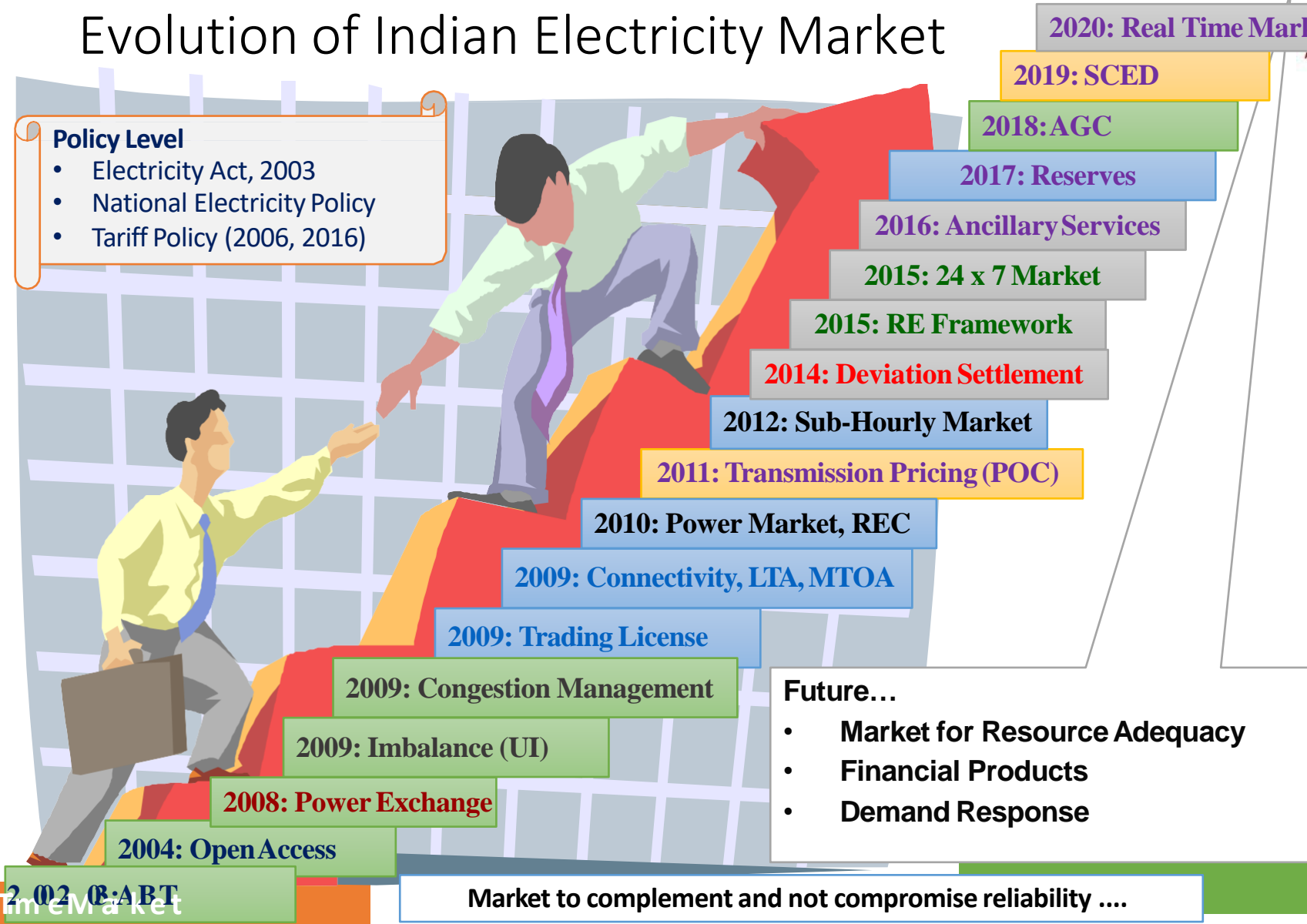


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Evolution of Indian Electricity Market



- Policy Level**
- Electricity Act, 2003
 - National Electricity Policy
 - Tariff Policy (2006, 2016)

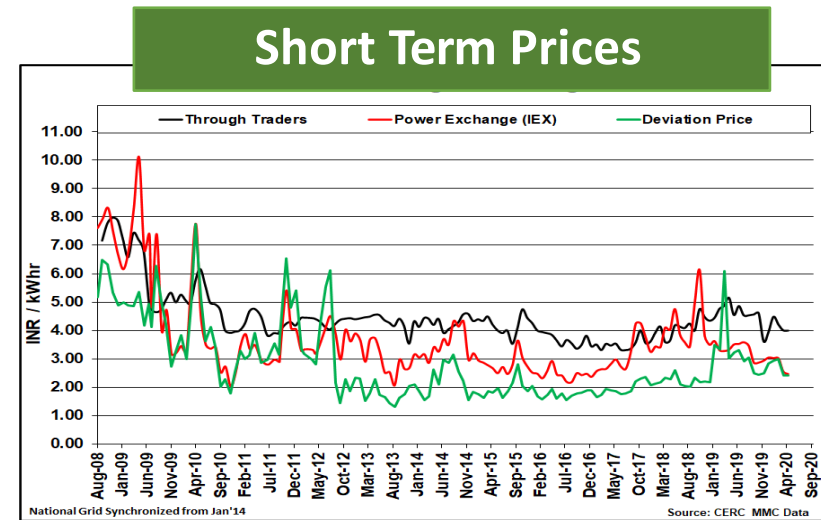
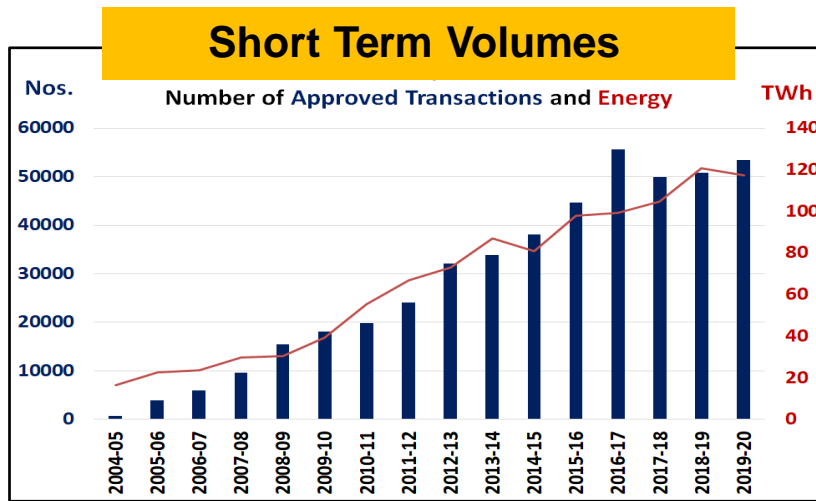
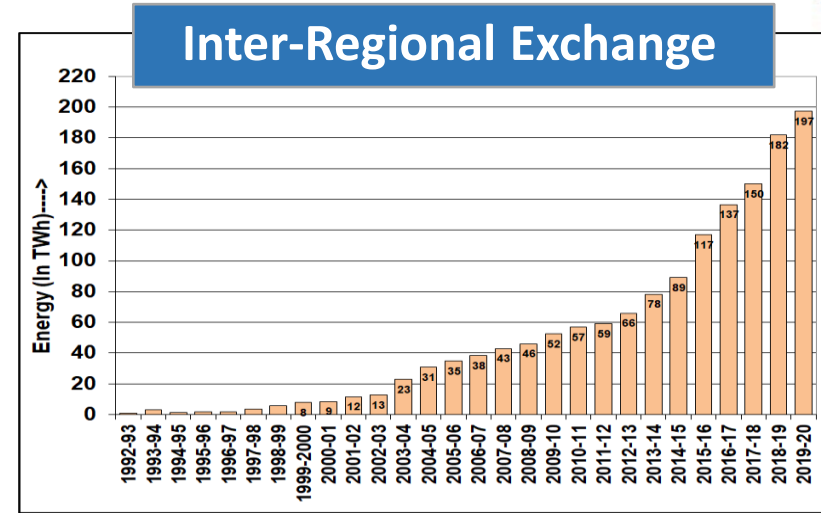
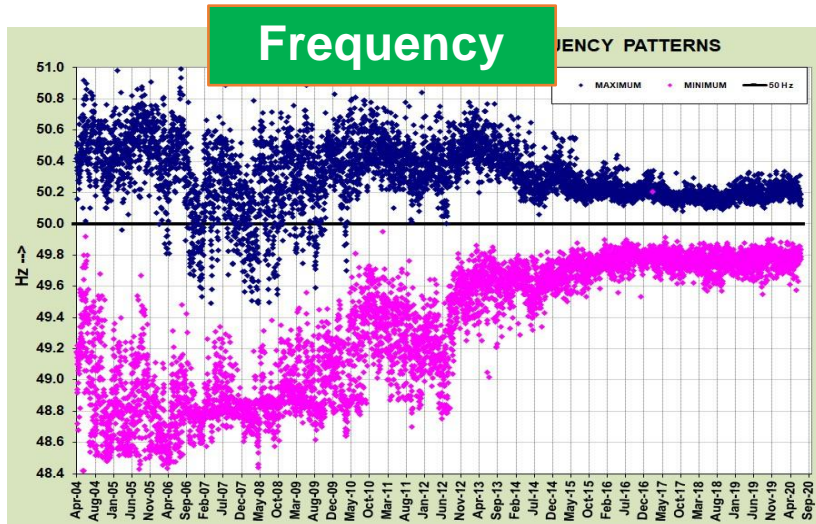


