

**First meeting of core team
07th -09th February 2017 at New Delhi, India**

**CONCEPT OF SARPEX & MARKET RULES &
DESIGN FOR PILOT MARKET**

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OUTLINE

CONTEXT

1. Why a power Exchange is required in the South Asian Region
2. Concept of Pilot Market (Mock Exercise for SARPEX):

SARPEX PILOT

1. SOUTH ASIAN REGIONAL POWER EXCHANGE (SARPEX) PILOT
2. BID SUBMISSION & AGGREGATION
3. PROPOSED MARKET CLEARING MECHANISM - PRICE & VOLUME DETERMINATION
 - i. STEP-WISE & PIECE-WISE ALGORITHMS - COMPARISON
4. CURVE NON-CONVERGENCE, CONGESTION & SETTLEMENT OPTIONS
5. PROPOSED MODE OF OPERATION
 - i. UNIFIED MODE
 - ii. SEQUENTIAL MODE
 - iii. UNIFIED AND SEQUENTIAL MODE COMPARISON

SARPEX MARKET DESIGN CONSIDERATIONS

1. GRID OPERATION – BID AREAS AND TRANSMISSION CAPACITY ALLOCATION
2. PROPOSED OPERATIONAL RULES
 - i. ILLUSTRATIVE MEMBER COUNTRY TRANSMISSION CHARGES AND LOSSES
3. PROPOSED OPERATING TIMELINES
4. CURRENCY

ANNEXURE

Why a power Exchange is required in the South Asian Region

- In the SA Regional Power market, currently we have long and medium term power trading through bilateral agreements. However to extract the full benefit of regional power trade of day ahead nature, a Regional Power Exchange is essential.

Hourly Complementarities.

This daily demand variation is also substantial and providing a sizable opportunity of hourly trade as shown in below. This representative table has been prepared based on 1st April 2014 hourly variation in the SA Countries

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	Min+ (Max-Min)*40%	Min+ (Max-Min)*60%
Dark	Min+ (Max-Min)*60%	Min+ (Max-Min)*80%
Darkest	Min+ (Max-Min)*80%	Max

Why a power Exchange is required in the South Asian Region Continued

- In the SA Regional Power market, currently we have long and medium term power trading through bilateral agreements. However to extract the full benefit of regional power trade of day ahead nature, a Regional Power Exchange is essential.

Seasonal Complementarities.

This daily demand variation is also substantial and providing a sizable opportunity of hourly trade as shown in below. This representative table has been prepared based on 1st April 2014 hourly variation in the SA Countries

	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	Green	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	Blue	Green	Blue	Blue
India - West	Red	Red	Red	Blue	Blue	Blue	Green	Green	Red	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	Green	Green	Blue
				Low	Medium	High						

The biggest advantage of a market place is that it is less amenable to manipulation, compared to non-market mechanism based on negotiations.

The sporadic demand-supply mismatch at the geographical level also calls for a market place where surpluses can be disposed of efficiently on a real time basis to optimize resource allocation.

Concept of Pilot Market (Mock Exercise for SARPEX):

- As a step towards the establishment of a SA Regional Power Exchange (SARPEX), the mock exercise will give practical options for establishing such an exchange.
- A trading platform mimicking a regional Energy Exchange for the SA Region will be created and operated in a pilot mode.
- The mock exchange will provide an answer to various key questions, related to possible volume which may become available to the regional market, the impact of regional market on domestic energy markets
- **The mock exercise results will provide the desired inputs for the decision makers in selecting a suitable option for market design. This will also give clarity about the identity of the buyers and sellers in such a Regional Exchange.**
- Additionally, the mock exercise will also develop/provide:
 - Develop a draft set of market design and rules of a SA regional electricity market.
 - Prepare a detailed report based on the analysis of the pilot market data to ascertain the desirability and the feasibility of a SARPEX, and
 - To build the capacity of relevant officials from the SA countries on the functions of a power exchange which is critical irrespective to the option finally selected.

