



“Regional Power Market and power exchange based trade in South Asian region- SARPEX”

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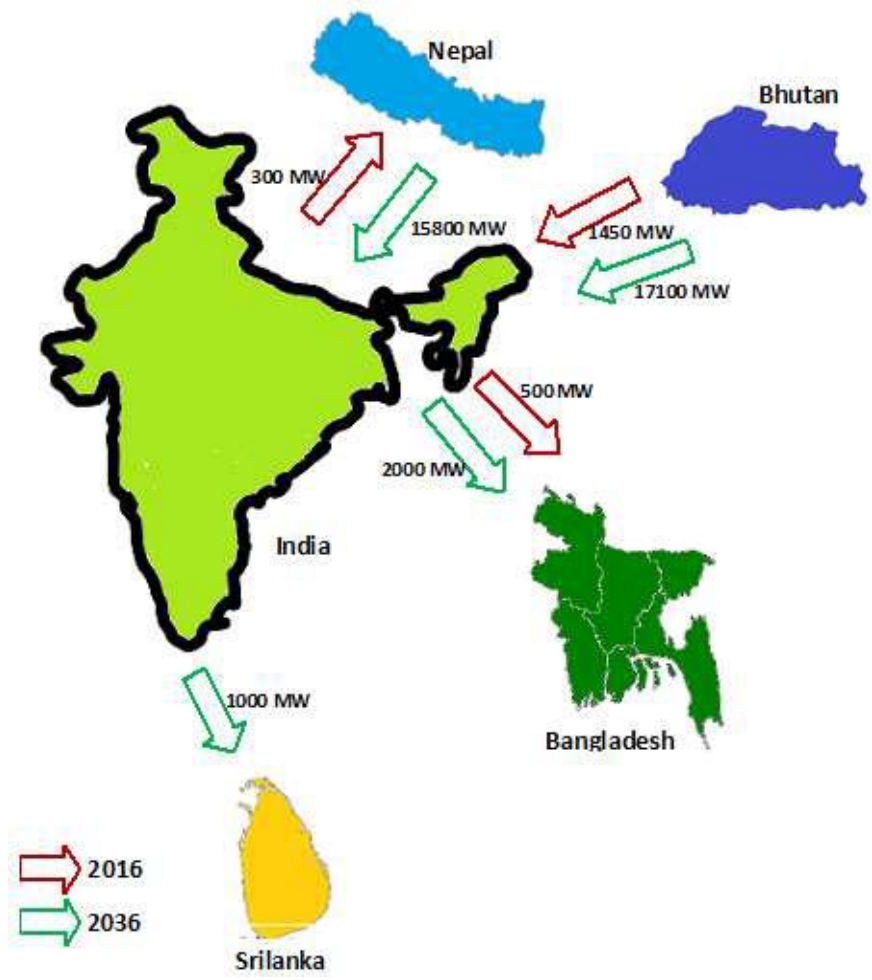


Contents

- Existing trade and complementarities
- Need of DAM (Day Ahead Market)
- SARPEX (South Asian Regional Power Exchange) journey so far
- Market design and rules
- Way-forward

Existing and Future Trade in South Asian region

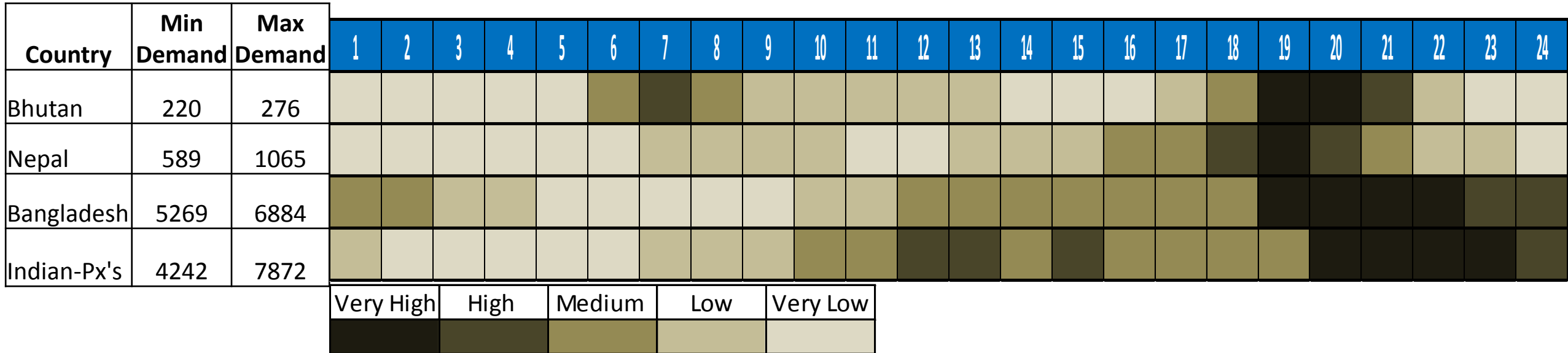
Country	Contracts quantum and duration	Type
Bhutan → India (1450 MW)	Chukka (336 MW), Kurichhu (60 MW) and Tala (1040 MW) long term power trade agreement	G to G
	Dagachhu (126 MW) Long Term	Commercial
India → Bangladesh (660 MW)	BPDB Long-term contract for 250 MW	G to G
	BPDB Medium-term contract for 250 MW	Commercial
	Tripura – Comilla 160 MW contract	G to G
India → Nepal (420 MW)	NEA Contracts in tune of 420-440 MW	G to G
	NEA Past contracts (2011-2015) during December-April months for ~20-30 MW	Commercial



