



USAID
FROM THE AMERICAN PEOPLE

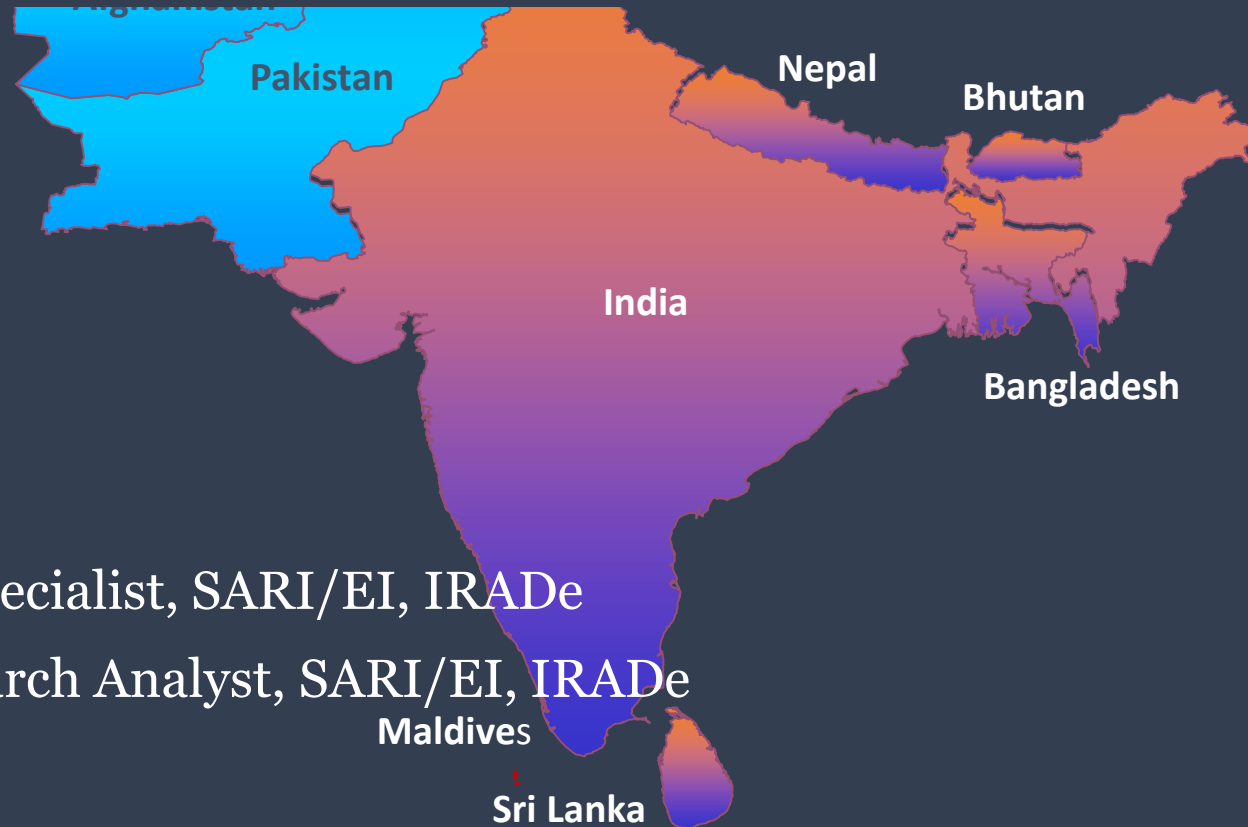
SARI/EI



Integrated Research and
IRADe Action for Development

SARPEX Mock Exercise

Day Ahead Market (DAM) in the South Asian Region



Presented by:

Mr. S.K. Ray, Technical Specialist, SARI/EI, IRADe

Mr. Gaurav Jain, Sr. Research Analyst, SARI/EI, IRADe

Maldives

Sri Lanka



"South Asian Regional Power Exchange (SARPEX) Mock Exercise"

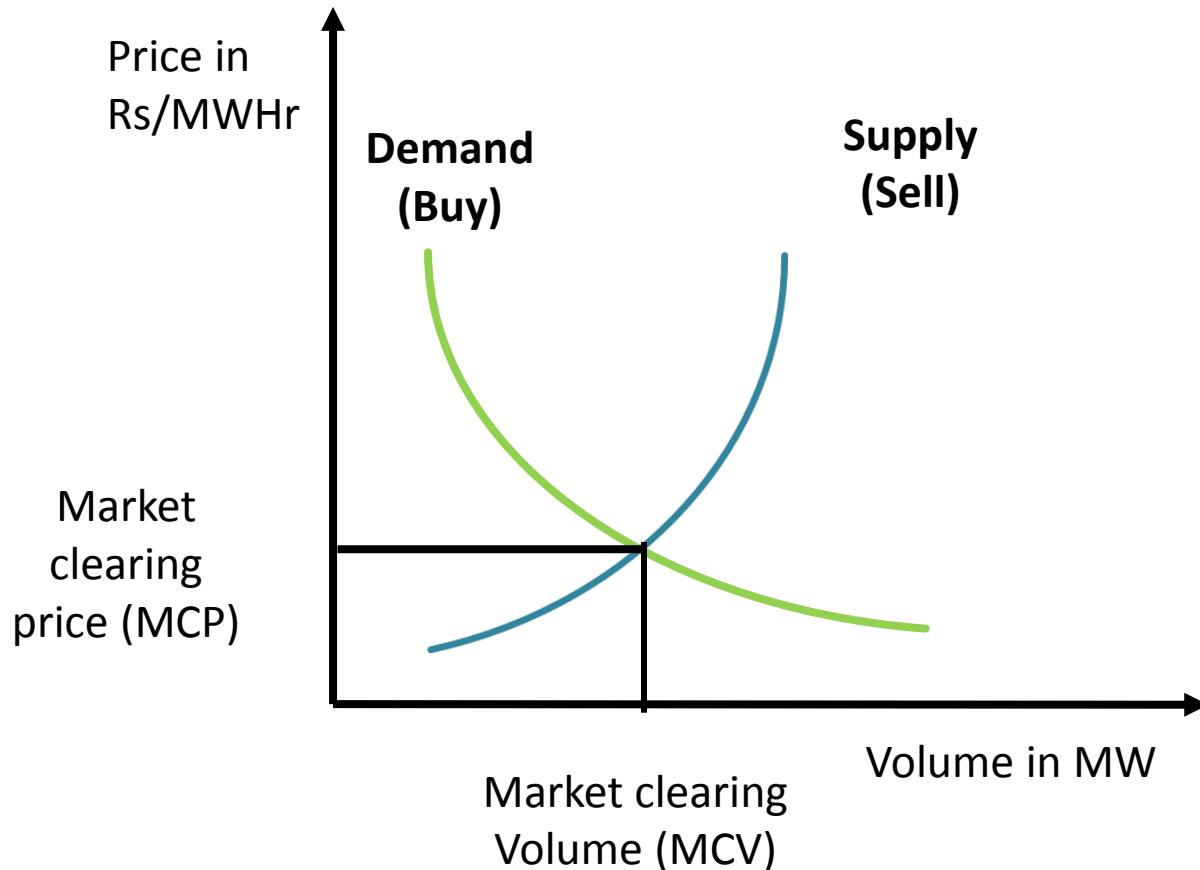
Content

- ***Overview & Brief about SARPEX exercise***
- ***Market Design & Rules***
- ***Results of SARPEX Mock Exercise***

