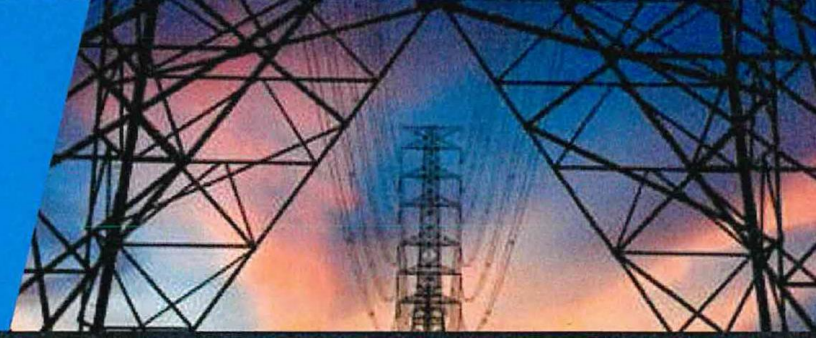


1st Power Conference on  
**India Power Market:  
Price Discovery Models**  
November 18, 2021



# Law of Supply and Demand: Dimensions of Short Term Market

S S Barpanda

Director (Market Operation), POSOCO, India

# Dimensions



**390 GW+**  
generation capacity

**200 GW+**  
peak demand

**> 4 TWh**  
daily energy met

**425,000 ckm+**  
EHV transmission

**100 GW+**  
renewables

**~ 100 GW**  
inter-regional capacity

**10 +**  
HVDCs

**3.2 million km<sup>2</sup>**  
area footprint

**1.3 Billion+**  
people served

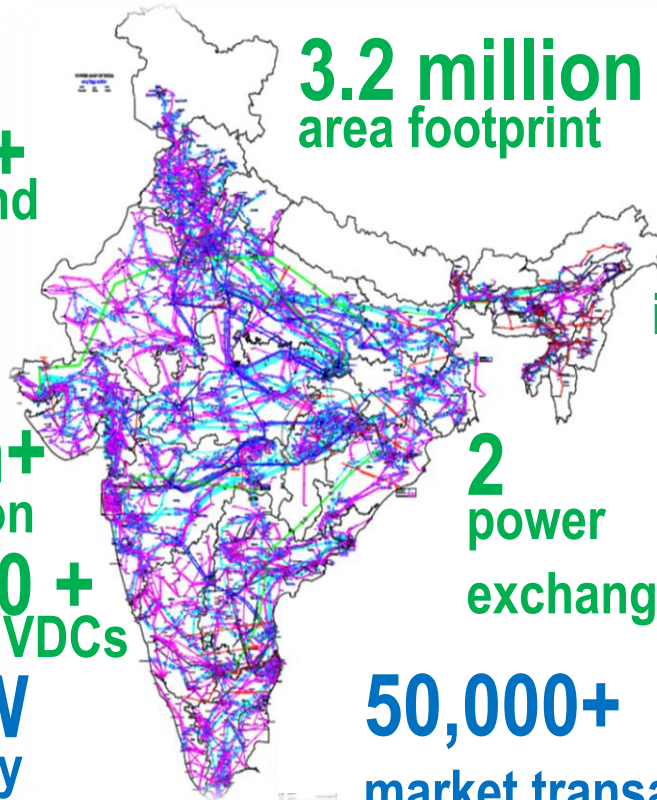
**4 GW+**  
international exchanges