Some Terminology relevant to the exercise

- Day ahead market: 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
- Modes of operation of pilot market :-
 - A) Residual 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 in the Indian exchanges are cleared simultaneously the pilot market platform

Conducting the Mock exercise

- **Selecting the days of operation** - Seventy one representative days have been selected covering the period of one year from April'2015 to March'2016 based on data sampling methodology approved by the Task Force – 3
- **Securing the bids:** Bids from the Indian power exchanges for these selected days have been extracted from the data available in the public domain. For Bangladesh, Bhutan and Nepal, the core team shall do the bidding.
- **Modes of operation of pilot market :-** The pilot market shall be run on both the modes of operation, unified as well as residual or sequential mode.
- **Running of the pilot market** – The matching engine will generate the results for the selected 71 days in both the modes of operation. The results will demonstrate how much transaction took place and at what rate. The volume of buy and sell or all the participating nations in different dispatch periods will be generated.
- **Extrapolation of results for one year** - The results obtained by the running of the pilot market for the selected dates shall be extrapolated to cover the total period of one year.
- **Analysis of the result** - The pilot market data will be analysed to ascertain the desirability and the feasibility of a SARPEX. This will not only be based on the traded volume and price but also on economic analysis of the results bringing out the financial impact on the trades on the participating Nations.



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Integrated Research and

Formation of Market Advisory Committee (MAC)

Market Advisory Committee (MAC) – All Task Force – 3 members are a part of the MAC. Additional members have been inducted. These additional members may be involved on specific matters or as full fledged members. Provision of additional member gives flexibility for taking in suitable experts into the forum in the interest of the success.

Current members of MAC – At present the following are the members of MAC :-

- 1) Mr Anil Razdan - Former Power Secretary Ministry of Power, India
 - 2) Mr Hans-Arild Bredesen CEO Nord Pool Consulting Norway
 - 3) Mr Peter Jørgensen Vice President Energinet Denmark
 - 4) Eng. Musara C Beta Chief Market Analyst Southern African Power Pool (SAPP) Zimbabwe
- Suggestions are welcome for additional members

Functions of the Market Advisory Committee (MAC).

- Advice on the design of the pilot market.
- Advice on the draft set of market rules for the pilot market.
- Monitoring of the pilot market activities and give suggestion as and when required.
- To facilitate stakeholder consultation and advocacy of the Mock exercise in the respective Nation.
- To give guidance to the core team in the respective Nation.

BBIN MARKET DESIGN IMPERATIVES

Current Scenario:

- India has two Power Exchanges i.e. IEX and PXIL, operational for the last 10 years
- Bangladesh, Nepal and Bhutan have also expressed their desire to trade by way of a Power Exchanges

Electricity Law, Policy and Regulatory Constraints:

- Existing regulations governing the BBIN's Power Sector can be streamlined to introduce Power Exchanges
- A basic framework in the form of either guidelines or an agreement may be used, until a formal legal and regulatory framework is in place

Demand-side and Supply-side Constraints:

- Three additional buy or sell side bids are anticipated post BBN's inclusion
- The magnitude of power supply / demand or number of players is not expected to be significant in the near-term.

Thickness and Liquidity:

- Thickness and liquidity anticipated to be limited in initial years
- The Exchange based cross-border trades elsewhere have also developed with limited number of transactions. For e.g. Nord Pool
- Over time, trades get a fillip with implementation of formal institutional frameworks and maturity of markets

Products:

- Transactions on Exchange may be initiated with the primary products such as the DAM spot. Initially, a designated agency from the Indian side may enable setting up transactions with BBN on Exchanges.

- **SWM and efficiency are also factored in while determining SARPEX's pricing and matching mechanisms**
- **However the Pilot SARPEX assumes no grid constraints and so produces an unconstrained solution**

**DRAFT MARKET RULES & DESIGN FOR SARPEX AND
SIMPLIFICATIONS MADE FOR PILOT MARKET**

Background and concept of behind the Mock Exercise

- The Core objective of the SARI/EI Program is to promote integration of Energy System and enhance Cross border Electricity Trade (CBET) among the South Asian Nations.
- **Task Force-3 Goal** - To create the enabling and systematic conditions for a sustainable market for energy trading and exchange in South Asia. The focus will be on :-
 - 1) **Development of Cross Border power exchanges and related market mechanisms** to enhance power trade in the South Asian Region.
 - 2) Market driven commercial practices in the field of power trading, including long term contractual instruments and medium/short term power trading.
- **Roadmap of Task Force -3** We are now in the third phase of the roadmap. “Setting up of the pilot market-based on the market rules and agreed pilot market design in the phase-2 .
- **Model of power Exchange** - The mock exercise has been conceptualized based on the recommended model for power exchange in Phase -1 and the draft set of market rules and design recommended in Phase -3. The Task Force members have finalized the recommendations based on a study conducted for the same.
- The mock exercise is being implemented by SARI project secretariat along with KPMG.