*Overview & Brief about SARPEX
Mock Exercise*

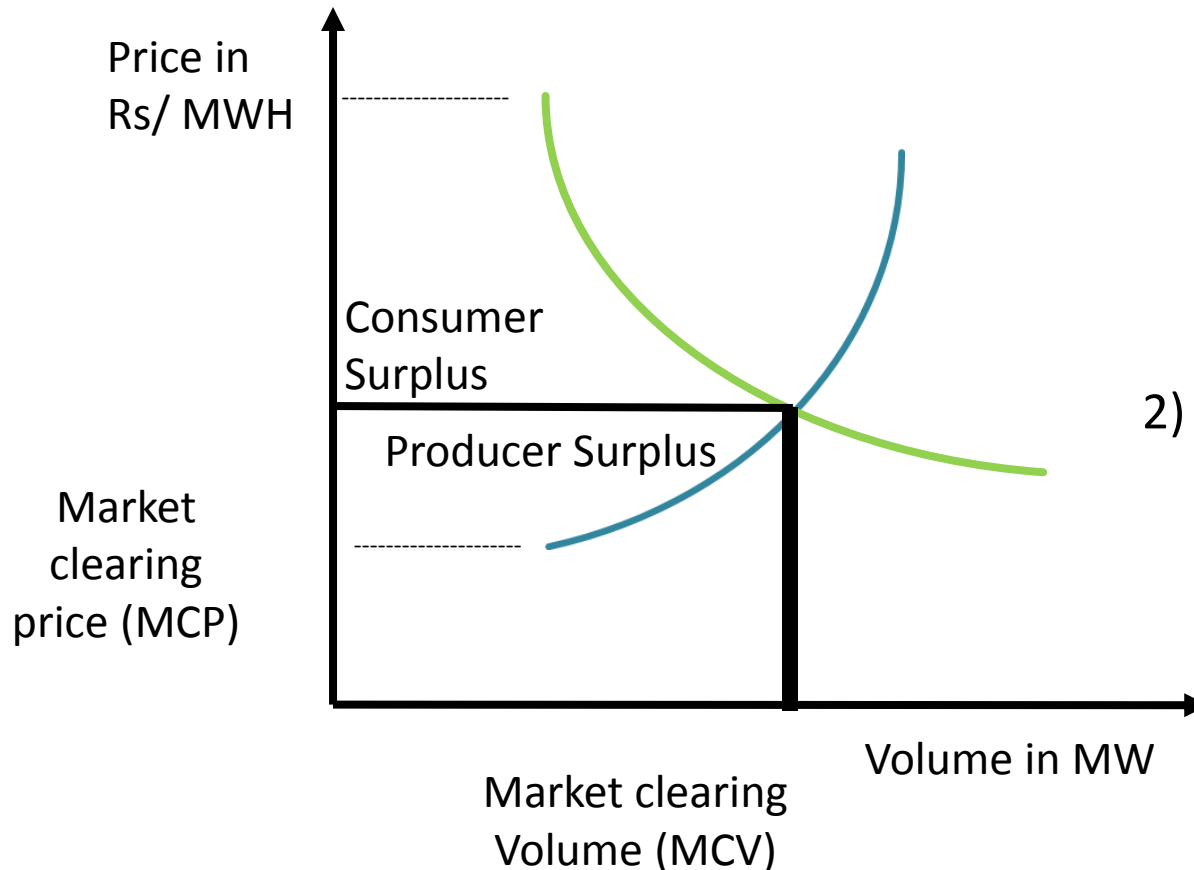


Basic Concepts of Day Ahead Market (DAM)



- A curve is plotted for the Supply. All the points in the curve represent the Supply bid volume for that price.
- The point of intersection gives the Market clearing price (MCP) and the Market clearing volume (MCV)
- All sellers willing to sell at MCP or at a lower price are cleared.
- All the buyers willing to buy at MCP or at a higher price are cleared.
- All trades are cleared at MCP irrespective of their bid price.
- A curve is plotted for the Demand. All the points in the curve represent the Demand bid volume for that price.

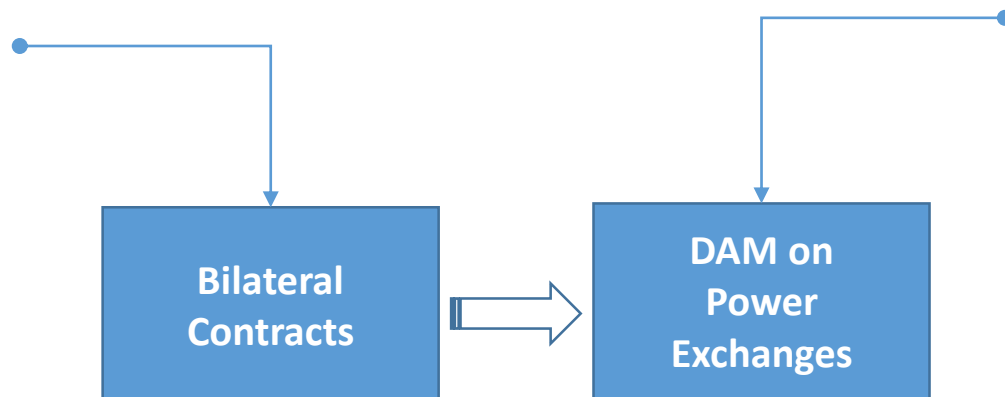
Concept of Consumer Surplus and Producer surplus



- 1) Consumer Surplus. All the buyers whose bids were higher than MCP have been cleared. However they will get power at a price lesser than their bid price. Thus they get power at a price lesser than that they were willing to pay. This gain is called the consumer surplus and benefits all buyers on the curve OD.
- 2) Producer Surplus. All the sellers whose bids were lower than MCP have been cleared. However they will get power at a price higher than their bid price. Thus they get to sell their power at a price higher than that they were willing to accept. This gain is called the producer surplus and benefits all sellers on the curve OS.

Benefits of DAM Over Other Contracts

- Trading parties specify the contractual terms
 - Negotiating & customization of contracts may take weeks, months to years
 - Assessing the creditworthiness of Counterparty involves risk & costs
 - Negotiated Price
 - Bilateral Transactions with clear identification of buyer and seller.
 - Long term commitment.
- Not suitable for closer to real time operations



- Standardized contract structures
 - Centralized trading with easier & faster access to operate closer to real time
 - Low transaction costs, safe counterparty with clearing and settlement service
 - Market determined price
 - Collective Transactions. No one to one identification of buyer and sellers.
 - No Long Term Commitment
- More suitable for closer to real time operations

Regional Complementarities- Monthly and Hourly

| | January | February | March | April | May | June | July | August | September | October | November | December |
|--------------------|---------|----------|-------|-------|--------|-------|-------|--------|-----------|---------|----------|----------|
| Bangladesh | Green | Green | Blue | Red | Red | Red | Blue | Blue | Blue | Blue | Green | Green |
| India - North East | Blue | Green | Blue | Green | Green | Blue | Red | Red | Blue | Red | Red | Blue |
| Bhutan | Red | Red | Blue | Blue | Blue | Green | Green | Green | Green | Blue | Blue | Red |
| India - East | Green | Blue | Red | Red | Blue | Red | Red | Red | Red | Blue | Green | Green |
| Nepal | Red | Red | Blue | Blue | Green | Green | Green | Green | Green | Blue | Blue | Blue |
| India - North | Blue | Blue | Green | Green | Blue | Red | Red | Red | Red | Blue | Green | Blue |
| India - West | Red | Red | Red | Blue | Blue | Blue | Green | Green | Green | Red | Red | Red |
| Pakistan | Green | Green | Blue | Blue | Blue | Red | Red | Red | Red | Blue | Blue | Blue |
| India - South | Red | Red | Red | Red | Blue | Green | Green | Blue | Blue | Blue | Green | Blue |
| | | | | Low | Medium | High | | | | | | |

| Countries | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bangladesh- April | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark |
| Bhutan - April | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light |
| India- April | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark |
| Nepal- April | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light |
| Pakistan-April | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark | Dark |
| Sri Lanka- April | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light | Light |

| Color Coding | Range | |
|--------------|--------------------|--------------------|
| | Lightest | Min |
| Light | Min+ (Max-Min)*20% | Min+ (Max-Min)*40% |
| Medium-Light | Min+ (Max-Min)*40% | Min+ (Max-Min)*60% |
| Medium-Dark | Min+ (Max-Min)*60% | Min+ (Max-Min)*80% |
| Darkest | Min+ (Max-Min)*80% | Max |

"South Asian Regional Power Exchange (SARPEX)- Mock Exercise"

Key Policy developments in Cross Border Trading

Inter-Governmental Agreement between Bhutan and India on development of JV Hydropower Projects

SAARC Inter-Governmental Framework Agreement (IGFA) on Energy Cooperation

Ministry of Power, India Guidelines on Cross Border Electricity Trade

Center Electricity Regulatory Commission, India regulation on CBTE.....