**120 TWh+**  
annual market trades

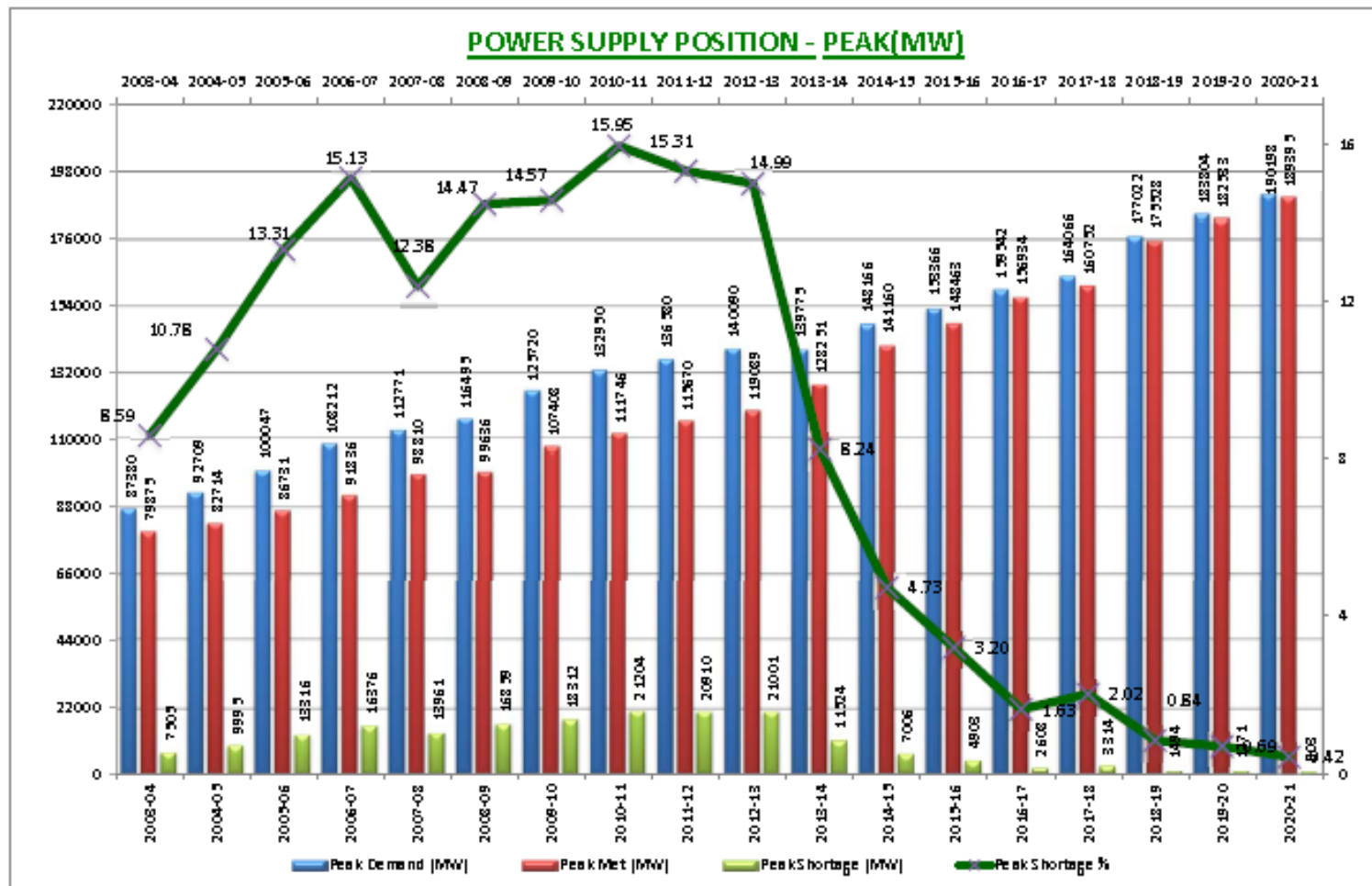
**2**  
power  
exchanges

**50,000+**  
market transactions

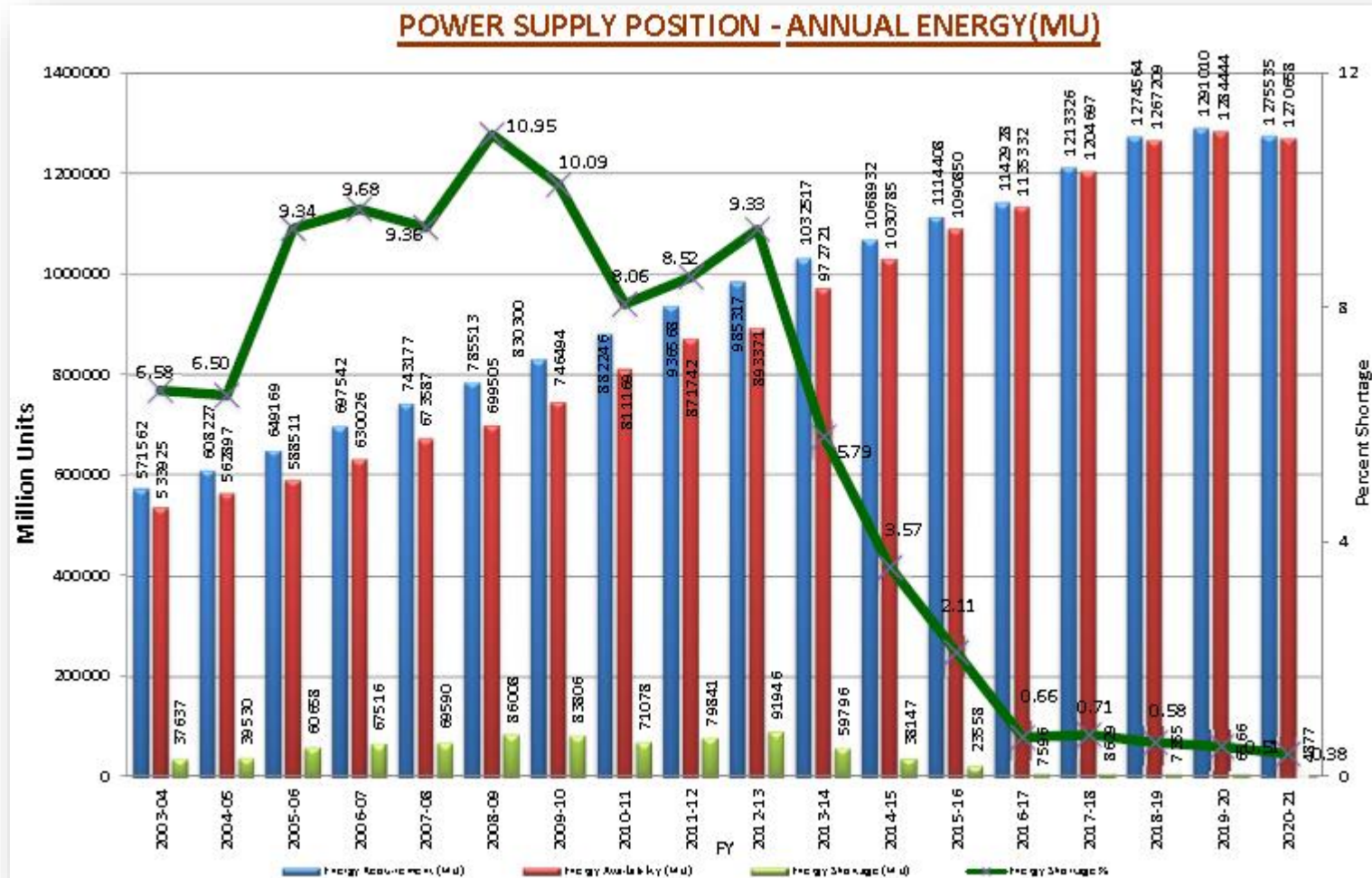
**6000+**  
market participants



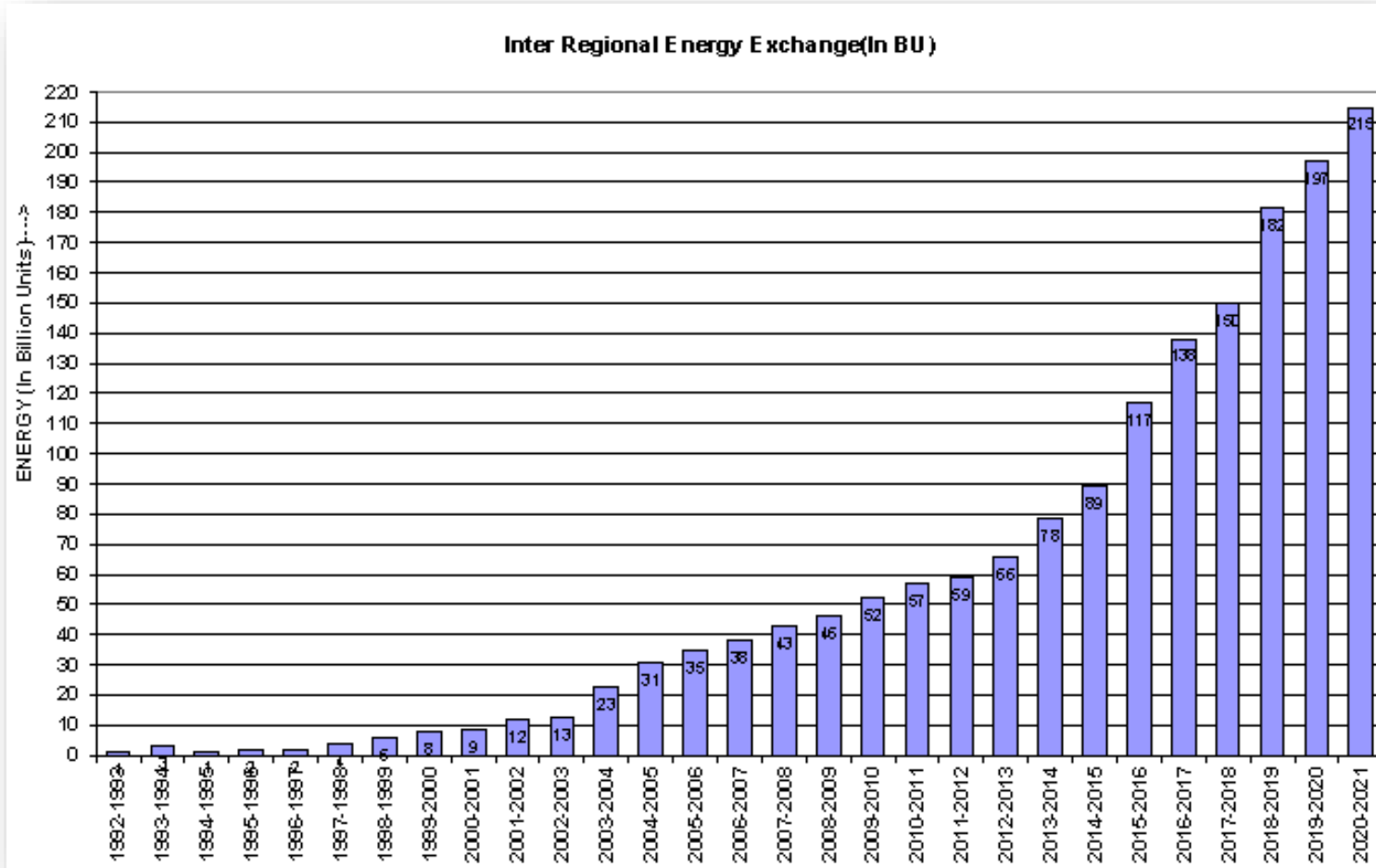
# Power Supply Position (Peak)...over the years