- Future...**
- Market for Resource Adequacy
 - Financial Products
 - Demand Response

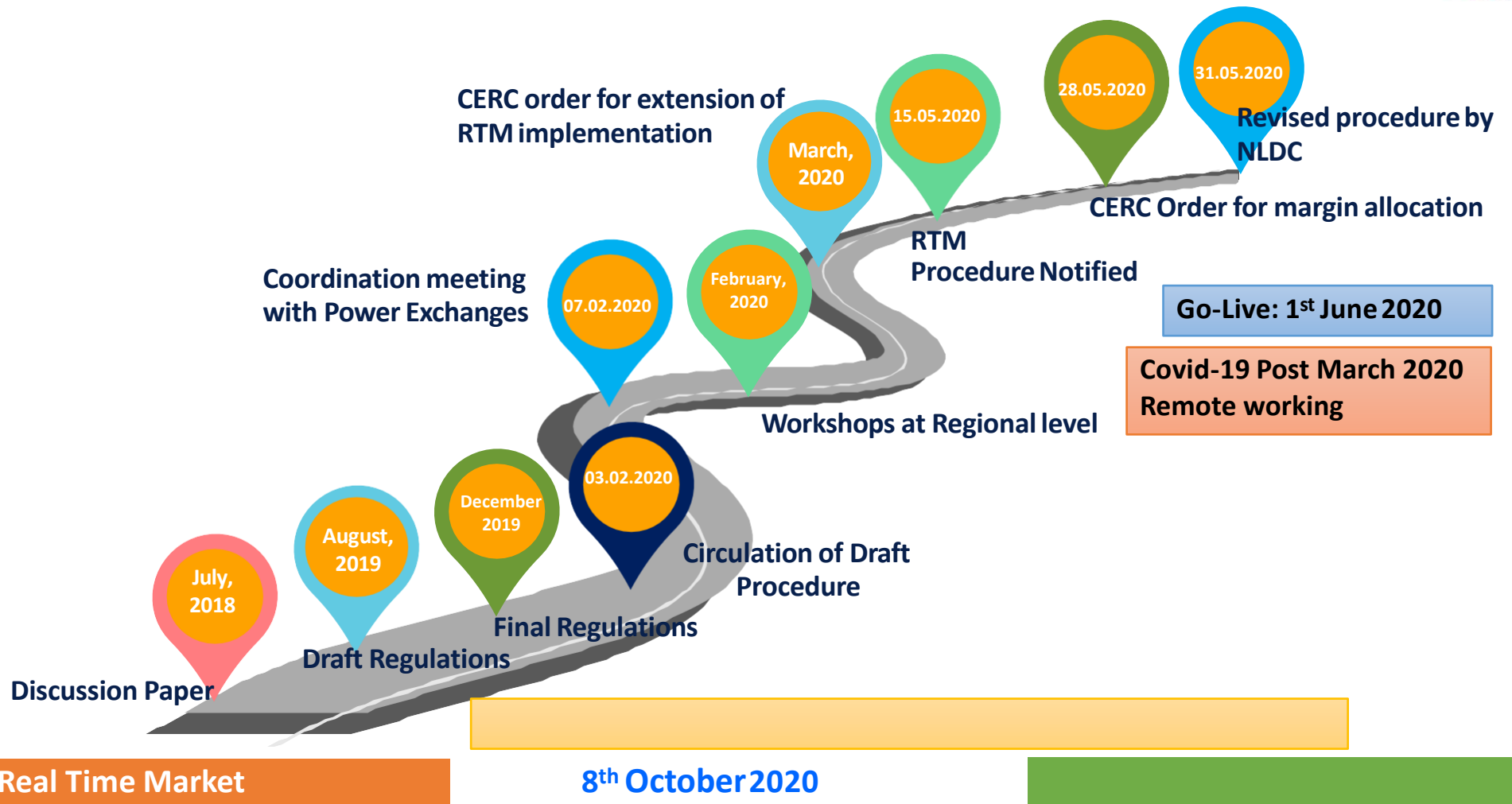
Real Time Market

Market to complement and not compromise reliability

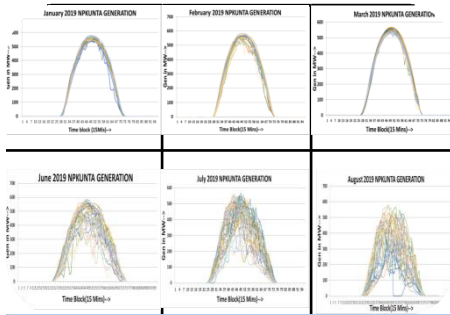
Improvements over the years



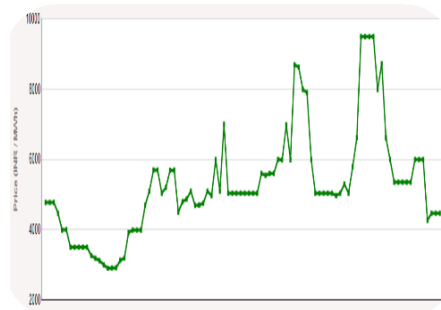
Evolution of Real Time Market in India



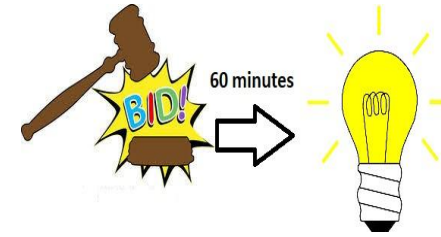
RTM - Objectives



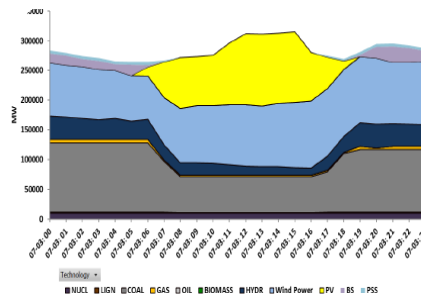
Balancing avenue mitigating variability



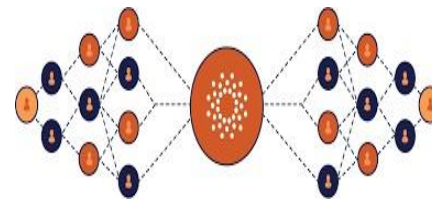
Managing price volatility



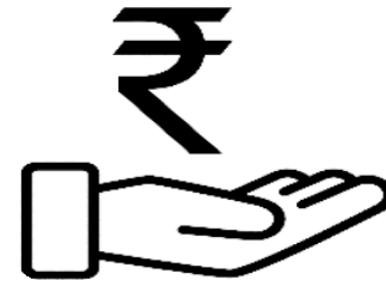
Fast market and defined processes (gate closure)