Benefits of SARPEX

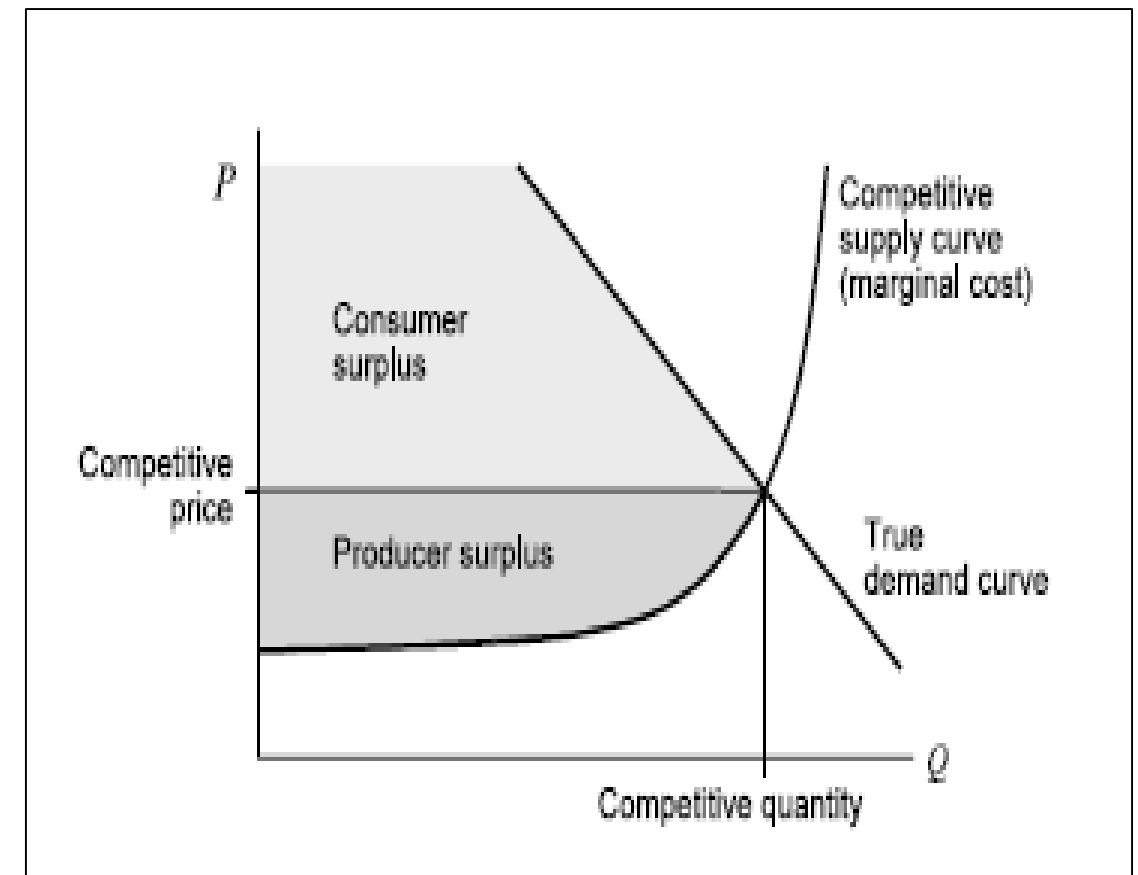
1) Social Welfare Maximization (SWM) & Efficiency

Social welfare is the sum of consumer and producer surplus.

Social Welfare Maximization (SWM) is the difference between the willingness to pay of the bidders minus the cost of the offers.