# Power Supply Position (Energy)...over the years

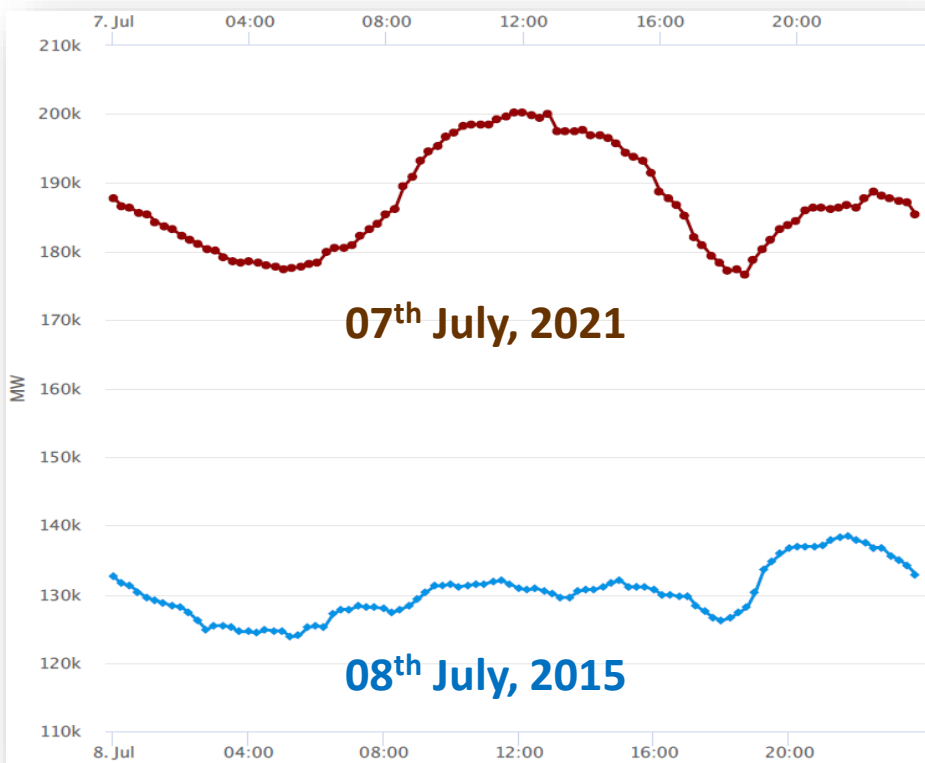


# Inter regional energy exchanges...over the years



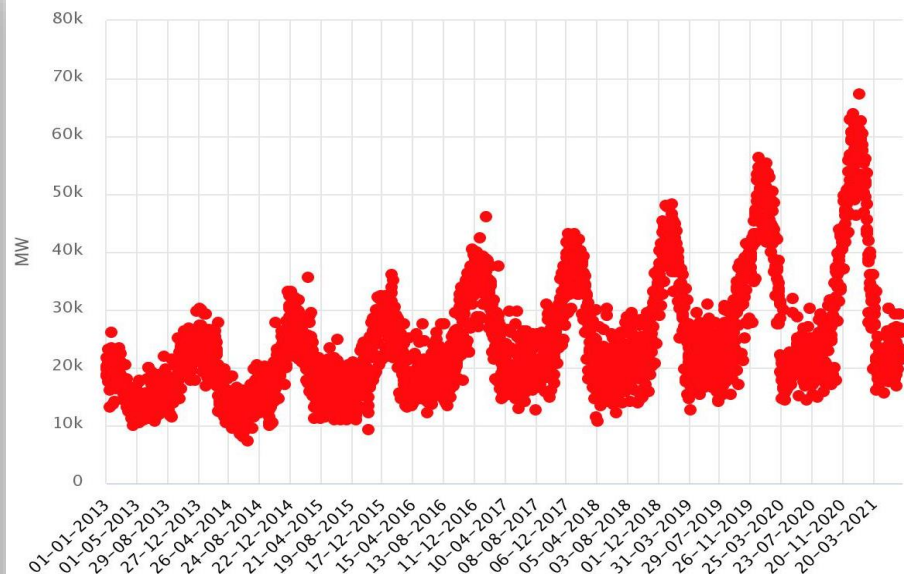


# Indian Power System Pattern and Behaviour



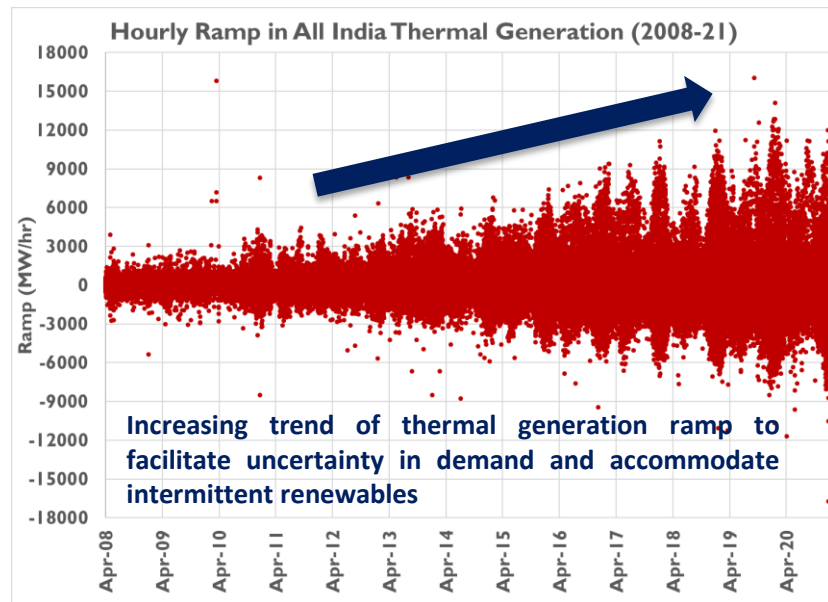