Source- Ministry of Power, Govt. of India

Commercial Mechanisms of Price Discovery in Power Trading is well established now in all the BBIN countries. Long term, medium term and Short term market product available in SA region.

Hourly complementarities- DAM may reap this opportunity



Country	Peak – Off peak in a day	Seasonal Variation Average Demand
Bangladesh	30 - 90%	45 - 50%
Bhutan	15 - 55%	20 - 25%
India	7 - 30%	8 - 10%
Nepal	50 - 125%	10 - 15%

Source: SARI/EI analysis based on 1st April 2015 Electricity Met Demand nos. and IEX Market Clearing Volume

Source: SARI/EI analysis based on FY 2015 Electricity Met Demand nos.

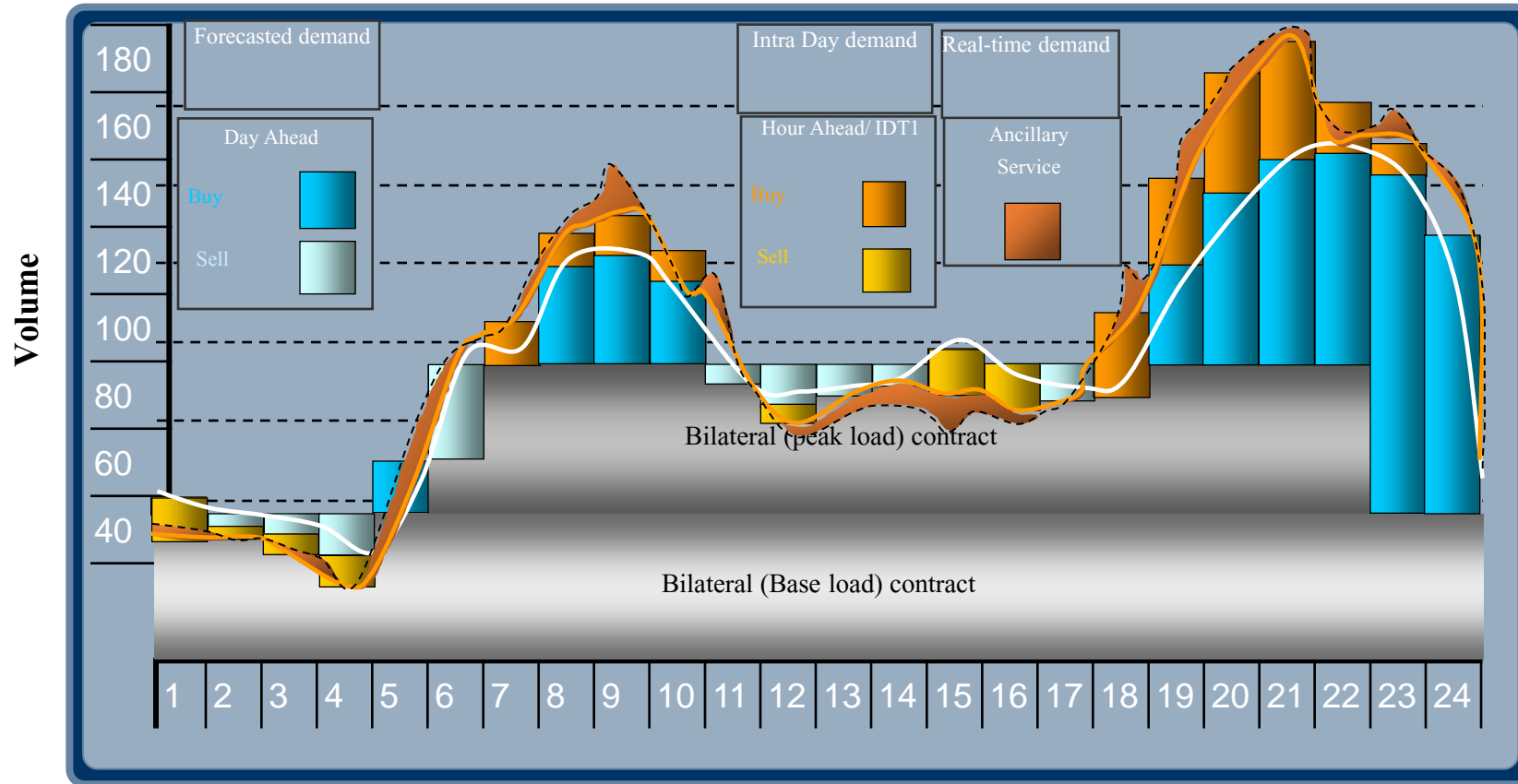
Seasonal Complementarities: Short Term Trade opportunity