Better portfolio management



Access to larger generator reserves pool




Additional revenue opportunity

Salient Features




- Half hourly market
- 15-minutes bidding window
- 15-minutes clearing window
- 48 times bidding and clearing every day.

Duration




- 30 minutes (two time-blocks of 15 minutes each)
- Financially and physically binding

Delivery




- Double sided closed auction
- Uniform pricing
- Price and Volume discovered for every 15 minutes

Price Discovery



- End of the right to revision of schedule or declared capability for specific half hour
- RTM window closes
- 1 hour time between gate closure and delivery

Gate Closure




- National Load Despatch Centre (NLDC), POSOCO
- Ensure grid security and reliability through ATC/TTC declaration.

Nodal Agency



- Cleared volume communicated 45 minutes prior to delivery
- Incorporation in the schedules by RLDCs and SLDCs
- Information to respective generators and discoms.

Communication



Congestion Management – Multiple Power Exchanges

SoR to Framework for RTM

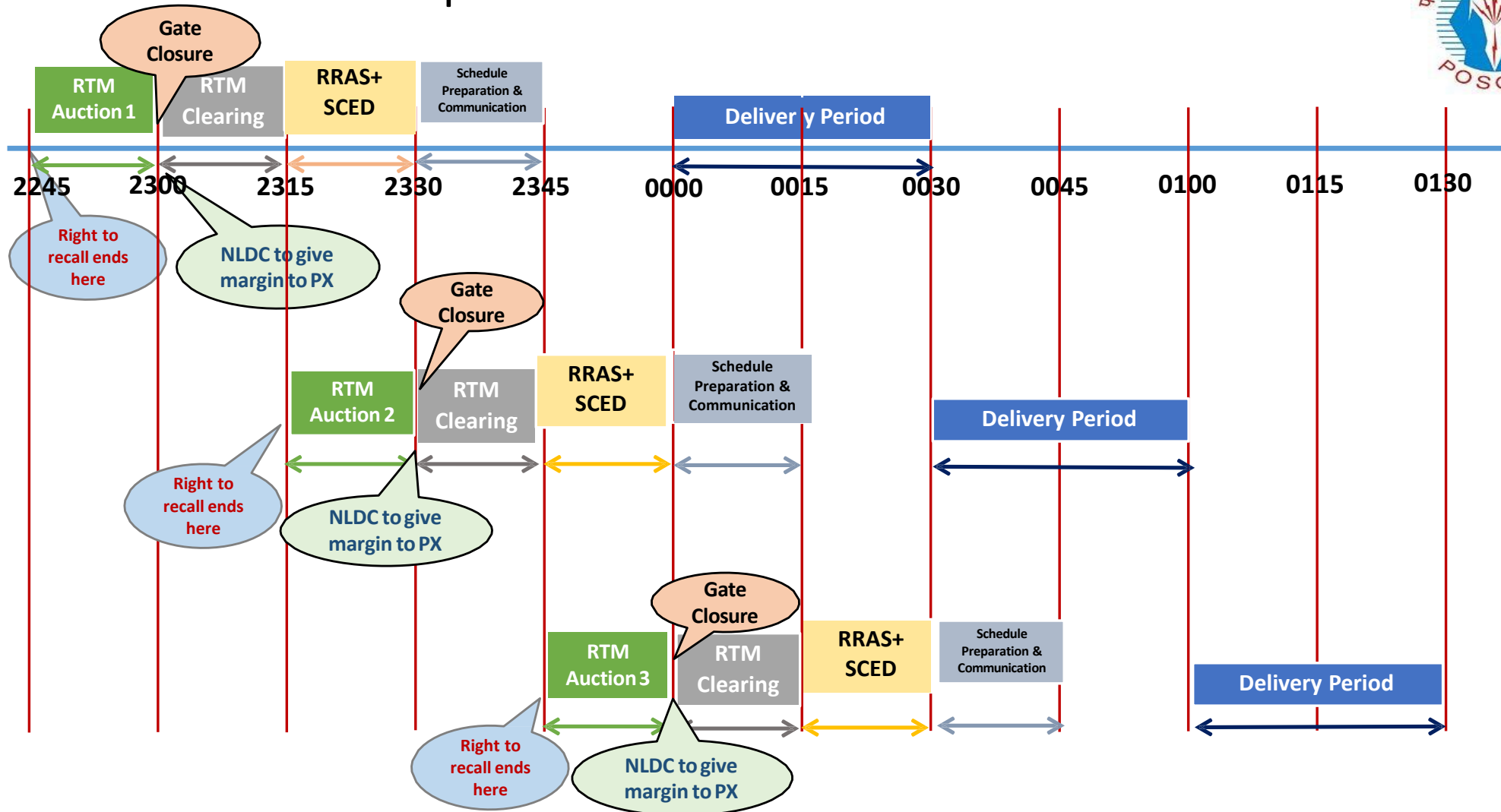
- Upfront allocation of margin in the ratio of DAM Volume
- Submission of final trade result by Power Exchanges