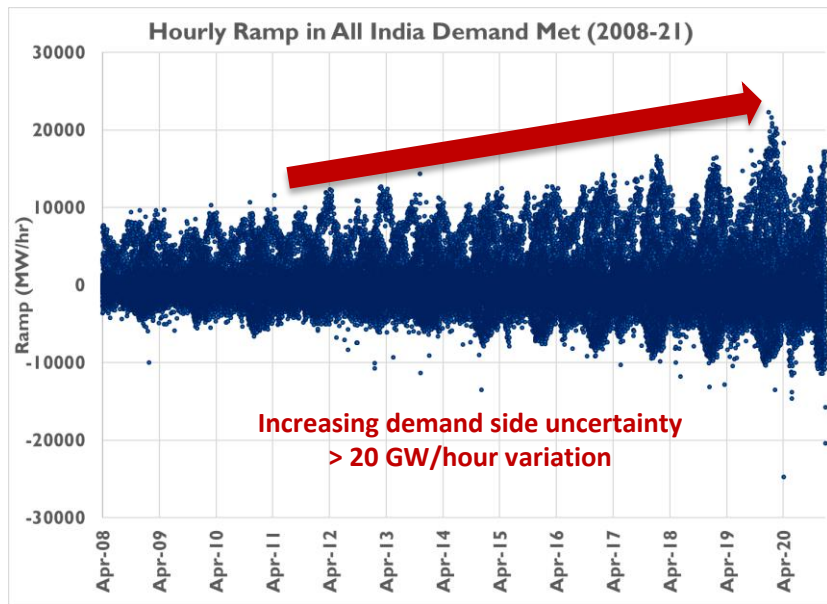
**Load shape changes necessitating resource flexibility**

Max-Min for All India from date: 01-01-2013 to 10-07-2021



- Minimal shortages leading to natural load shape
- Agricultural load shifting to solar hours
- Space cooling impact
- Induction cooking...Future?