	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

Source: World Bank report



Optimal Management of daily Demand Supply Position



- The DAM spot can be used for optimal management of daily variations in demand or supply through buy/sell trades.



Need of DAM and implication in South Asian Region

Need of Day Ahead Market

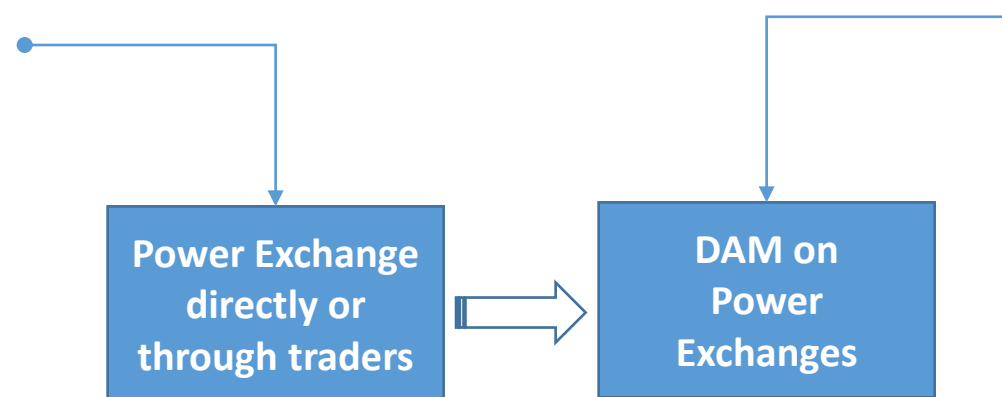
- Reaping the daily demand complementariness of SA countries.
- Demand-supply balancing opportunity near to real time.
- Standardized contract.
- Increase in the investment by providing more market choices.
- Competitive power market platform and market determined prices.

Quantification of benefits in South Asian region

- Better resource utilization and increase energy access in the region.
- Social Welfare Maximization (10 Billion Rs as per SARPEX mock exercise).
- Price signals for investment growth in generation and transmission.
- Increase in underutilized generation assets PLF. (>90% of time blocks - Sell bids higher than Buy bids)
- Untraded 30 BUs in the year 2016-17 (About 3400 MW on an average day.) which could be used.