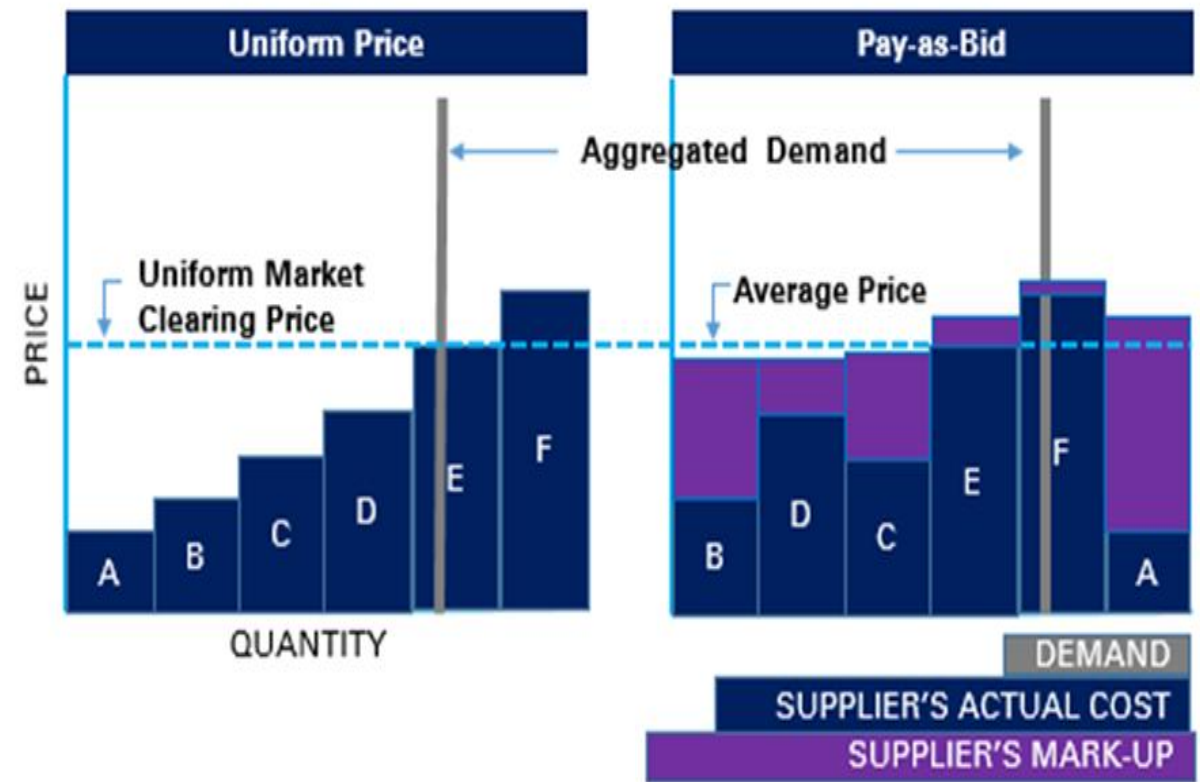
2) The implementation of a Day Ahead Market (DAM) is crucial to the electricity trade development in the SAR and more immediately in the neighbouring countries of BBIN. The non-storability makes the power sector susceptible to fuel price volatility and electricity demand-supply imbalances. This in turn may be mitigated at least to some extent by a DAM.

3) There are immense opportunities for import and export of power in the region and the non-existence of a regional DAM is the key missing element for achieving efficient use of the network infrastructure



Price discovery

- 1) **Uniform pricing is preferred over Pay-as-Bid (PAB)** or discriminatory pricing where each participant pays as per the bid.
- 2) 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.
- 3) The buyers bid their marginal utility based on the financial constraints or willingness-to-pay.
- 4) The underlying assumption in this case is that suppliers/buyers will be unable to affect the eventual market clearing price, leaving no incentive to bid above the marginal cost.
- 5) In case of Pay-as-Bid (PAB) or discriminatory pricing each participant pays as per the bid. The price paid by the buyer depends on the seller's bid. Sellers bid their best-guess of the market clearing price with a goal to maximize revenues. Consequently, the plants with the lowest bids may not reflect the plants with the lowest marginal costs thereby impeding efficiency and the primary objective of social welfare maximization





4.2.3 Double-sided Closed Bid Auction (DSCB)

- A Double-sided Closed-Bid auction is one where both buyers and seller bid and given the sealed nature of the bid, each bidder is only aware of his bid
- Typically the following bids are deemed winners:
 1. Supply bids below the market clearing price – fostering low supply costs
 2. Buy bids above the market clearing price - fostering allocation based on the greatest willingness-to-pay
 3. Both the aforementioned conditions aid in achieving the objectives of maximized social welfare, efficiency and fairness

SUMMARY

BBIN's market constraints and objectives serve as boundaries for market design

Double Sided Sealed Bids (DSB) are proposed as part of the auction design

SARPEX will use the Market Clearing mechanism to determine its MCP and MCP

Price is discovered through the Uniform Pricing mechanism

Market Clearing Algorithm

1) Two predominantly used algorithms are step-wise and piece-wise approaches

2) Step-wise Approach:

Price determination

Step-wise curves use simple aggregation of bids and offers to construct the demand and supply curves used to determine price..