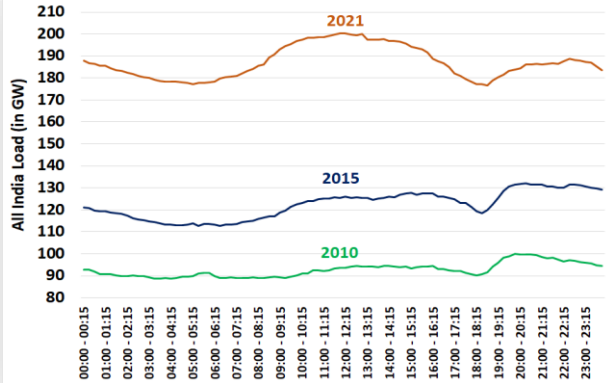
# Flexibility Need and Provision



# Daily Operations

## Summer

All India Load Profile - Typical Summer Day

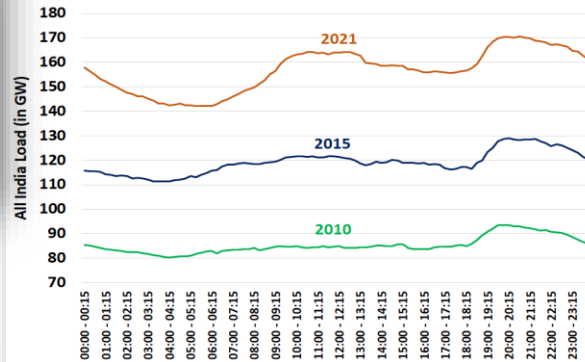


## Diurnal Variation

## All India Load Curve of a Typical day

## Monsoon

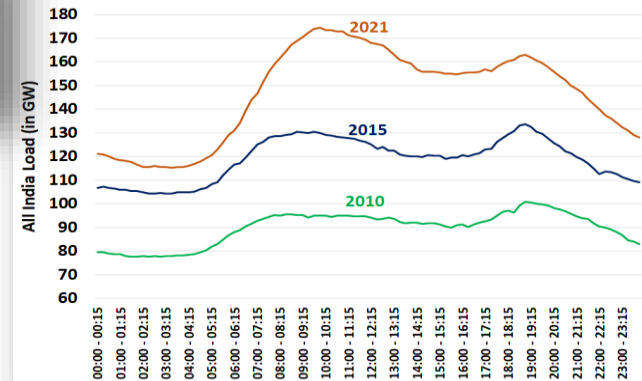
All India Load Profile - Typical Monsoon Day