Apr, 2014

Sep, 2014

Nov, 2014

Oct, 2015

Nov, 2016

Feb, 2017

2017

Power Trade Agreement (PTA) between India and Nepal

Sub-Regional Cooperation between Bangladesh, Bhutan, India and Nepal (BBIN)

Center Electricity Regulatory Commission, India draft notification on CBTE

"South Asian Regional Power Exchange (SARPEX)- Mock Exercise"

Some Terminology relevant to the exercise 1/2

- Day ahead market (DAM): Bidding in the market is done on day n, for trades which are effective on day n+1.
- Unconstrained Market Price and volume (UMP & UMV) : The discovered market price and volume which do not take into account transmission constrains.
- Constrained Market Price and volume (CMP & CMV) : The discovered market price and volume discovered after taking into account the transmission constrains
- Bid Area : When ever there is a transmission congestion between two parts of the grid, there is a difference in MCP created due to the same. The market is said to have split into different are(s) having different MCP and each such are is called a bid area.
- Modes of operation of pilot market:-
 - A. Sequential Mode - The pilot market shall be run such that the Indian domestic exchanges are not in any manner influenced by the operation of the pilot market. The un-cleared bids of Indian Domestic exchanges shall be matched against the bids of the other nations in the pilot market platform.
 - B. Unified Mode - The pilot market shall be run such that all the bids including the bids from Indian participants are cleared simultaneously the pilot market platform.

Some Terminology relevant to the exercise 2/2

- India Only Mode: Along with the Unified mode and the sequential mode, the results mention “India Only Mode”. This is nothing but the matching engine run with only the bids of India. This represents the Indian Domestic DAM. The results are useful for comparison purpose as we will see.
- Month-wise/Monthly Weighted Average Buy Price - Average MCP typically observed in a month, weighted by the total volumes bought by a country in each block for that month. It is calculated by extrapolating the block-wise MCP of selected days over the entire month
- Month-wise/Monthly Weighted Average Sell Price - Average MCP typically observed in a month, weighted by the total volumes sold by a country in each block for that month. It is calculated by extrapolating the MCP of all selected days over the entire month.
- Month-wise/Monthly Weighted Average Market Clearing Price - Average MCP typically observed in a month, weighted by the total volumes cleared in each block in that month. It is calculated by extrapolating the block-wise MCP of all selected days over the entire month
- Daily Average Price - The MCP observed for a typical day in each month. It is computed by averaging the Month-wise MCP over each block of time

Brief about SARPEX Mock Exercise

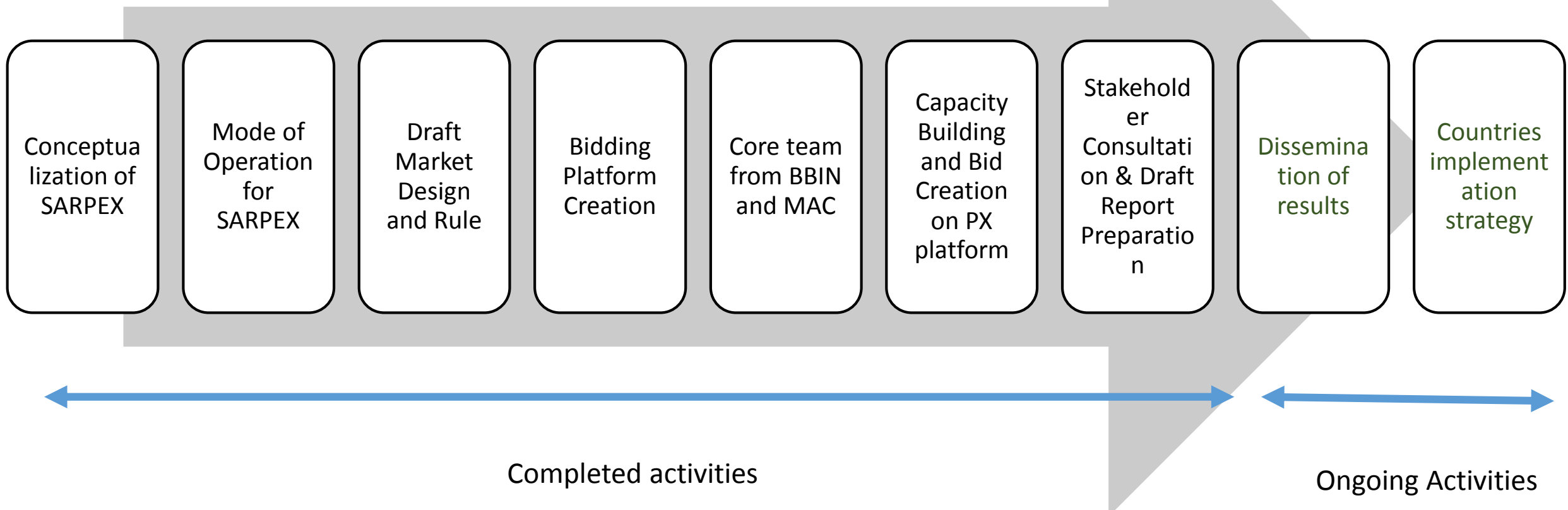
- The exercise covers the period from April'2015 to March'2016.
- 71 days have been selected in this one year period to cover all kind of demand situation and various other crucial factors (Sampling methodology) in the BBIN region.
- Core teams have been nominated by Bangladesh, Bhutan and Nepal who will bid for all the dispatch periods of all these 71 days.
- Indian bids for these 71 days have been extracted from information available in public domain.
- The mock trading platform was run to generate results for all these 71 days.
- The mock trading platform shall be run in two modes of operation, “Unified mode” and “Sequential or Residual Mode” as explained further in this presentation.
- The market rules and design for running of the mock exercise have been finalized for both the modes of operation.

Brief about SARPEX Mock Exercise .. Continued

- The transmission losses and charges have been factored in as in case of a regular day ahead market.
- The figures of transmission losses and charges used for Bangladesh, Bhutan and Nepal are mentioned further in this presentation.
- The result of the matching engine yields the unconstrained solution.
- The result for the 71 days was extrapolated to get the result for the entire year for both the modes of operation.
- The consumer and producer surplus, quantum of power sold/bought, sale/buy price etc. for each participating Nations and the entire region was worked out in both the modes .
- The impact of the regional trading platform on the domestic market was be analyzed.
- Based on the above, a particular set of market rules and design will be recommended for SARPEX.



SARPEX- Mock Exercise activities



Selected Days for Pilot Market Exercise

A total of 71 days were selected as the sample for Mock Exercise

Selection of the days was based on the following criterion:

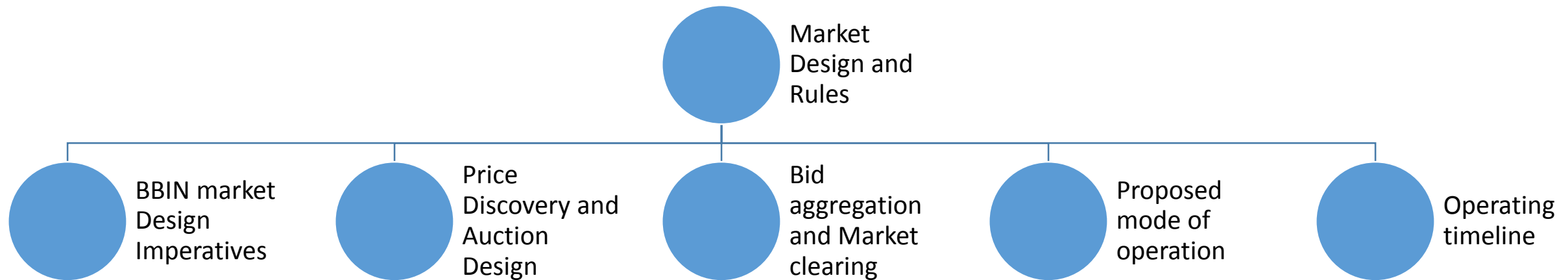
Average to Peak Load condition in all nations, Unconstrained Market-clearing Price and Volume on Indian Exchange(s), Day and Month Effect and Public holidays/Special days observed in all the nations

| APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|-----------------------------|---------------------------|------------------------------|-----------------------------|------------------------------|-------------------------------|
| Sunday, April 5, 2015 | Wednesday, May 13, 2015 | Thursday, June 11, 2015 | Thursday, July 2, 2015 | Saturday, August 8, 2015 | Sunday, September 13, 2015 |
| Saturday, April 11, 2015 | Friday, May 15, 2015 | Sunday, June 14, 2015 | Saturday, July 11, 2015 | Sunday, August 9, 2015 | Sunday, September 20, 2015 |
| Monday, April 13, 2015 | Saturday, May 16, 2015 | Monday, June 15, 2015 | Monday, July 13, 2015 | Tuesday, August 11, 2015 | Tuesday, September 22, 2015 |
| Sunday, April 19, 2015 | Tuesday, May 19, 2015 | Sunday, June 21, 2015 | Thursday, July 16, 2015 | Wednesday, August 19, 2015 | Wednesday, September 23, 2015 |
| Wednesday, April 29, 2015 | | Friday, June 26, 2015 | Sunday, July 26, 2015 | Thursday, August 20, 2015 | Monday, September 28, 2015 |
| | | Saturday, June 27, 2015 | Monday, July 27, 2015 | Saturday, August 22, 2015 | |
| | | Tuesday, June 30, 2015 | | Sunday, August 23, 2015 | |
| | | | | Wednesday, August 26, 2015 | |
| | | | | Sunday, August 30, 2015 | |
| OCTOBER | NOVEMBER | DECEMBER | JANUARY | FEBRUARY | MARCH |
| Tuesday, October 13, 2015 | Friday, November 27, 2015 | Thursday, December 10, 2015 | Wednesday, January 6, 2016 | Sunday, February 7, 2016 | Saturday, March 5, 2016 |
| Wednesday, October 14, 2015 | | Monday, December 14, 2015 | Friday, January 8, 2016 | Monday, February 8, 2016 | Tuesday, March 8, 2016 |
| Saturday, October 17, 2015 | | Tuesday, December 15, 2015 | Saturday, January 9, 2016 | Thursday, February 11, 2016 | Monday, March 14, 2016 |
| Thursday, October 22, 2015 | | Sunday, December 20, 2015 | Monday, January 11, 2016 | Sunday, February 14, 2016 | Saturday, March 19, 2016 |
| | | Wednesday, December 23, 2015 | Thursday, January 14, 2016 | Wednesday, February 24, 2016 | Monday, March 21, 2016 |
| | | Thursday, December 24, 2015 | Tuesday, January 19, 2016 | | Monday, March 28, 2016 |
| | | Tuesday, December 29, 2015 | Wednesday, January 20, 2016 | | Tuesday, March 29, 2016 |
| | | Wednesday, December 30, 2015 | Thursday, January 21, 2016 | | Thursday, March 31, 2016 |
| | | | Friday, January 29, 2016 | | |

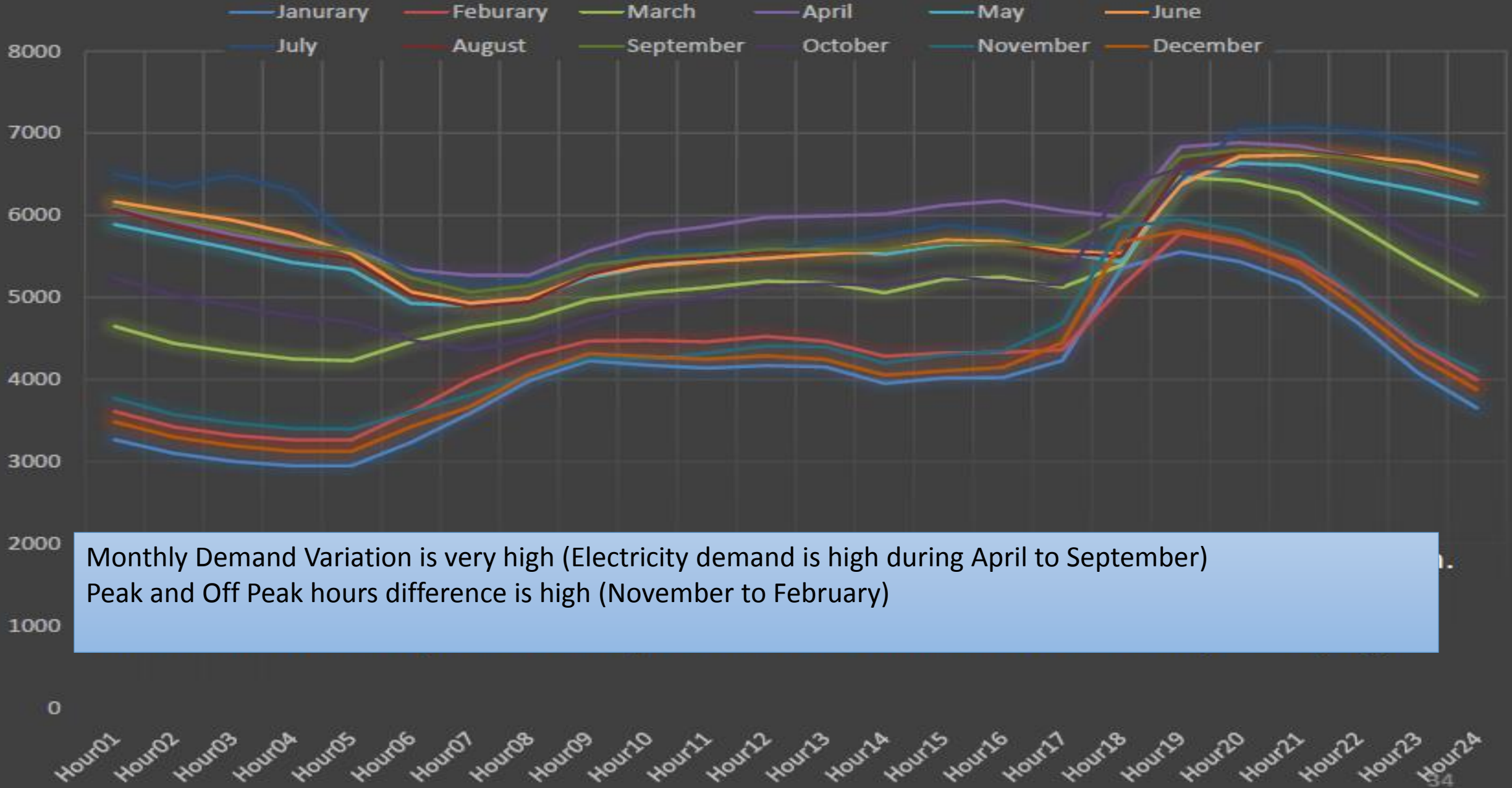
Market Design & Rules

Market Design and Rule For SARPEX

- An efficient market design for Power Exchanges may optimizes the Social Welfare is fundamental to developing and sustaining integration of the SARPEX countries.
- Harmonisation of the market rules across the SARPEX countries through an appropriate market design will likely lead to efficient utilization of available resources and infrastructure.