CERC Order dated 28.05.2020

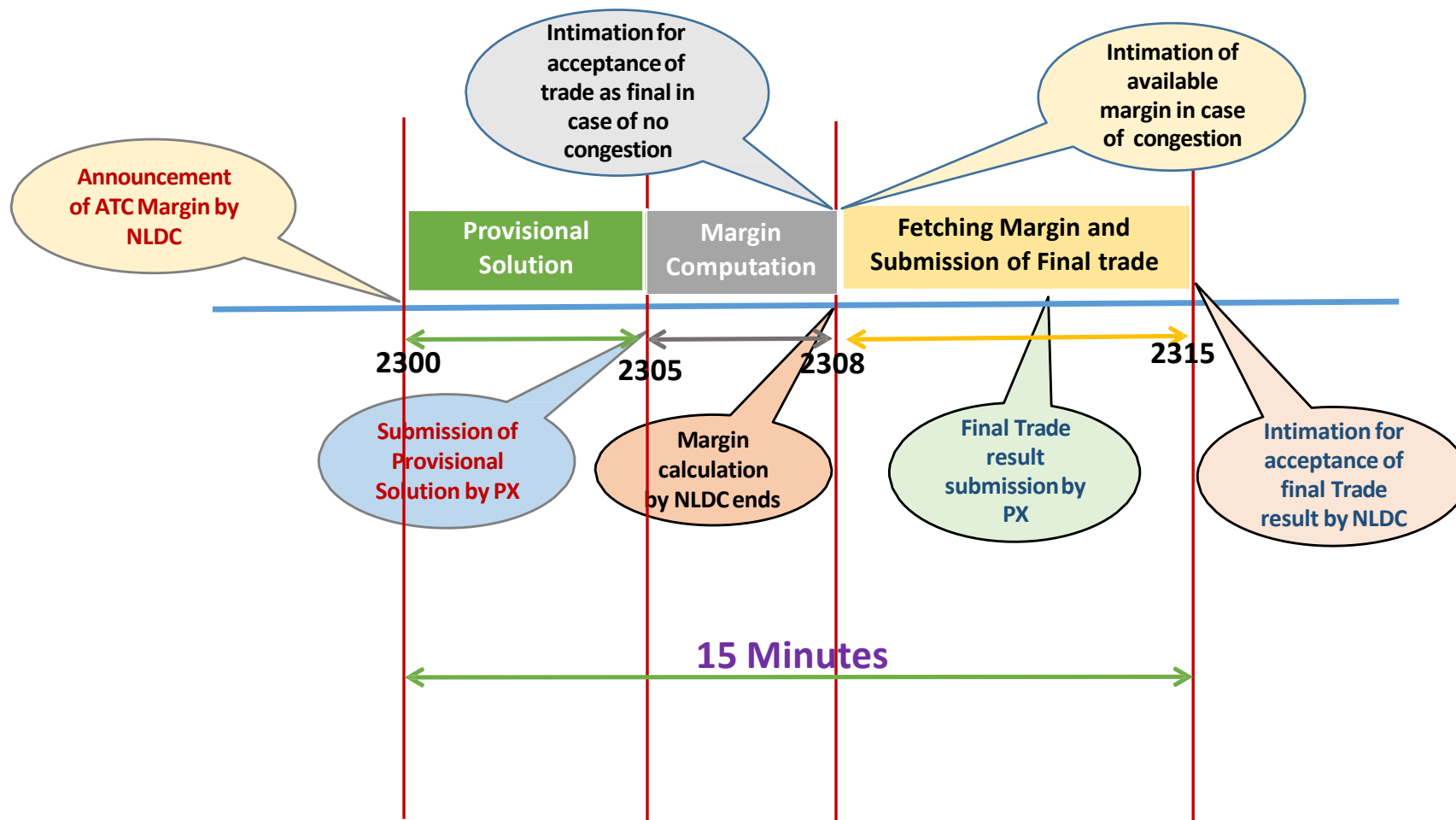
- Iterative process
- PXs to submit Provisional Solution
- Checking for congestion by nodal agency
- No congestion
 - Provisional solution accepted as final
- Congestion
 - Margin allocation in the ratio of provisional volume



Operational Timelines for RTM



Timelines for RTM Clearing



Software Development for RTM Implementation



- RTM Core Engine
 - REST API
 - Node.JS
 - Oracle; Mongo DB
- RTM Dashboard
 - REACT.JS
 - Node.JS
 - Mongo DB



RTM Dashboard at NLDC

- Synchronization of WBES at all RLDCs
- Interfacing of WBES and RTM
- Several round of mock exercises



Mock Exercise with Power Exchanges
04.05.2020 to 06.05.2020

In-House Software for RTM Processing at NLDC
April'2020



Deployment of New Scheduling Software across RLDCs
May'2020

Modification in RTM Clearing Engine
28.05.2020 to 30.05.2020

CERC Order for Corridor Allocation
28th May 2020

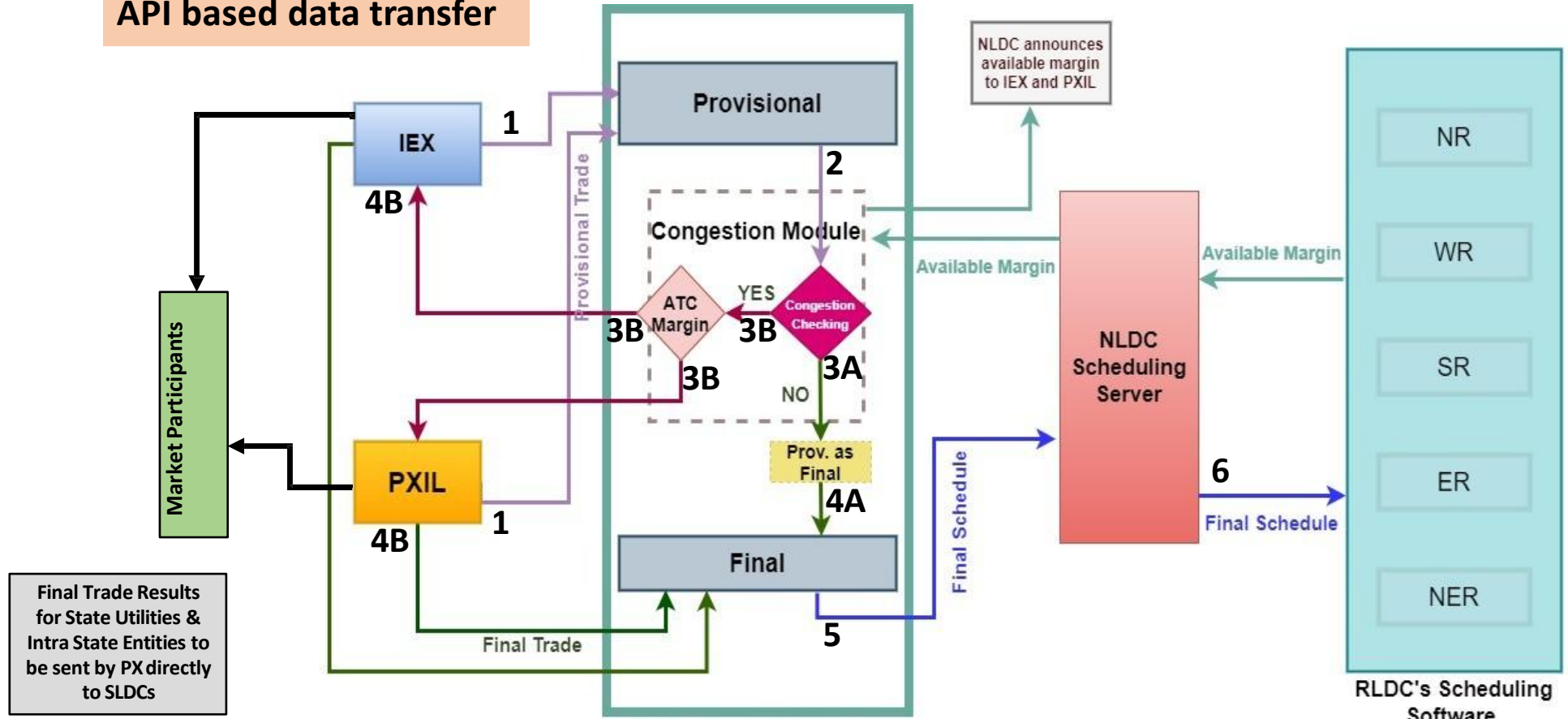
Second round of Mock Exercise
30.05.2020 to 31.05.2020