## Seasonal Variation

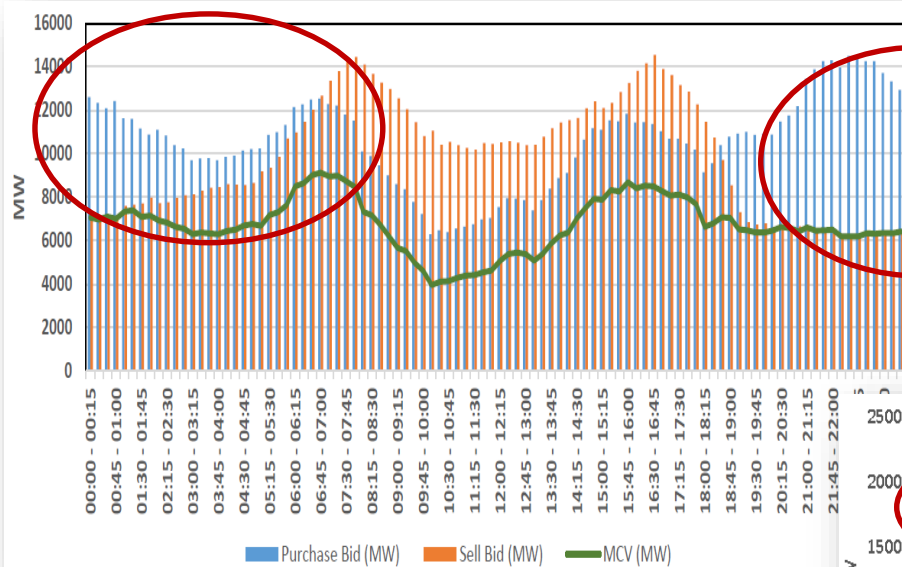
## Winter

All India Load Profile - Typical Winter Day



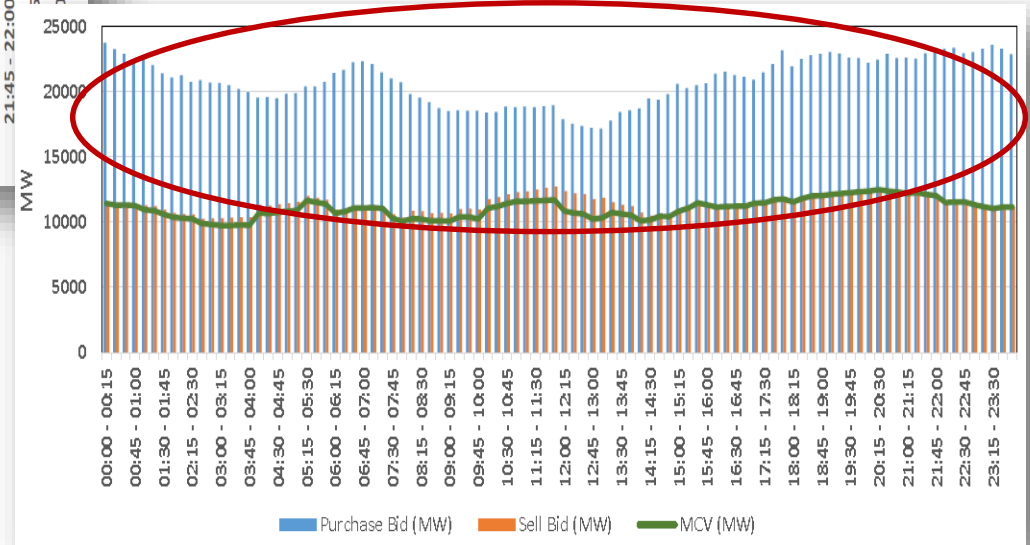


# Need for Reserves

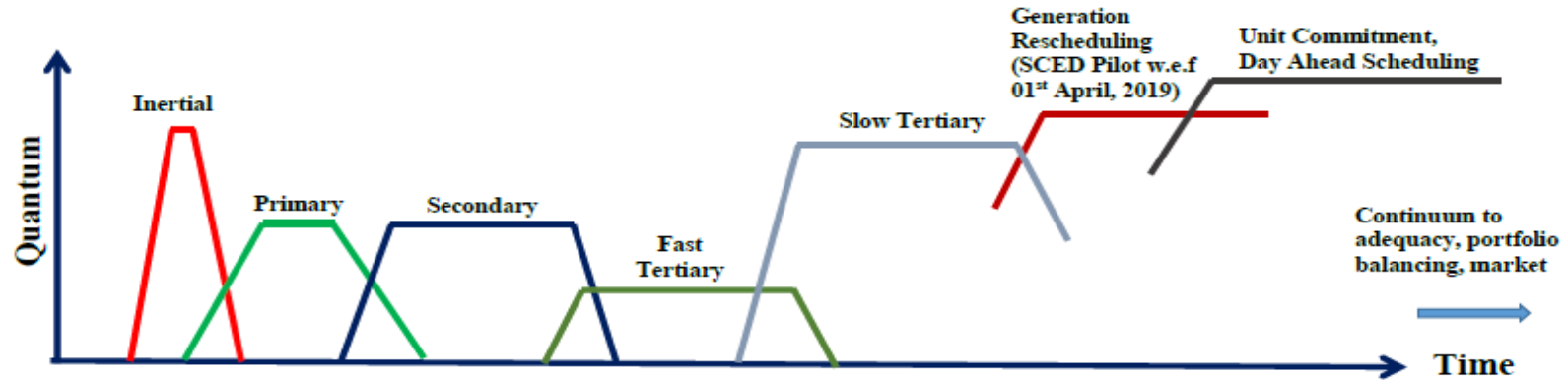


Buy Bids >> Sell Bids

Need for SCUC mandate



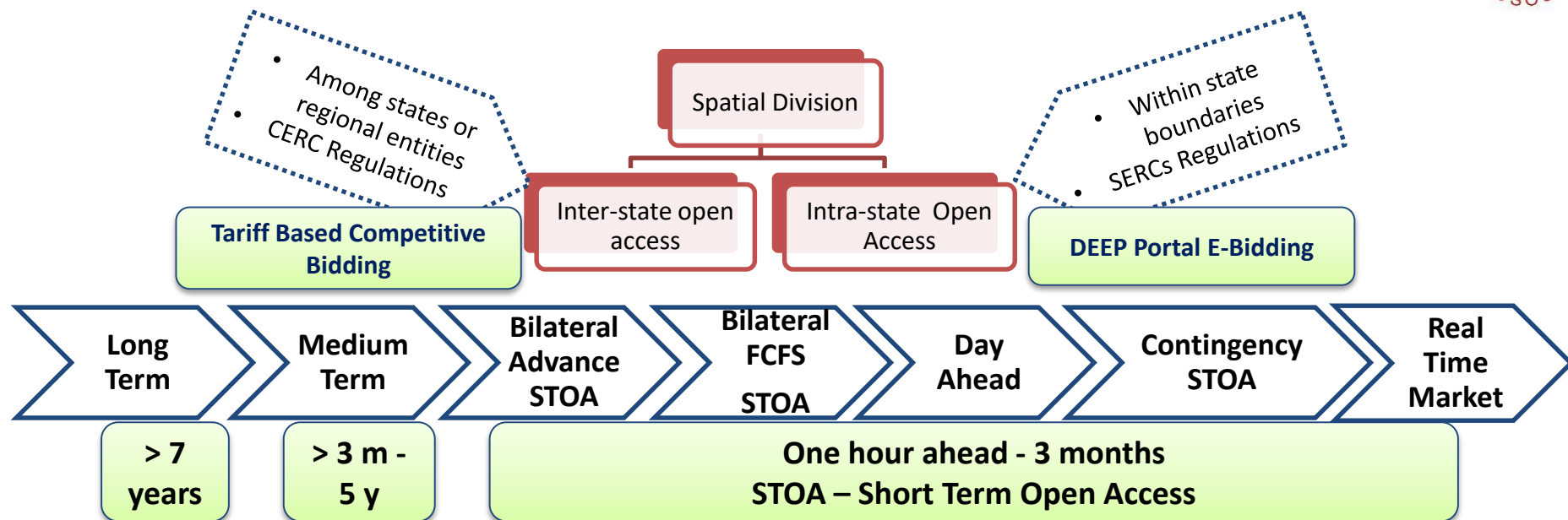
# System Balancing Continuum



Response → ↓ Attribute	Inertial	Primary	Secondary	Fast Tertiary	Slow Tertiary	Generation Rescheduling/Market	Unit Commitment
Time	First few secs	Few sec - 5 min	30 s – 15 min	5 - 30 min	> 15 – 60 min	> 60 min	Hours/ day-ahead
Quantum	~ 10000 MW/Hz	~ 4000 MW	~ 4000 MW	~ 1000 MW	~ 8000-9000 MW	Load Generation Balance	Load Generation Balance
Local / LDC	Local	Local	NLDC/RLDC	NLDC	NLDC/SLDC	RLDC / SLDC	RLDC / SLDC
Manual / Automatic	Automatic	Automatic	Automatic	Manual	Manual	Manual	Manual
Centralized / Decentralized	Decentralized	Decentralized	Centralized	Centralized	Centralized/ Decentralized	Decentralized	Decentralized
Code / Order	IEGC / CEA Standard (?)	IEGC / CEA Standard	Roadmap on Reserves	CERC Order on FRAS Pilot	RRAS Regulations	IEGC	IEGC
Paid / Mandated	Mandated	Mandated	Paid	Paid	Paid	Paid	Paid
Regulated / Market	Regulated	Regulated	Regulated	Regulated	Regulated / Market	Regulated / Market	Regulated / Market
Implementation	Existing	Partly Existing ; Testing under progress	Pilot 5 plants; Pan India by end of FY20	Pilot 19 plants (Nov'18 – May'19)	Existing (62 GW)	Existing; Real time market w.e.f. June'20 with hourly gate closure	Existing

**Need for strengthening from both ends of continuum for introduction of markets !**

# Transmission Access Administration



## Nodal Agency (Inter-state Transactions)

- Central Transmission Utility (CTU)
- Regional Load Despatch Centre(s) (OTC Market)
- National Load Despatch Centre (Spot/Real Time Market)

## Nodal Agency (Intra-state Transactions)

- State Transmission Utility (STU) for intra-state
- State Load Despatch Centre(s) (OTC Market)

# Thank you !!



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