Benefits of a DAM through a Power Exchange

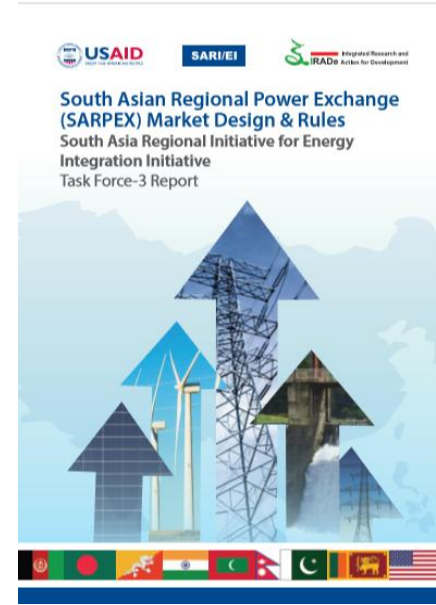
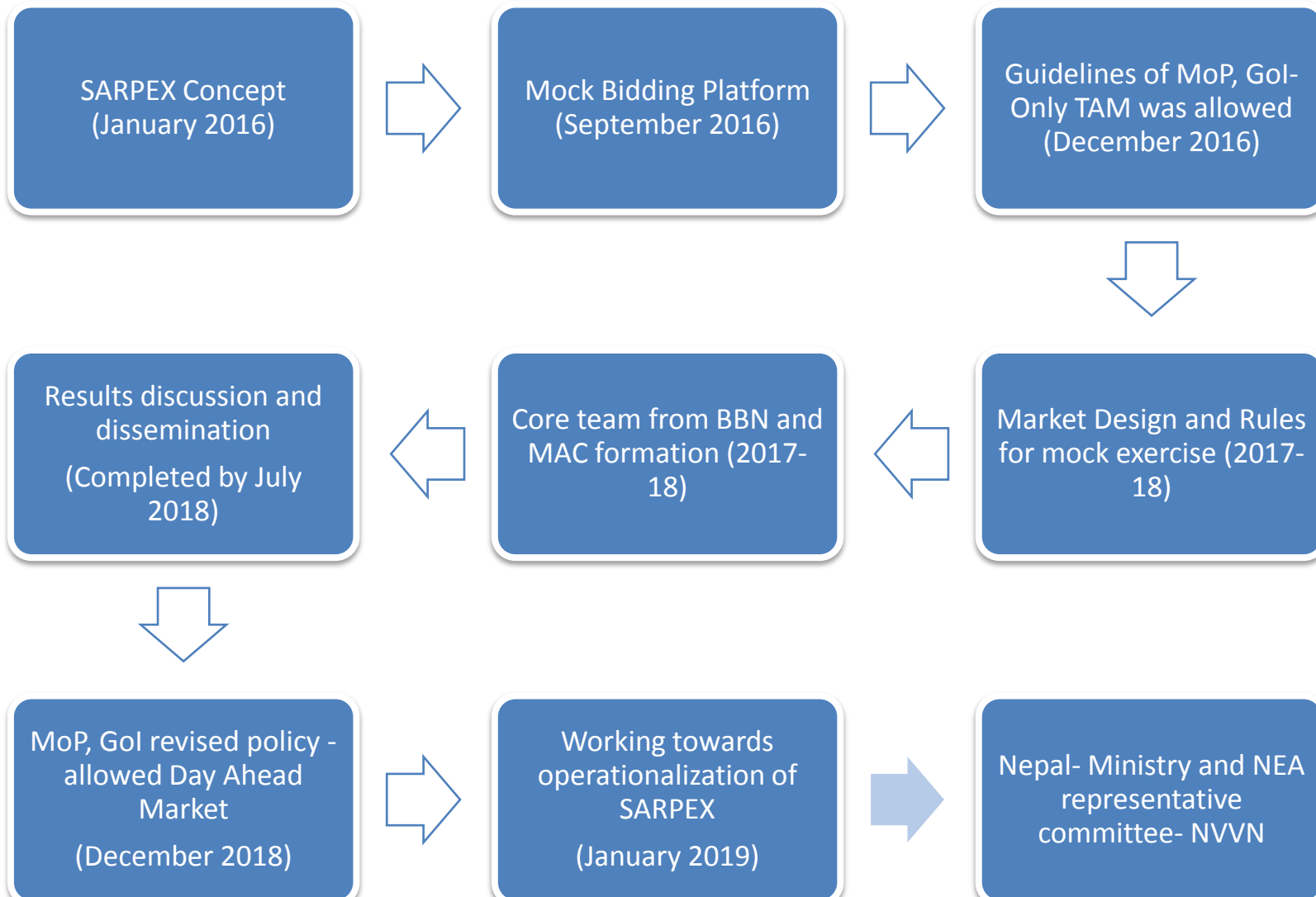
- Trading parties specify the contractual terms
 - Negotiating & customization of contracts may take weeks, months to years
 - Assessing the creditworthiness of Counterparty involves risk & costs
- Not suitable for closer to real time operations



- 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
- More suitable for closer to real time operations

While PPAs provide certainty to buyers and seller, Power Exchanges allow countries to manage the daily variations in load requirements on a 15-minute basis

Steps already taken towards operationalization of SARPEX



Existing Policy Provision

- Neighboring countries may participate in Indian power exchanges through the electricity trading licensee of India.
- For the specified quantum after obtaining the approval from the Designated Authority.