Go-Live
01.06.2020

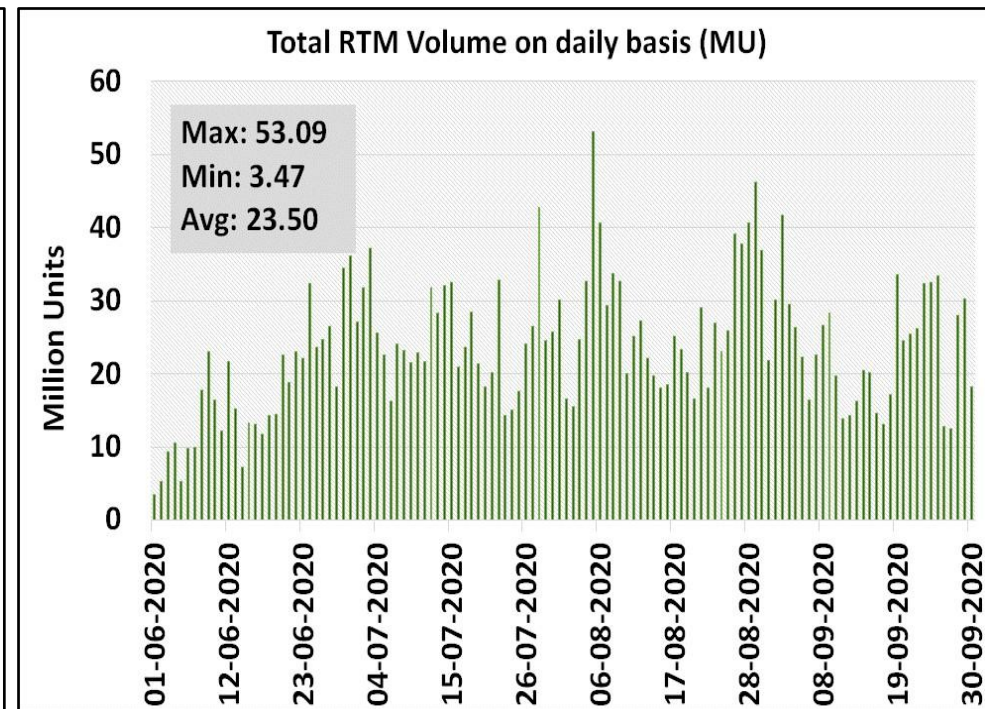
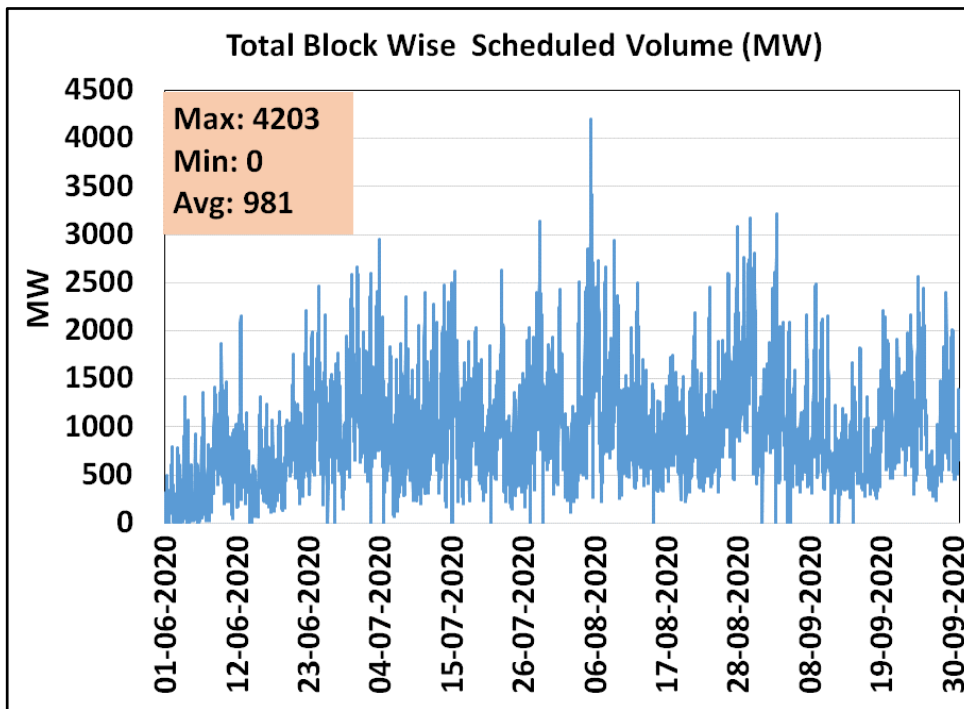
Information Exchange