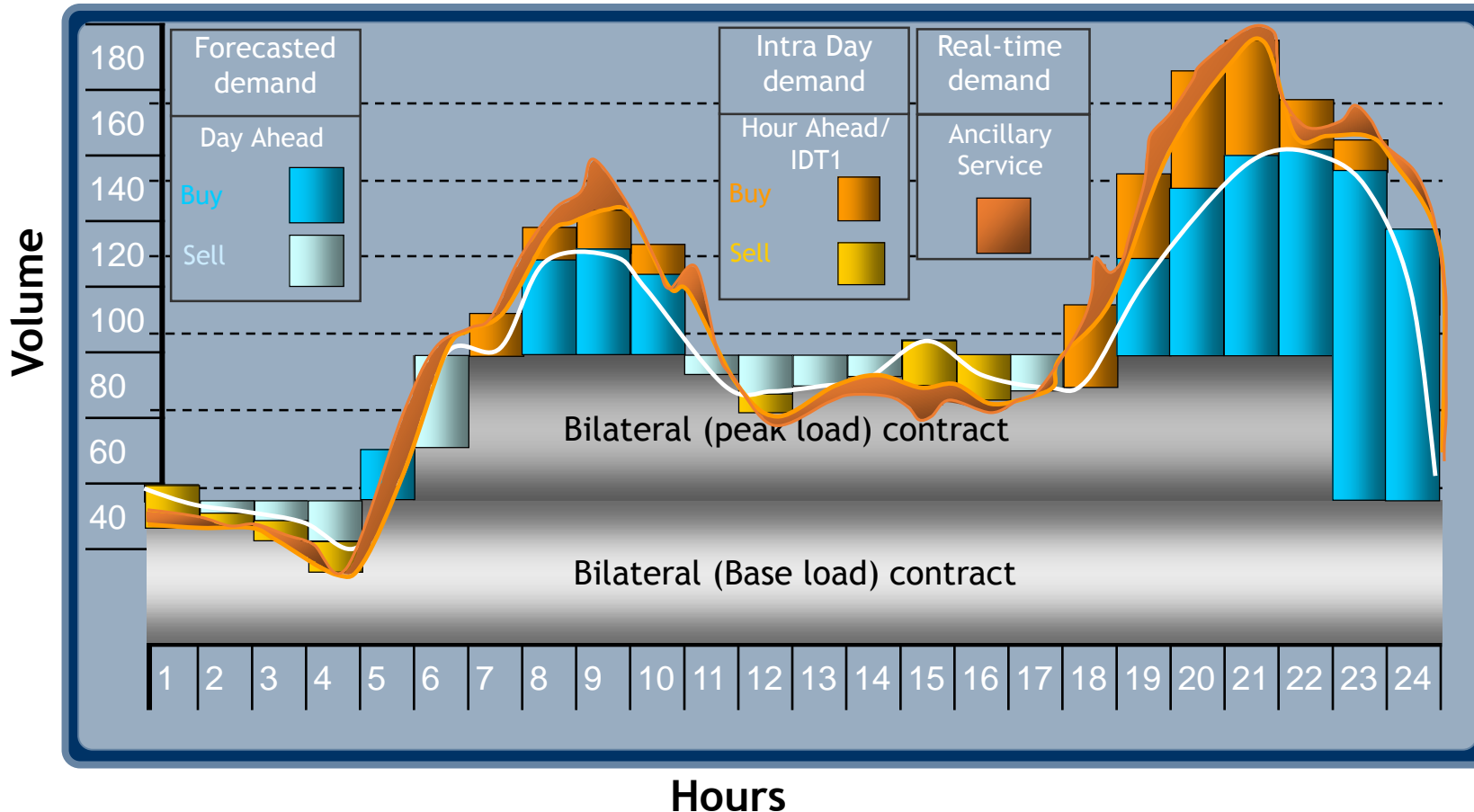


BANGLADESH LOAD PROFILE



Monthly Demand Variation is very high (Electricity demand is high during April to September)
Peak and Off Peak hours difference is high (November to February)

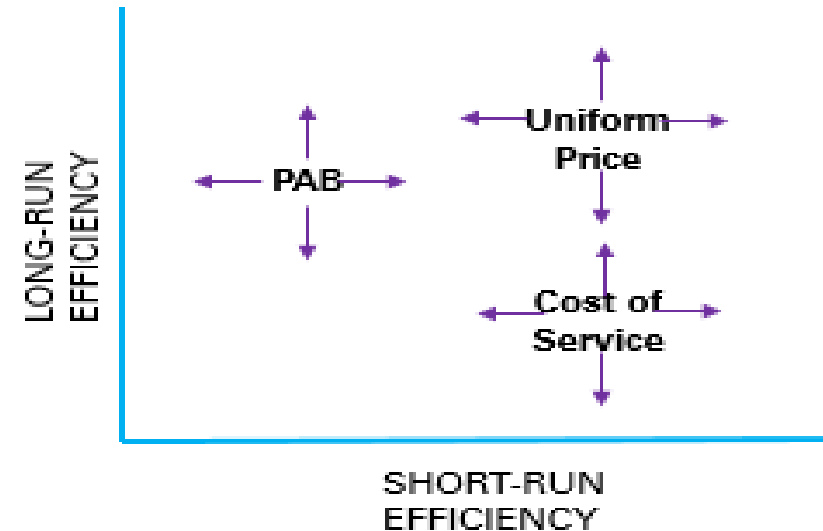
Market Product and Application: Optimal Management of daily Demand Supply Position



- The DAM spot with 15-minute dispatch is inherently more compatible than bilateral for closer to the real time needs for balancing the demand supply gaps
- Optimal management of daily / seasonal variations in demand or supply - buy/sell the surplus / deficits

BBIN Market Design Imperative

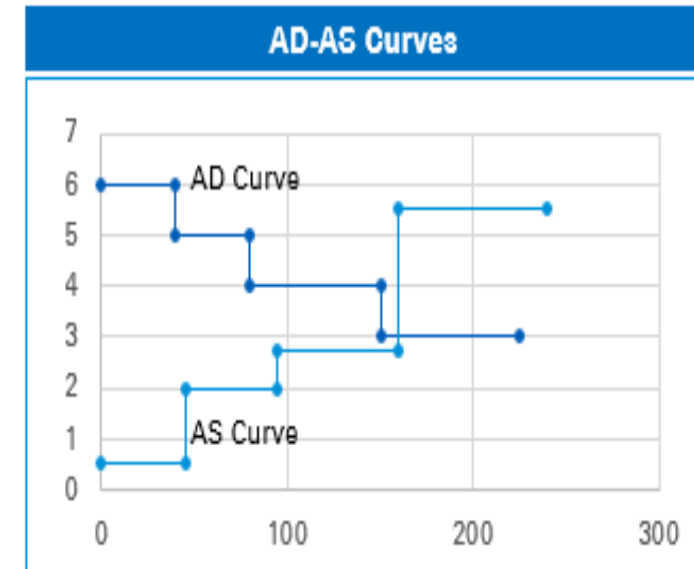
- Existing Laws, Prevailing Market conditions
- Power Exchanges use the Market Clearing mechanism to determine an efficient price and volume to clear the market.
- This mechanism uses an algorithm that aggregates bids and arrives at a Market Clearing Price (MCP) and Market Clearing Volume (MCV).
- In a Uniform Price auction, the sellers have an incentive to bid their marginal cost of generation or the forgone opportunity to sell in another market, since irrespective of what they bid a uniform price will be paid to all.
- Similarly, the buyers bid their marginal utility based on the financial constraints or willingness-to-pay.
- The underlying assumption in this case is that suppliers/buyers will be unable to affect the eventual market clearing price, owing to the large number of participants, leaving no incentive to bid above the marginal cost.



Bid Aggregation and Market Clearing

- The AD and AS curves are obtained by stacking buy bids & sell bids, placed every 15 minutes.
- The intersection point of the curves so obtained, is called the equilibrium price.
- Similarly, the buyers bid their marginal utility based on the financial constraints or willingness-to-pay.
- The underlying assumption in this case is that suppliers/buyers will be unable to affect the eventual market clearing price, owing to the large number of participants, leaving no incentive to bid above the marginal cost.

| Sample Bids for a time period | | | |
|-------------------------------|----------|--------|----------|
| Bids | | Offers | |
| Price | Quantity | Price | Quantity |
| 6 | 40 | 0.5 | 45 |
| 5 | 40 | 2.0 | 50 |
| 4 | 70 | 2.75 | 65 |
| 3 | 75 | 5.5 | 80 |



Operating Rules for SARPEX

Participation Pre-Requisites

- In SARPEX, all trades are expected to be through the Indian Grid; while the operational control of respective grids of Countries is within their own jurisdiction.
- Thus, provision of NOC to allow access to the Grid Operator in absence of standardized Open Access Regulations.