Operationalization of SARPEX

- Trade in the PX's through the trading organization
- Transmission Access and Allocation
- Operational Rules – Scheduling, Deviation and Settlement, Transmission Charges and Losses
- System and procedures
 - Formation of bid areas
 - Transmission capacity allocation
 - Coordination between LDC
 - Participation pre-requisite – Approval from DA

Operationalization of SARPEX

- Bidding strategy and Policy aspects
- Market design and rules
- Technical assistance/support to operationalization- country specific support for process and procedures development.

Market Participants

Buy

- Electricity Trader
- Open access consumer
- Industries with CPP
- Discom

Sell

- Electricity Trader
- CPP/IPP
- Inter-state GS/State GS
- Discom

Bidding strategy – Discom and Generator

Long-term

- 25-year PPA - Tariff on cost-plus or competitive bid

Medium Term

- 3 Month- 3 Years
- Tariff covers : Fixed Cost + Variable Cost+ Mark Up (< long term)

Short Term (OTC)

- Intraday- 3 Months to be procured through competitive bidding only
- Single tariff covering Tariff covers Fixed Cost+

Day-Ahead Market (most preferred)

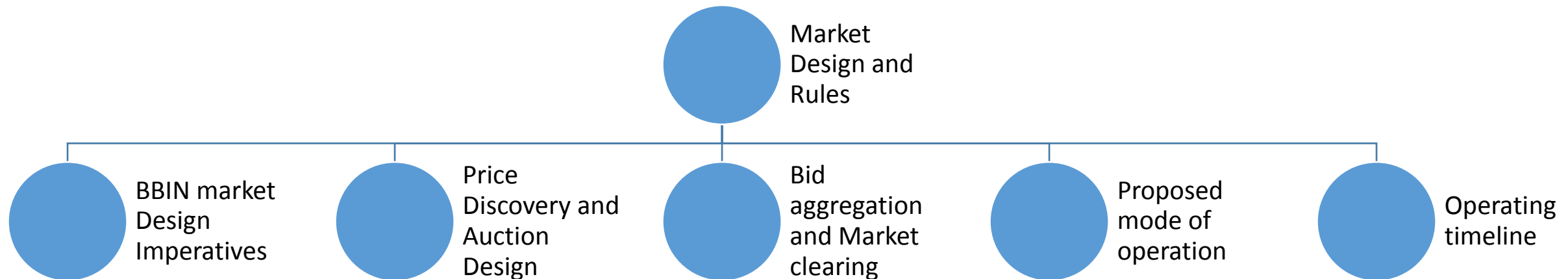
- Highly liquid and transparent marketplace
- More accurate load management

Intra-day

- Last-minute adjustments (Gate closure 4 hours)
- Less liquid

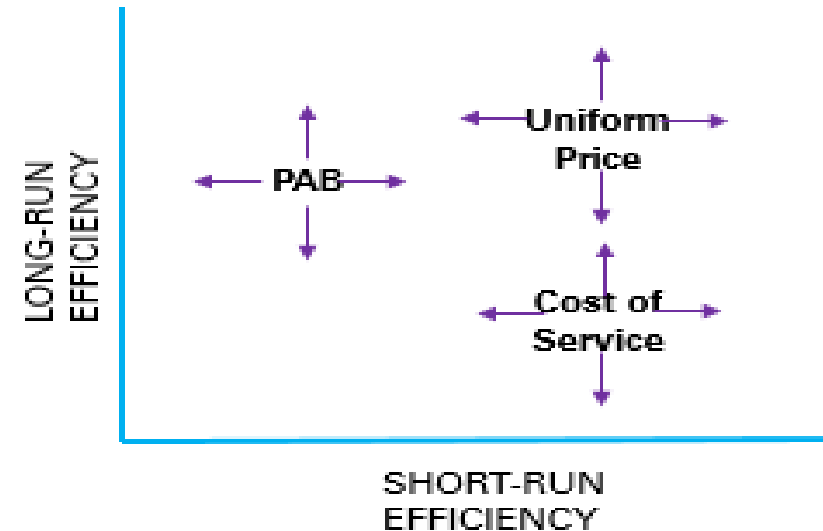
Market Design and Rule

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



BBIN Market Design Imperative

- 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.