Volume determination

The market is cleared at the intersection of the stepwise linear curves, maximizing total cleared volume.

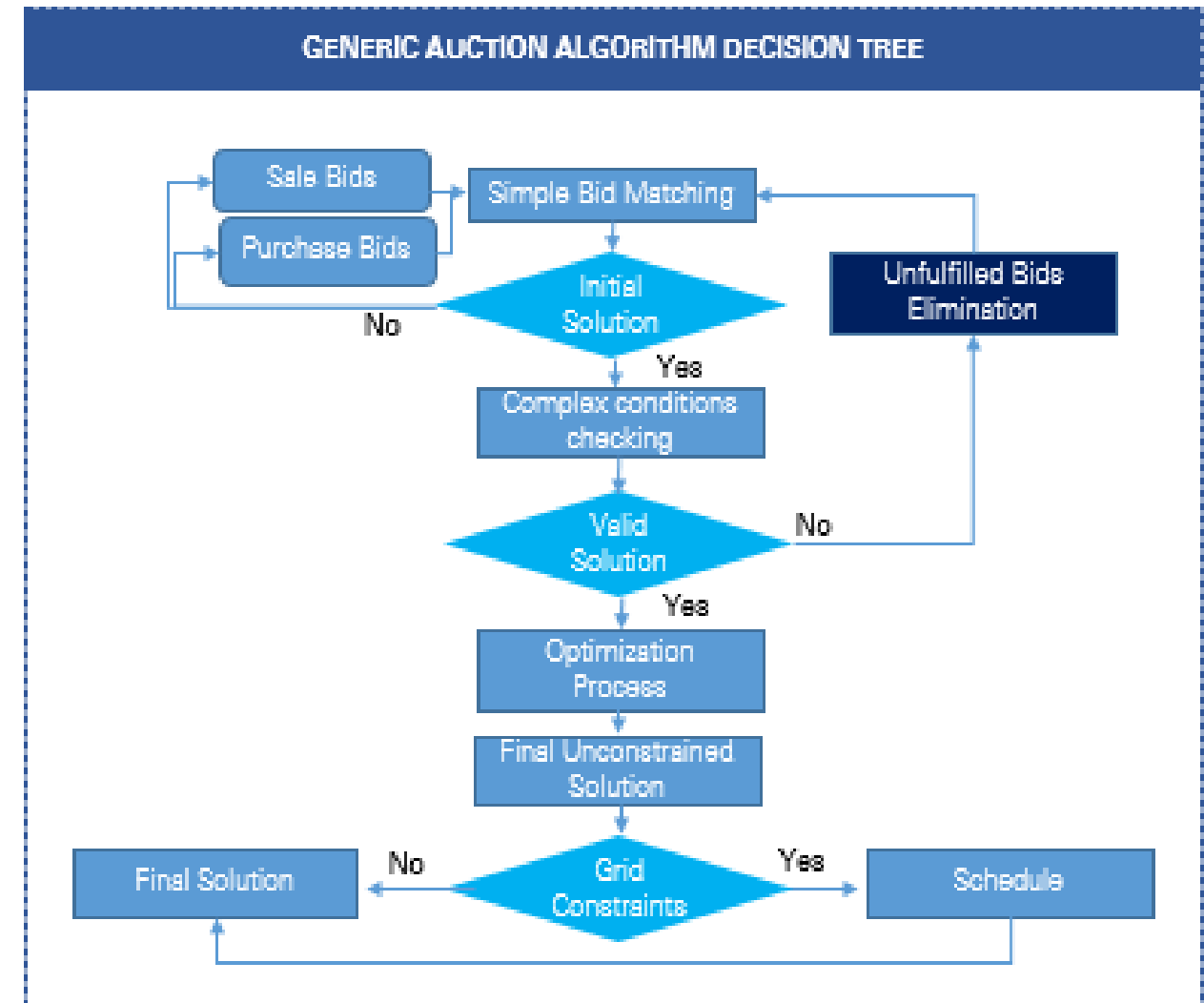
3) Piece-wise Approach:

Price determination

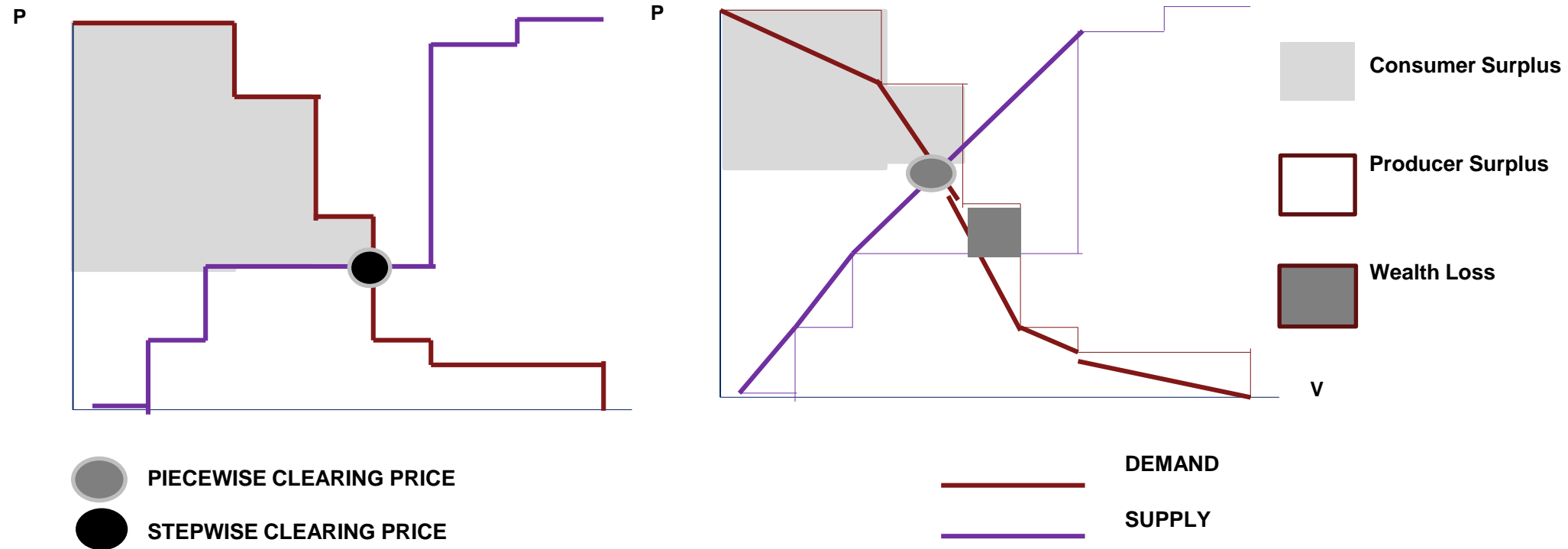
This approach uses linear interpolation instead of simple aggregation to get piecewise linear curves.

Volume Determination

Cleared volume determination is not clearly outlined in the piecewise approach, except that traded volume is established by comparing the clearing price with the participants' bid



Market Clearing Algorithm Continued.....



Recommended for SARPEX - Piece-wise approach

SARPEX's market architecture and auction design:

Design Aspect	Options			
Price Discovery	Uniform	Pay as Bid		
	<input checked="" type="checkbox"/>			
Auction Design	Single-sided	Double-sided	Closed	Open
		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Bid Aggregation	Simple	Algorithm		
		<input checked="" type="checkbox"/>		
Market Clearing Algorithm			Step-wise	Piece-wise
			<input checked="" type="checkbox"/>	
Equilibrium Point Discovery Method	Extrapolation	Shifting of Curves		
	<input checked="" type="checkbox"/>			
Congestion Management	Market Splitting	Network Capacity Auction	Zonal/Nodal Pricing	Others
	<input checked="" type="checkbox"/>			
Settlement Systems	Single	Multi		
		<input checked="" type="checkbox"/>		