Scheduling

- Unlike Bilateral Contracts, where delivery points are mutually agreed by counter parties, the delivery points are pre-determined in Exchange in order to have a uniform price for all the buy and sale transactions
- The interconnection of the cross-border transmission line and the inter-state transmission network of India (International periphery) may be the delivery point for buy or sale of power by Member Countries

Operating Rules for SARPEX

Deviation Settlement

- Deviation is the mismatch in scheduled and actual injection / drawl of power to / from the grid. Inadvertent deviations from schedule may pose threats to the grid stability and security
- Nodal Agency to be responsible for overall settlement of deviations at the International Periphery and penalties would be as per the applicable DSM rates.
- Deviation settlement may be pro-rated in the case of multi Nodal Agency involvement for different transaction types

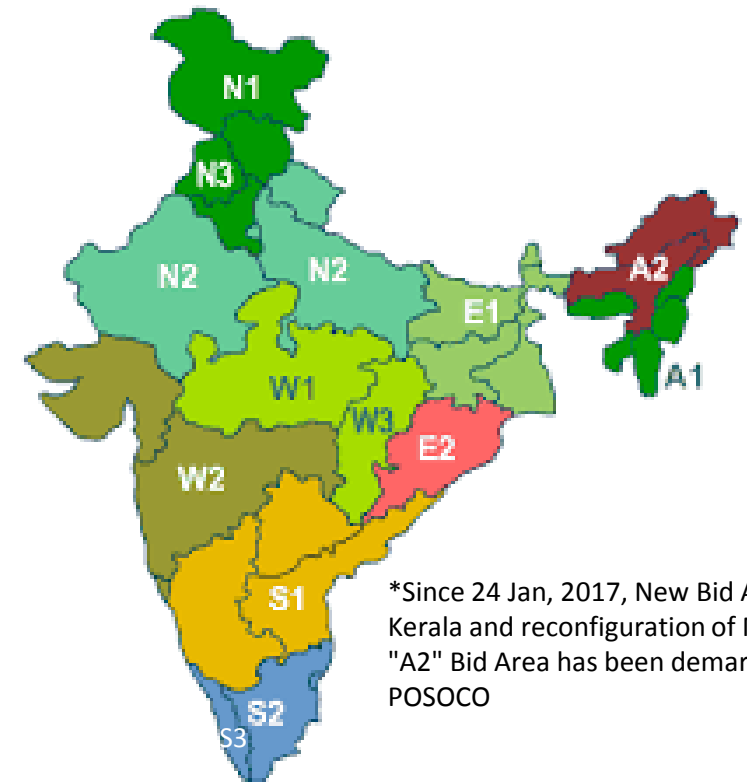
Transmission Charges & Losses

- Currently, all the Member Countries have their own mechanisms for estimation and application of transmission charges and losses on the entities using the grid
 - In case of cross border bilateral contracts, the charges are levied in accordance with the MOU / contractual terms
 - The POC injection and drawal charges and losses for various interconnection points of cross-border transmission lines in the Indian grid are already in place

Key considerations in the formation of Bid Areas

- Bid areas determine the prices paid or charged by buyers or sellers in any specific geography in keeping with the grid constraints
- In case of transmission constraints, separate markets are formed in the congested areas which requires creation of separate bid areas (market splitting principle)
- Other factors for creation of a separate Bid area may be economic, political or technical, network topography in nature

Existing Bid Area definitions in India*

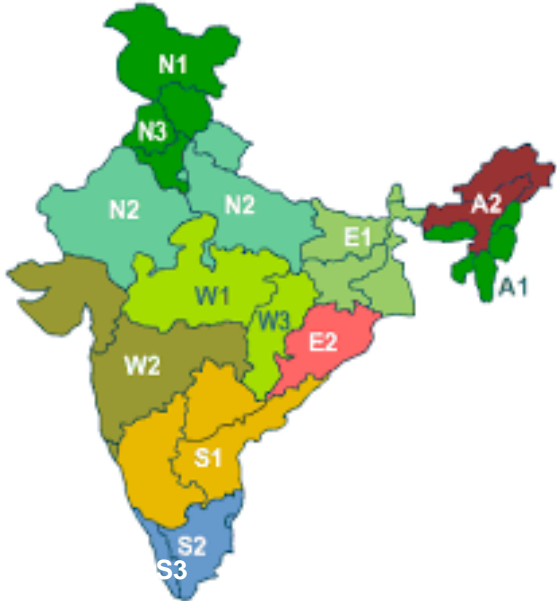


*Since 24 Jan, 2017, New Bid Area "S3" for Kerala and reconfiguration of Meghalaya in "A2" Bid Area has been demarcated by POSOCO

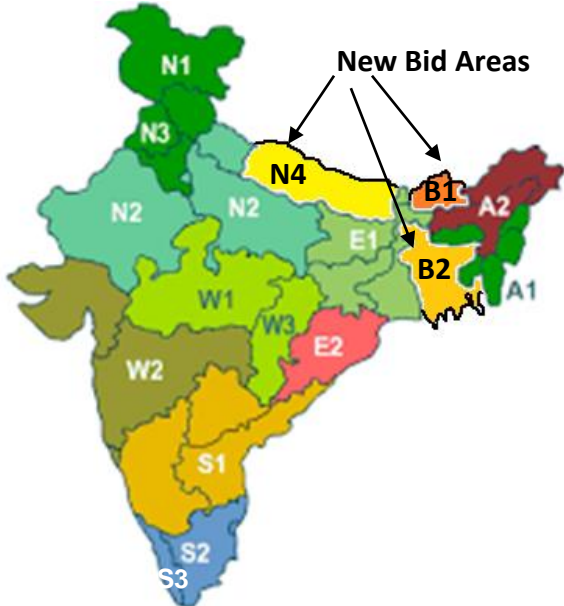
Disclaimer: This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

SARPEX Bid Areas

Retaining the Indian Bid Areas



Additional Areas for each new country



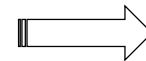
- Creation of individual bid areas for each country may be desired due to the following
 - Differences in the Sovereign Laws, Power Sector Structure, Grid operation related processes and procedures
 - Perceived constraints in the cross border transmission lines
 - Settlement of Deviations from schedules
 - Alignment of time differences
 - Settlement of currency related issues

Disclaimer: This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Time Zones and deviation in BBIN

Time zones observed in BBIN relative to UTC

| Country | Time zone (In Hours) | IST Deviation (In Minutes) |
|------------|----------------------|----------------------------|
| India | UTC + 5:30 | - |
| Bhutan | UTC + 6:00 | +30 minutes |
| Bangladesh | UTC + 6:00 | +30 minutes |
| Nepal | UTC + 5:45 | +15 minutes |



Mismatches in time-zones has implications on coordination of DAM operational activities

Coordination Challenges in operating SARPEX due to Time Mismatches

Electricity Dispatch at the “day boundary” for three consecutive days

| | D-2 | | | | | | D-1 | | | | D | | | | | | | |
|------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Slots | 41 | 48 | 49 | 71 | 95 | 96 | 1 | 2 | 41 | 49 | 95 | 96 | 1 | 2 | 41 | 49 | 95 | 96 |
| India | 10:00 | 11:45 | 12:00 | 17:30 | 23:30 | 23:45 | 00:00 | 00:15 | 10:00 | 12:00 | 23:30 | 23:45 | 00:00 | 00:15 | 10:00 | 12:00 | 23:30 | 23:45 |
| Nepal | 10:15 | 12:00 | 12:15 | 17:45 | 23:45 | 00:00 | 00:15 | 00:30 | 10:15 | 12:15 | 23:45 | 00:00 | 00:15 | 00:30 | 10:15 | 12:15 | 23:45 | 00:00 |
| Bhutan | 10:30 | 12:15 | 12:30 | 18:00 | 00:00 | 00:15 | 00:30 | 00:45 | 10:30 | 12:30 | 00:00 | 00:15 | 00:30 | 00:45 | 10:30 | 12:30 | 00:00 | 00:15 |
| Bangladesh | 10:30 | 12:15 | 12:30 | 18:00 | 00:00 | 00:15 | 00:30 | 00:45 | 10:30 | 12:30 | 00:00 | 00:15 | 00:30 | 00:45 | 10:30 | 12:30 | 00:00 | 00:15 |

Coordination Issues

Day D-2 Day D-1 Day D

Dispatch periods at the “day boundary” i.e. Slot 95 and Slot 96 may lead to coordination issues. While these slots belong to Day “D-1” in India, they belong to Day “D” i.e. the next day in Bhutan, Bangladesh and Nepal