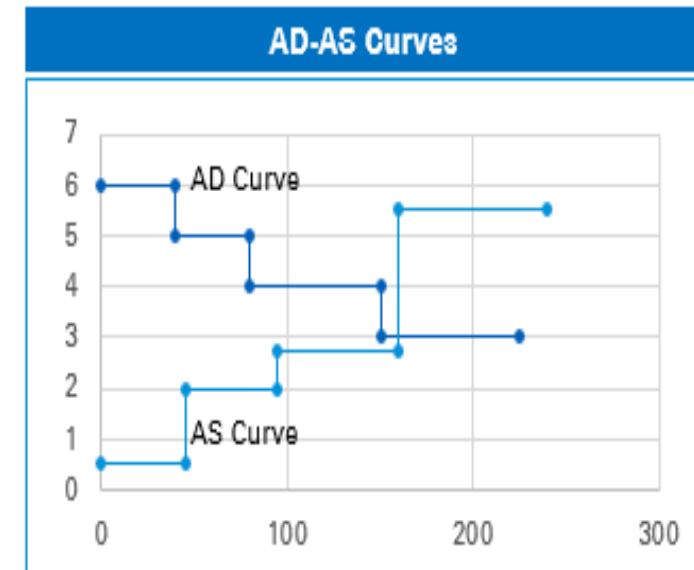


Disclaimer: This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

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

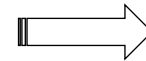


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Time Zones and deviation in BBIN

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 required 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

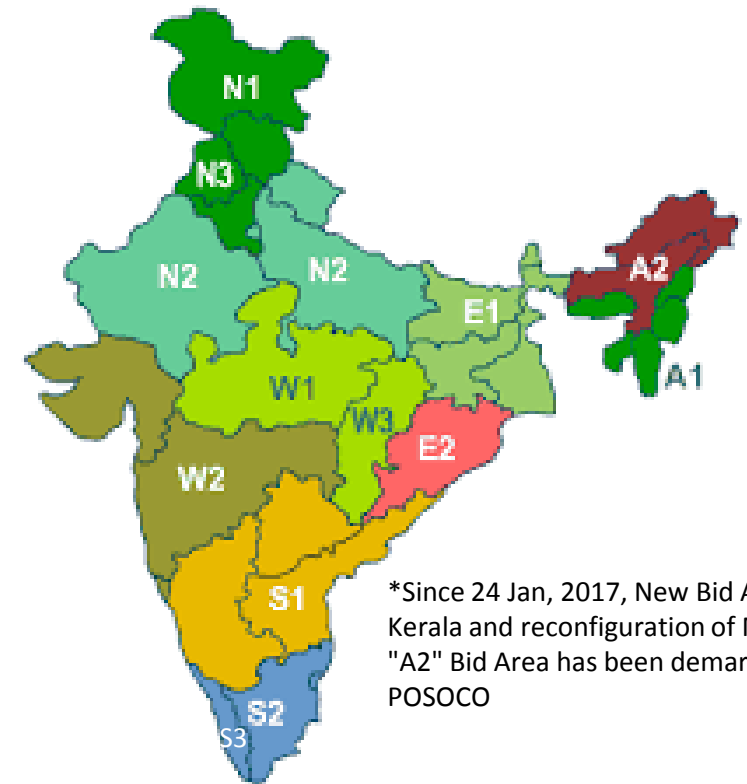
Day D-2 Day D-1 Day D

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. However, this can be overcome.