GRID OPERATION – BID AREAS AND TRANSMISSION CAPACITY ALLOCATION

Bid Area Formation:

- Bid areas determine the price paid/charged in a specific geographical location in keeping with grid constraints and congestion.
- When bid areas are formed purely based on congestion considerations they are called congestion zones.
- Key considerations in Bid area formation
 - Physical Considerations: separate markets are formed in the congested areas which in turn necessitates the creation of separate bid areas or congestion zones for the Member Countries.
 - Other Considerations: Economic, political, geographical or technical in nature. For example: Indian generators JITPL and Sterlite are physically located in Eastern Region, but included in the Western Region bid area-W3, due to the transmission network topology

Transmission Allocation:

- Highest priority for transmission access is accorded to the long term PPAs
- Indian Exchanges are allocated only the residual transmission capacity

Bid Area Formation on SARPEX:

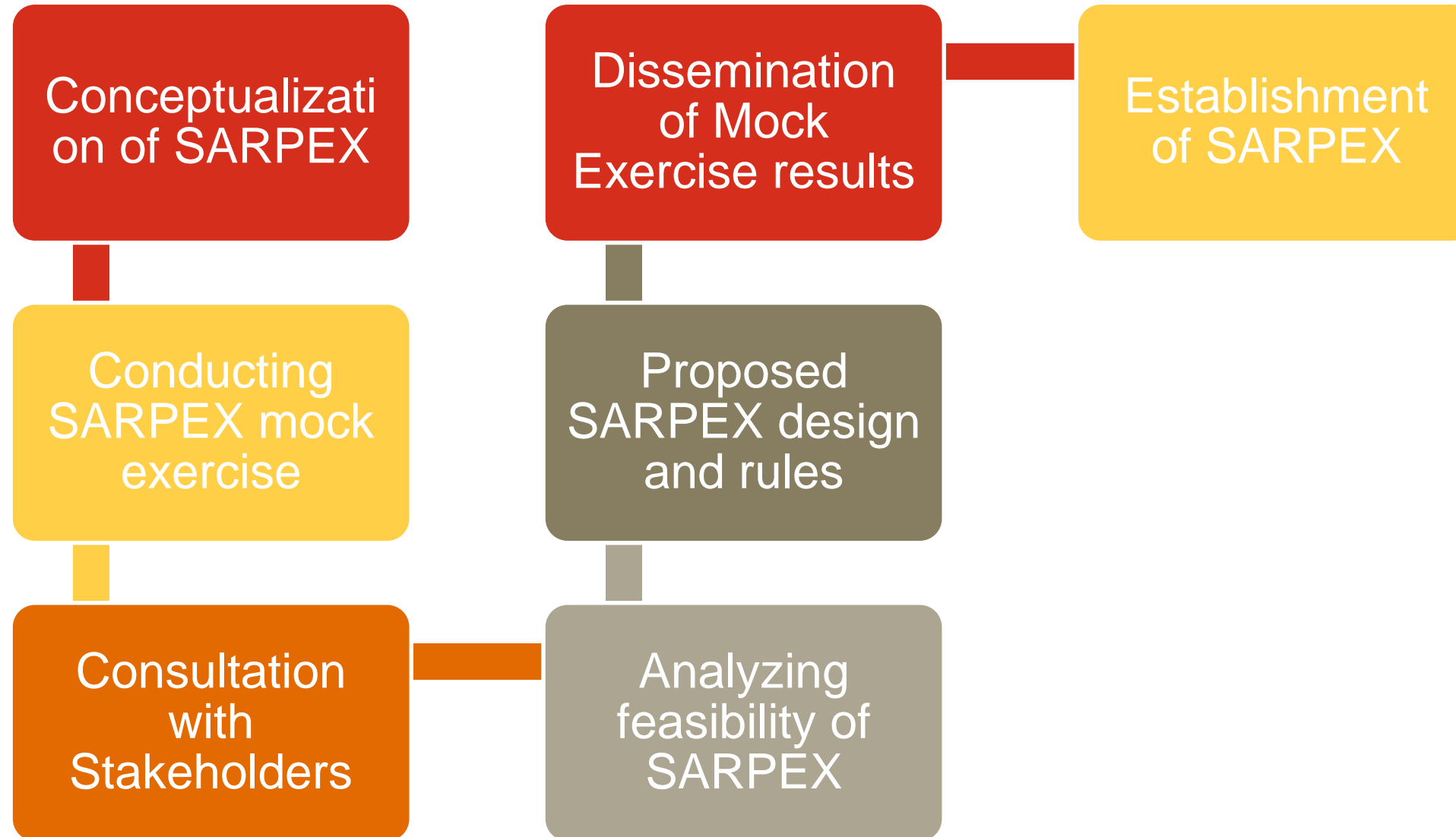
- Formation of separate bid areas for BBN is proposed
- Joint Country Power Development Fund proposed to be set-up for management of the Congestion Revenues