*Results of SARPEX Mock
Exercise*

Total Yearly Surplus in the 3 Modes for FY'16

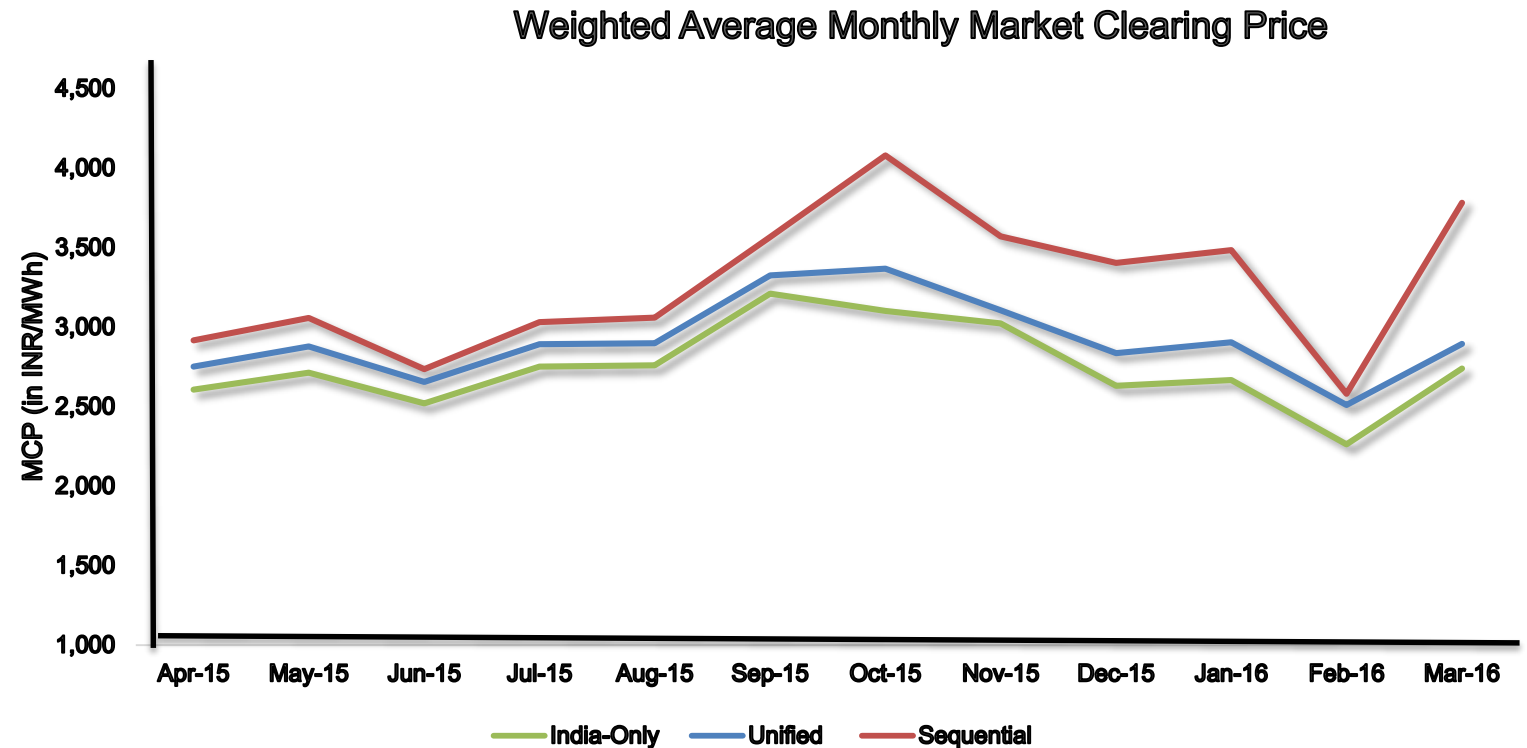
| Surplus (Rs Billion) | |
|----------------------|--------|
| India Only | 313.53 |
| Unified | 323.63 |
| Sequential | 323.24 |

The surplus in the two modes of Operation for SARPEX are practically the same on a Regional basis.

The difference, is negligible given that the Mock Exercise only simulates the possible behavior of all bidders in the DAM on SARPEX through inputs that are accurate to a reasonable degree of accuracy

Weighted Average Market Clearing Price in the 3 Modes for FY'16

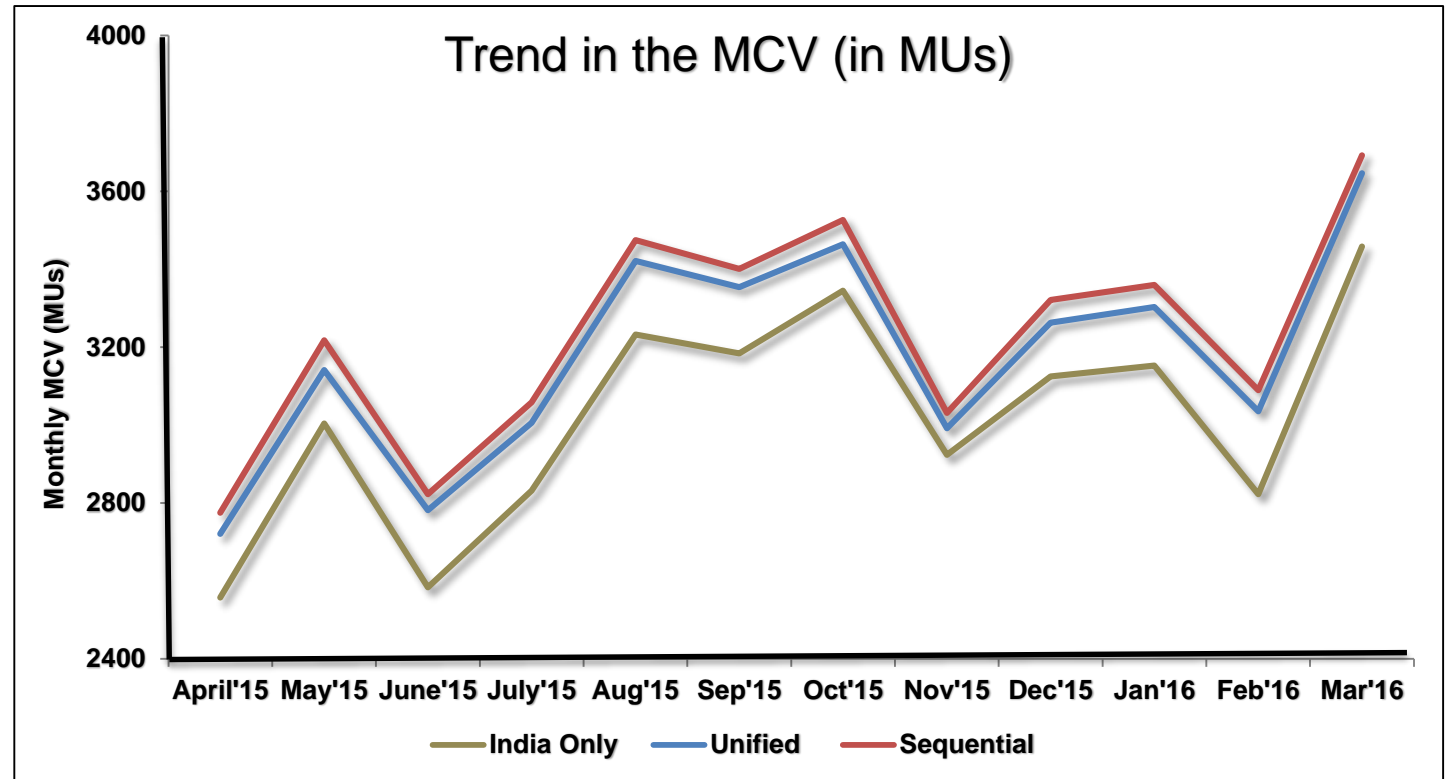
| | Monthly Weighted Average Market Clearing Price (in Rs/MWh) |
|------------|--|
| India-Only | 2745 |
| Unified | 2910 |
| Sequential | 3269 |



The market clearing volume for the respective mode is used as weight for computing the above figures

Total Market Clearing Volume in the 3 Modes for FY'16

| | Total Yearly Market Clearing Volume (in MUs) | % Increment over India-Only Mode |
|------------|--|----------------------------------|
| India-Only | 36219 | - |
| Unified | 38127 (1908*) | 0.05 |
| Sequential | 38768 (2549*) | 0.07 |



The figures for Unified and Sequential Mode include the existing DAM operations in India, referred as India-Only Mode

** The figures for in the bracket represent the change in MCV over India-Only Mode. This is the actual additional volume generated by the DAM. The MCV in case of sequential mode is significantly higher*