API based data transfer

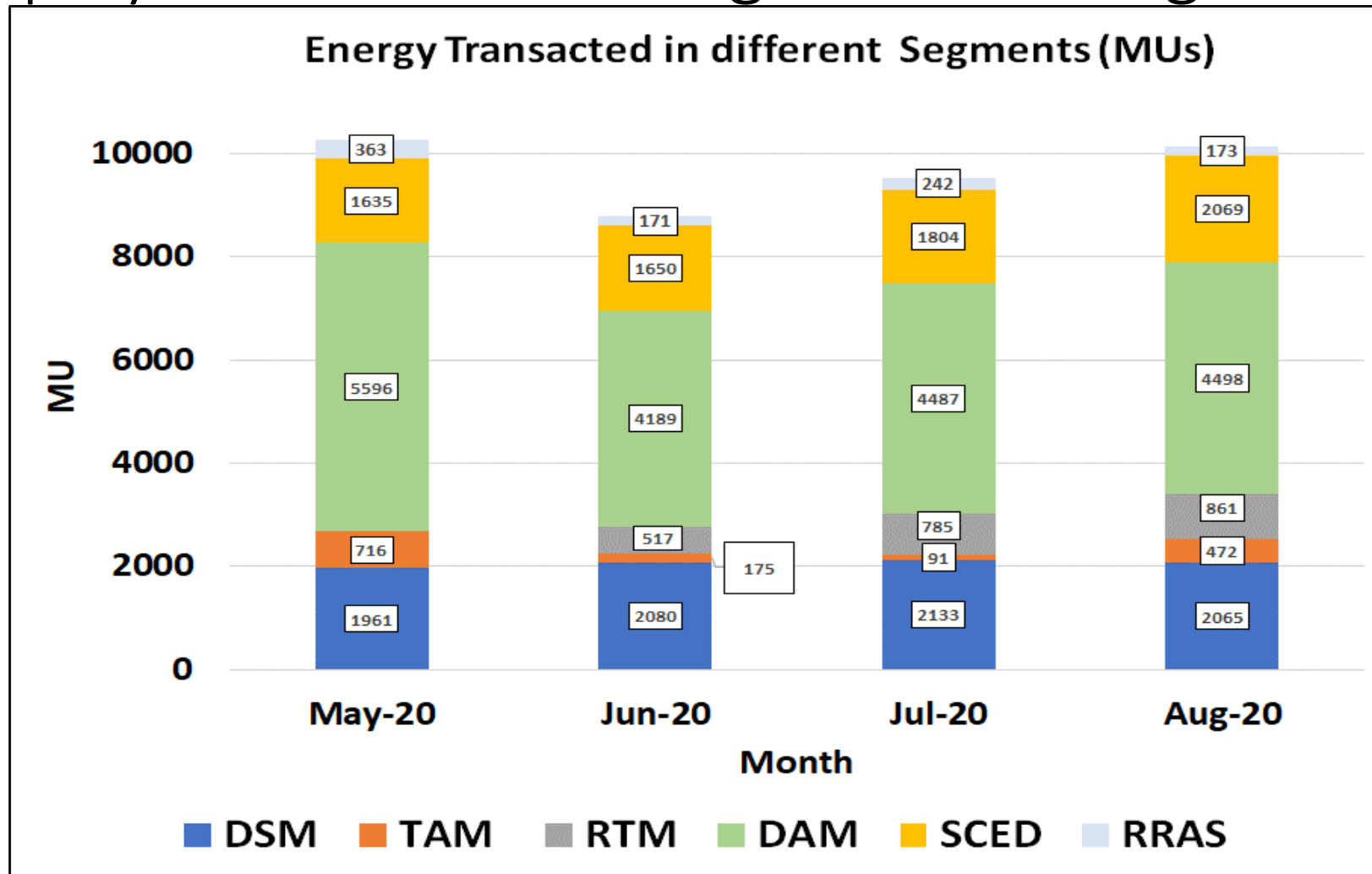


Total Market Clearing Volume in RTM

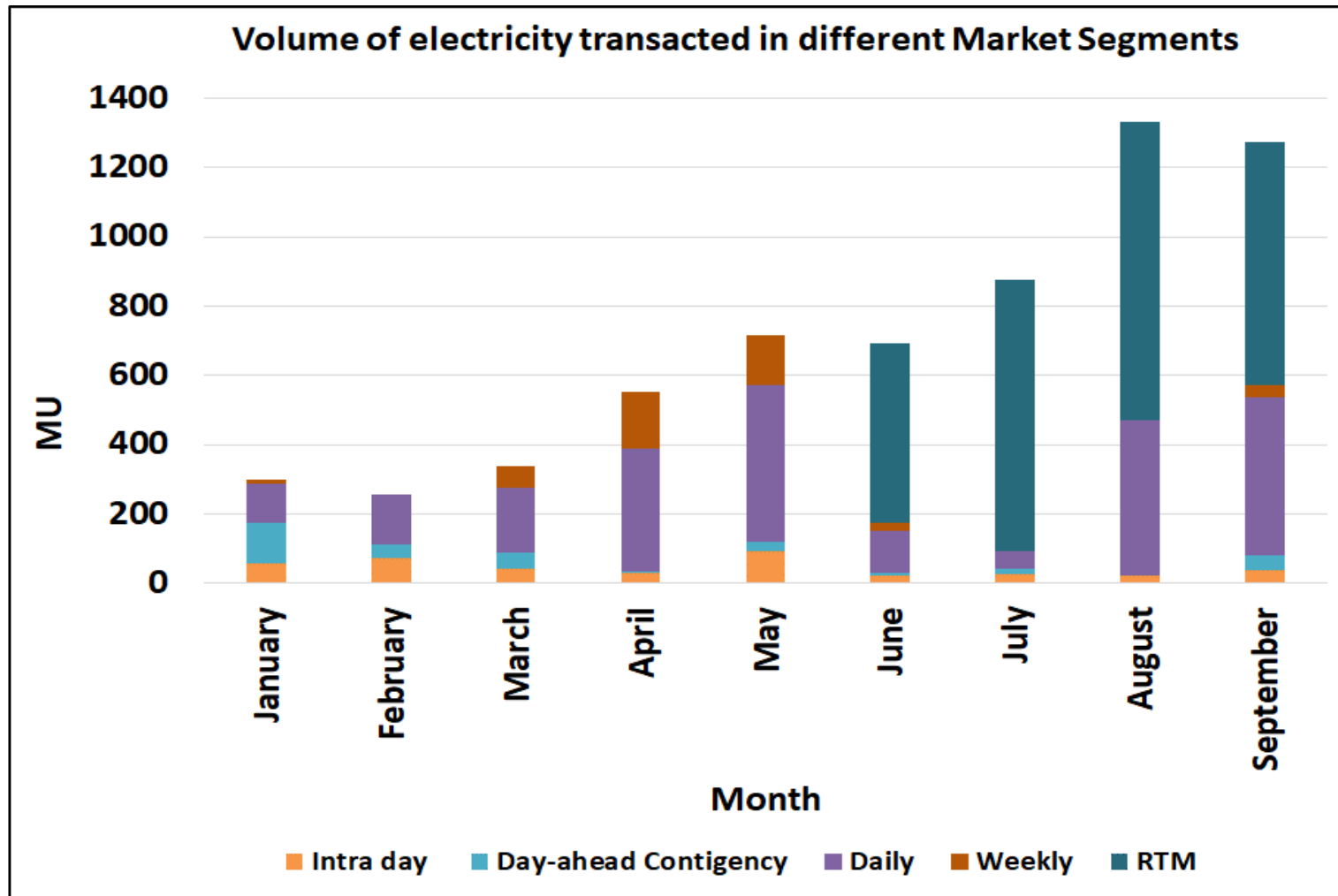


Maximum during 1st June to 30th Sept 2020 > 4000 MW

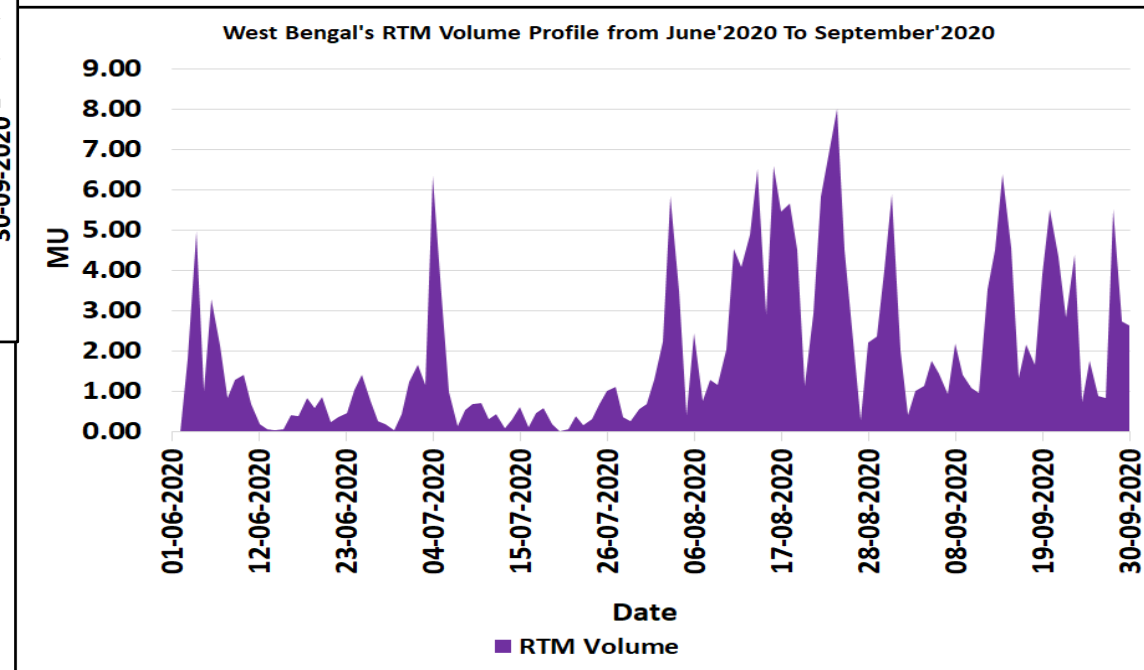
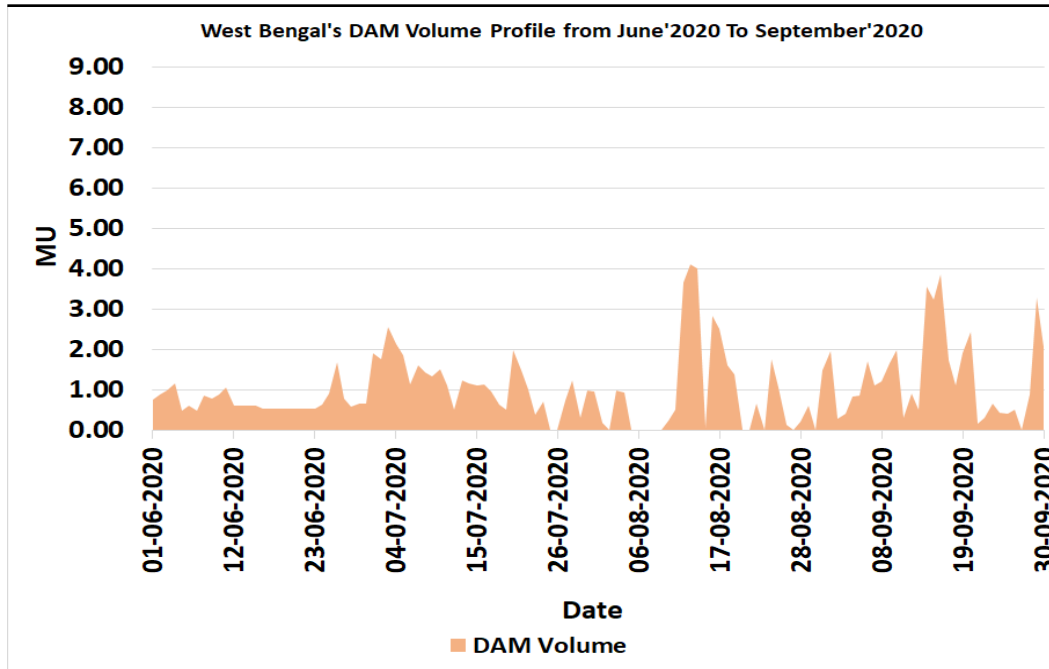
Interplay of Volume among different segments