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

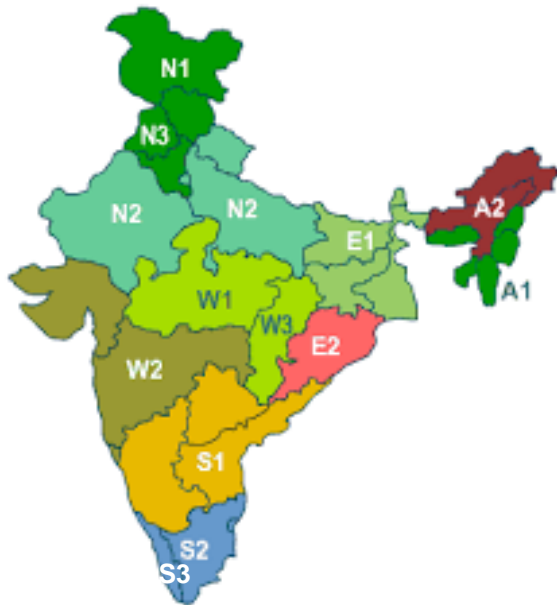
Existing Bid Area definitions in India*



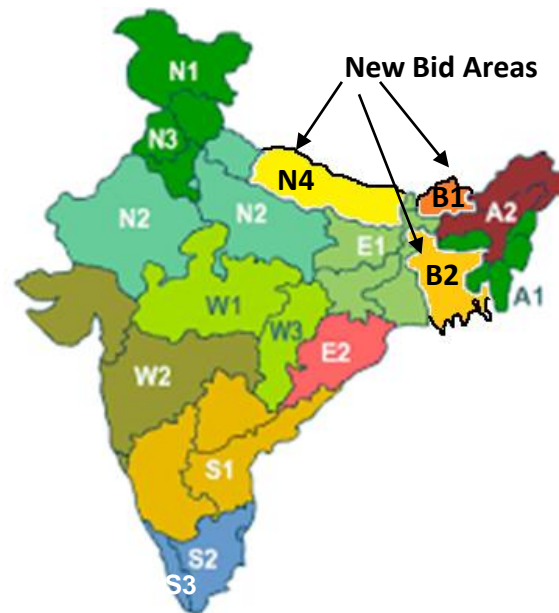
*Since 24 Jan, 2017, New Bid Area "S3" for Kerala and reconfiguration of Meghalaya in "A2" Bid Area has been demarcated by POSOCO

Bid Areas

Retaining the Indian Bid Areas



Additional Areas for each new country at later stage



- 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

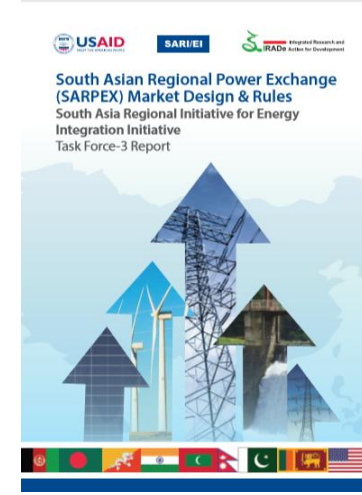
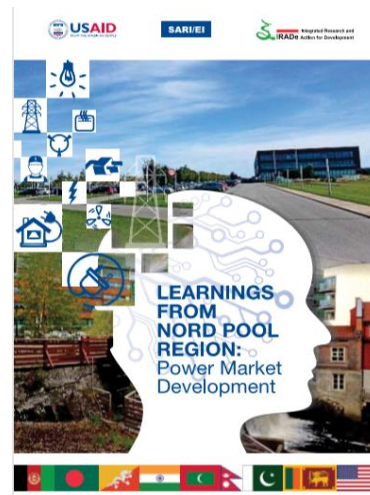
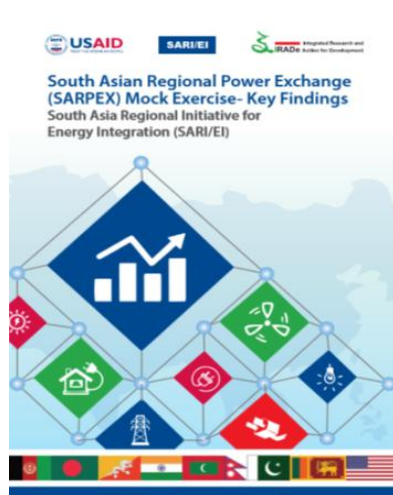
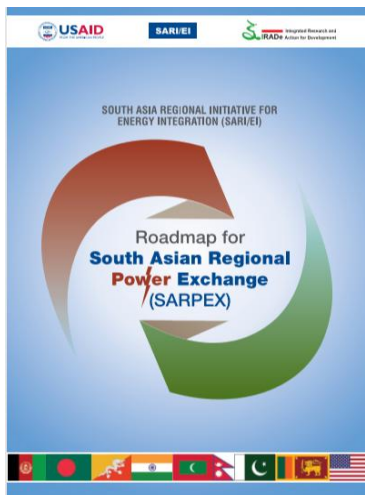
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Pictures of Events



REPORTS

Power Exchange and Regional Power Market





Thank You!

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