Surplus accrued to each nation (including the surplus of Indian DAM) for FY'16 Billion INR

| | Regional Surplus | Surplus Gain to Bangladesh | Surplus Gain to Nepal | Surplus Gain to Bhutan | Surplus Gain to India |
|------------|------------------|----------------------------|-----------------------|------------------------|-----------------------|
| Unified | 323.63 | 8.85 | 0.7 | 0.3 | 313.78 |
| Sequential | 323.24 | 8.23 | 0.63 | 0.42 | 313.96 |

The Surplus of India – only market is 313.53 Billion which is included in the above

Surplus accrued to each nation (Excluding the surplus of Indian DAM)for FY'16 Billion INR

| | Regional Surplus | Surplus Gain to Bangladesh | Surplus Gain to Nepal | Surplus Gain to Bhutan | Surplus Gain to India |
|------------|------------------|----------------------------|-----------------------|------------------------|-----------------------|
| Unified | 10.1 | 8.85 | 0.7 | 0.3 | 0.25 |
| Sequential | 9.71 | 8.23 | 0.63 | 0.42 | 0.43 |

The share of Bangladesh is more than 80% of the total Surplus

Total Volumes (unconstrained) bought by each nation on SARPEX for FY'16

MUs

| | India | Bangladesh | Nepal | Bhutan | Total |
|-------------------|--------------------------|-------------|------------|-------------|---------------------------|
| India-Only | 36219 | - | - | - | 36219 |
| Unified | 35406 (-813*) | 2011 | 719 | 0.1 | 38137 (1908*) |
| Sequential | 36219 (0*) | 1920 | 630 | 0.04 | 38769 (2549*) |

The additional volume over India only mode gives **the volume of the Cross Border DAM** which is 1908 Mus in case of Unified mode and 2549 Mus in case of sequential mode. **Roughly 6-7 Mus per day (UCV)**

The figures for Unified and Sequential Mode include the existing DAM operations in India.

** The figure in the bracket represents the change in purchase volume over India-Only Mode*

Share of Bangladesh is about 75% of the Total Volume

Volumes (unconstrained) sold by each nation on SARPEX for FY'16

In MUs

| | India | Bangladesh | Nepal | Bhutan | Total |
|-------------------|--------------------------|------------|-----------|------------|--------------|
| India-Only | 36219 | - | - | - | 36219 |
| Unified | 37715 (1496*) | - | 10 | 412 | 38137 |
| Sequential | 38342 (2123*) | - | 10 | 427 | 38779 |

The figures for Unified and Sequential Mode include the existing DAM operations in India.

** The figure in the bracket represents the change in purchase volume over India-Only Mode*

Weighted Average Buy Price for each nation on SARPEX for FY'16

In INR/MW hr

| | India | Bangladesh | Nepal | Bhutan |
|------------|-------|------------|-------|--------|
| India-Only | 2745 | - | - | - |
| Unified | 2919 | 2938 | 2893 | 3751* |
| Sequential | 2745 | 3099 | 2881 | 3438* |

The prices represent the Unconstrained MCP , weights have been computed using the cleared buy volume of each nation

** Bhutan is predominant seller on the Exchange. These buy volumes are very small*

The Buy Price for Bangladesh is about INR 3.00 per unit. This is much below the cost of domestic Power in Bangladesh

Weighted Average Sell price for each nation

In INR/ MWHr

| | India | Bangladesh | Nepal | Bhutan |
|------------|--------------|------------|-------|--------|
| India-Only | 2745 | - | - | - |
| Unified | 2918 | - | 2000 | 2983 |
| Sequential | 2965 (2768*) | - | 3000 | 3339 |

The prices in the sequential mode represents the weighted average price accrued to sellers from the sale of power in the sequential market

- The figure in the bracket represent the weighted average price to Indian sellers from the sale of power in domestic as well as residual market*

** Nepal is predominant buyer on the Exchange. These sell volumes are very small*

Modes of operation of DAM with CBTE

A. Unified Mode

The Cross Border Participants are allowed to bid directly into the Indian Domestic market DAM platform. The exchange operates such that all the bids, from Indian participants and Cross Border Participants are cleared simultaneously.

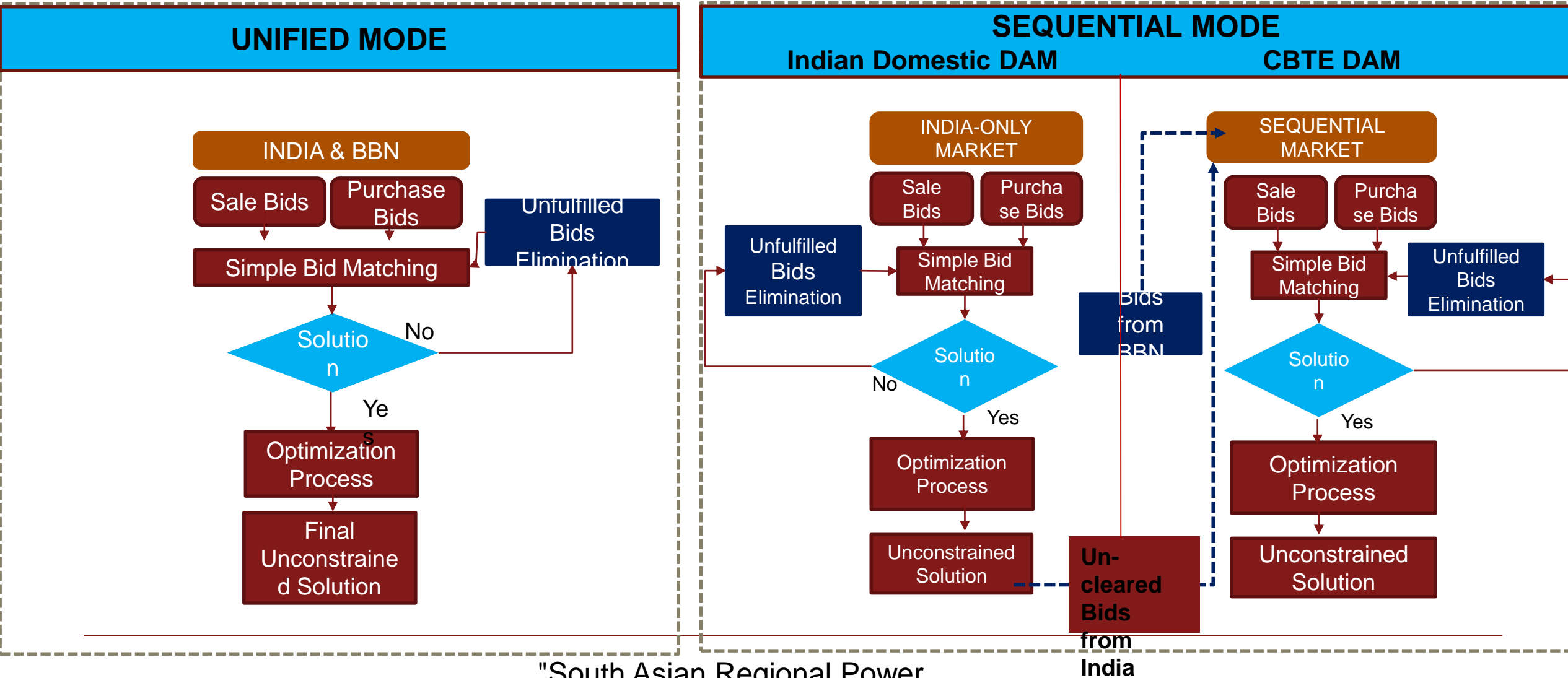
B. Sequential Mode

In this case, the market operates in two stages. In the first stage, the Indian Domestic Market (DAM) operates as it is done currently. The un-cleared bids of the eligible participants from the first stage is transferred to the second stage. These are then cleared against the bids of the Cross Border Participants.

The Sequential mode actually provides for a level playing fields for all the South Asian countries.

Reason – The BBN nations have bundled utilities or at least a single buyer seller model. Thus they are in a position to ensure that due priority is given to the domestic market before going to the Cross Border Market. India is unbundled and there is no single body to ensure the same. In the sequential mode, the same logic get applied to India.

Modes of operation of DAM with BBIN Participants



Discussions and Way Forward



THANK YOU

For more details please contact:-

- 1) S. K. Ray Technical Specialist, IRADe skray@irade.org ,+91 9971792136
- 2) Gaurav Jain Sr. Research Analyst IRADe gjain@irade.org , +91 9643380643