Shifting Market Preferences - Volumes in TAM & RTM



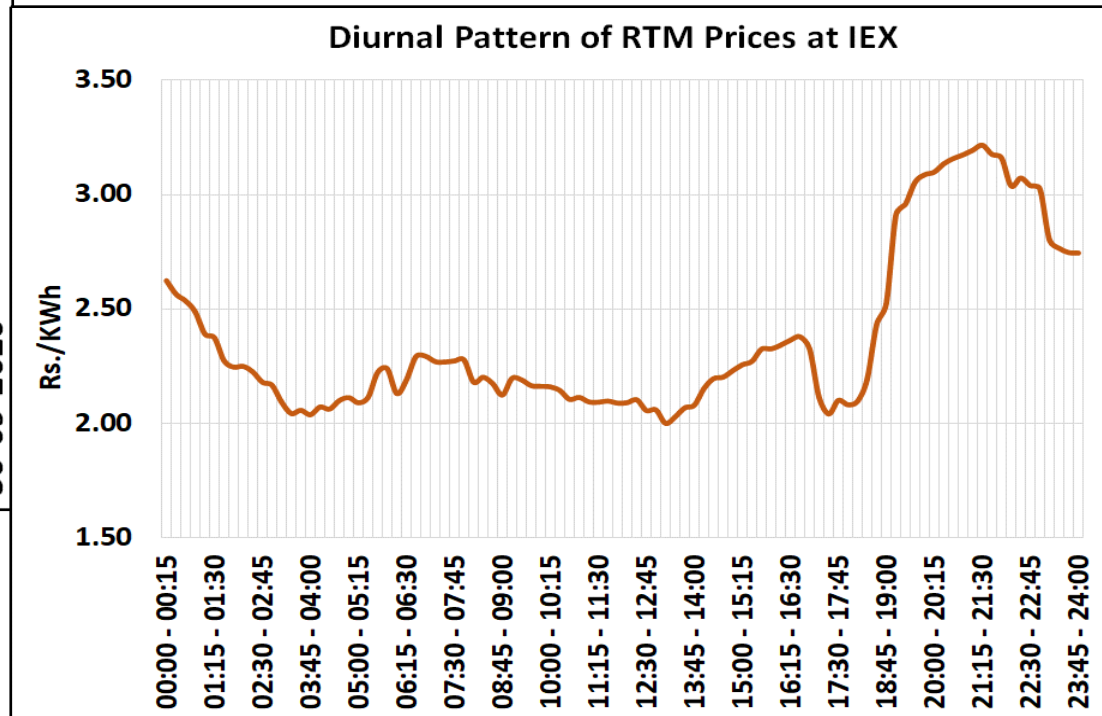
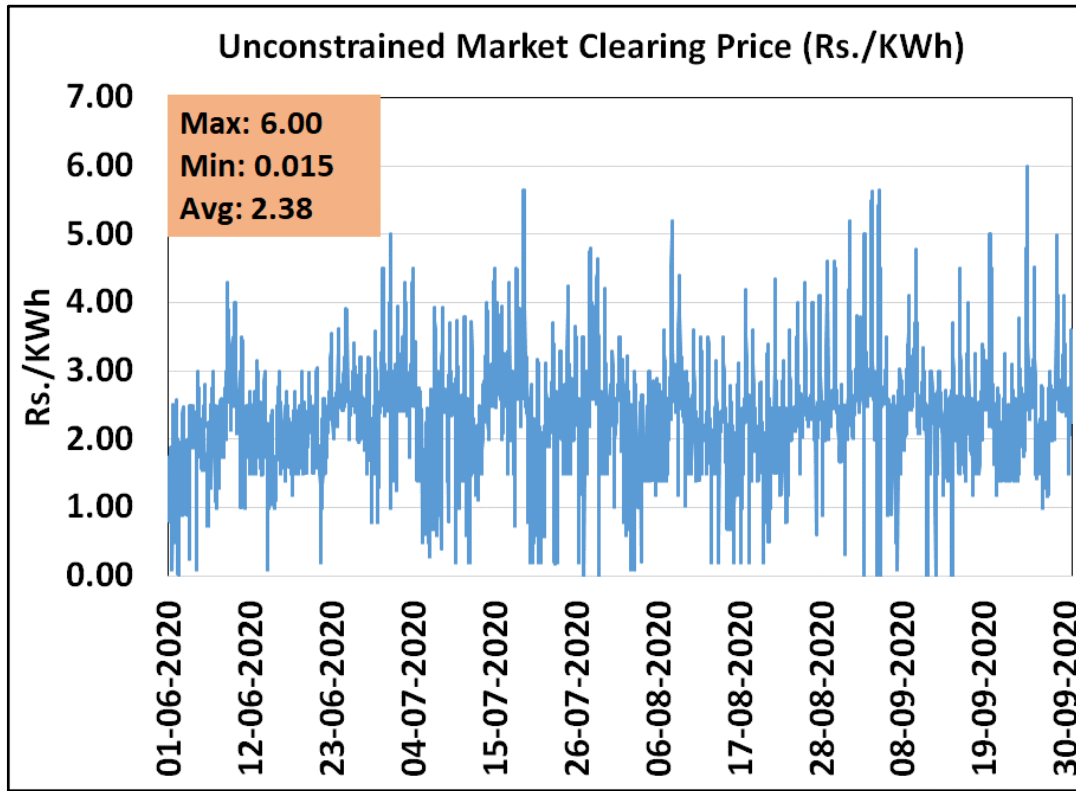
DAM & RTM Volumes for West Bengal



Real Time Market

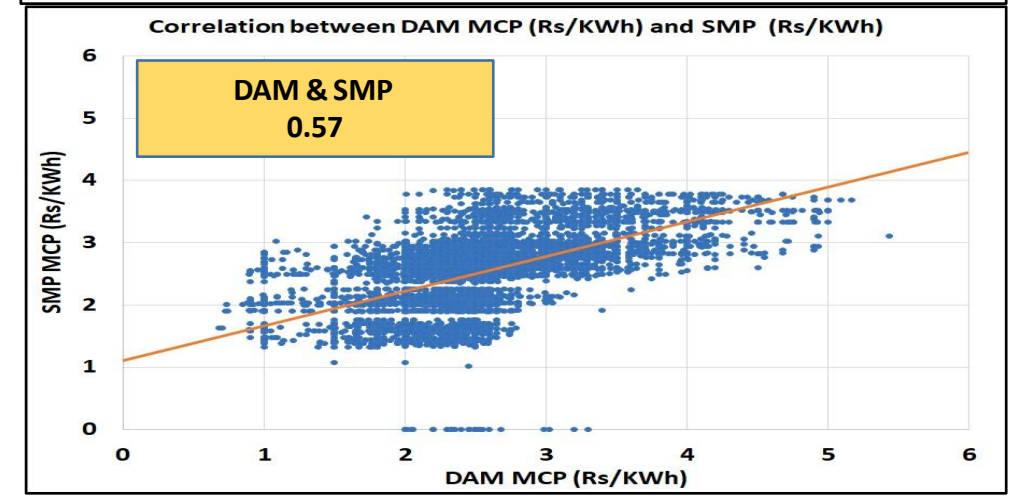
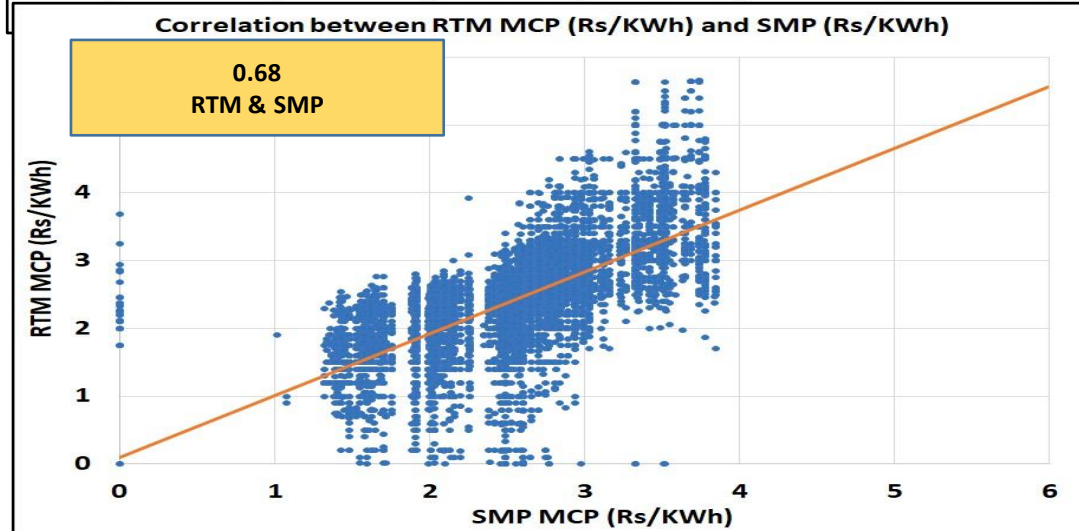
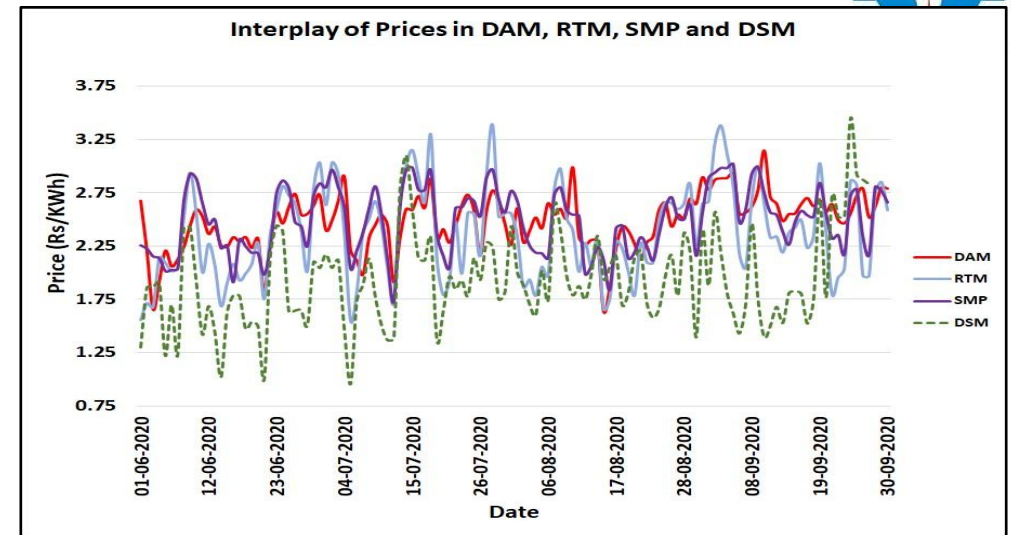
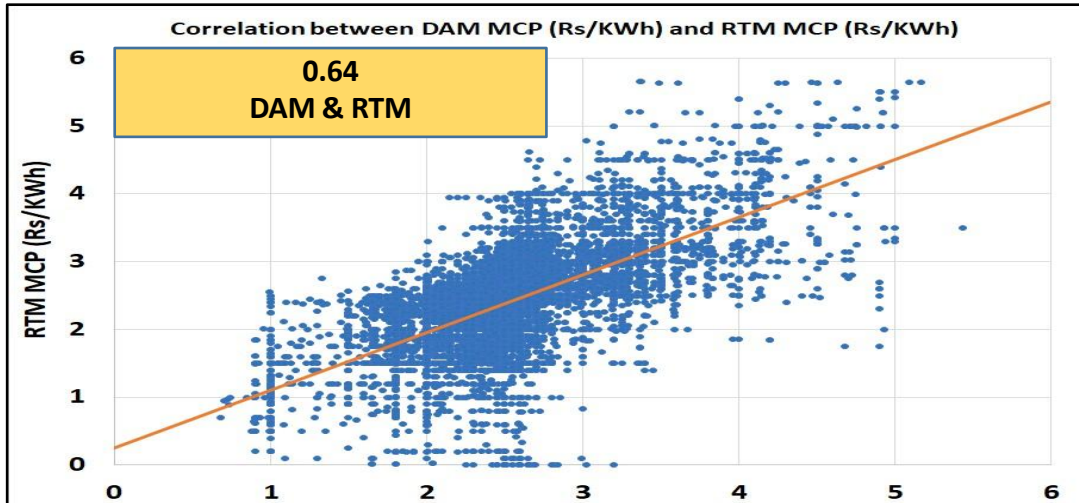
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Unconstrained Market Clearing Price (RTM)



Source - IEX

Interplay between Prices



Real Time Market

Moderately Correlated



Top 5 Buyers and Top 5 sellers during Quarter – (June – August)

Top 5 Buyers during the quarter		
S. no.	Entity Name	Purchased Quantum in Mus
1	TELANGANA	586.65
2	Rajasthan	273.63
3	Maharashtra	190.75
4	Haryana	188.99
5	Andhra Pradesh	177.02

Top 5 sellers during the Quarter		
S. no.	Entity Name	Sold Quantum in Mus
1	Jammu & Kashmir	428.95
2	Karnataka	222.93
3	Orissa	153.48
4	Uttar Pradesh	123.39
5	Madhya Pradesh	99.15



Events of Power Purchased by Generator during Quarter

S. No.	Name of Generator	Purchased Quantum (MUs)
1	AD Hydro	0.02
2	Chuzazen	0.17
3	DVC	0.21
4	ESIL	0.34
5	Essar Power MP Ltd	8.82
6	Jindal Power Ltd. Stg-I	0.48
7	Jindal Power Ltd. Stg-II	0.88
8	Jorethang HEP	8.91
9	Maruti Clean Coal and Power Ltd	0.08
10	Raipur Energen	2.59
11	Tashiding HEP	4.28
12	Teesta Urja Limited	12.63
	Total	39.41

Win-Win for all



Challenges



24x7 continuous
48 number of
sessions with small
response time

Dedicated
manpower for
software,
hardware and
communications
setup pan-India



Constant 24X7
interactions with
generators and
DISCOMs pan-India

Robust, resilient
system automation
and integration at
NLDC / RLDCs /
SLDCs / Power
Exchanges





**Putting Together the Pieces – Operating in a
Intermittent ‘Normal’ and Variable ‘Paradigm’**

Indian Grid is ‘Renewable Ready’ !