Transmission Capacity Allocation:

- Each member country's transmission corridor allocation methodology is proposed to be retained, and transmission capacity allocated to SARPEX is the residual capacity after accounting for the long term, medium term and short term transactions.

“THE GRID CONSTRAINTS & TRANSMISSION CAPACITY ALLOCATION PROCEDURES DON'T APPLY TO PILOT MARKET “

Further Step for SARPEX: Feasibility and desirability



PROPOSED MODES OF OPERATION

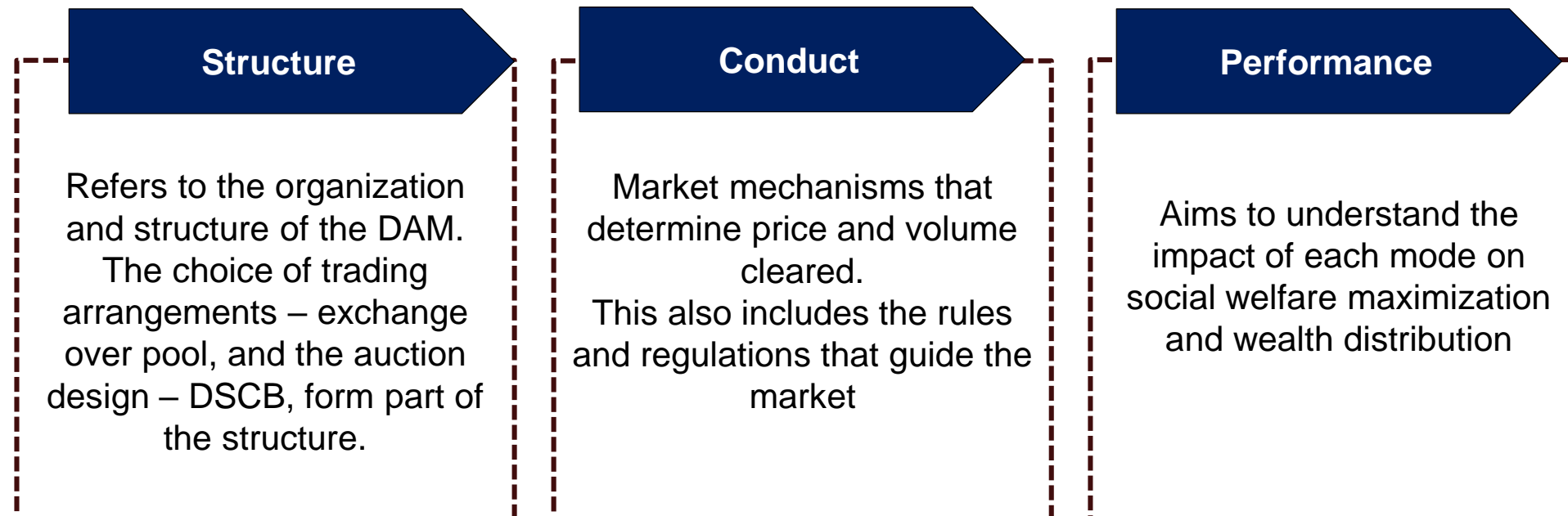
OPTION 1 – UNIFIED MODE

The bids from the Indian participants and BBN countries' participants would be cleared simultaneously.

OPTION 2 – SEQUENTIAL MODE (RESIDUAL MODE)

The bids from the Indian participants and BBN countries will be cleared in a sequential manner.

Both modes of operation are discussed on the basis of the structure, conduct and performance paradigms



UNIFIED MODE

Structure:

- BBN introduced as new bidding areas
- Trading on a 15-minute intervals
- DSCB Auction model
- Price discovery through Uniform Market Clearing Price mechanism

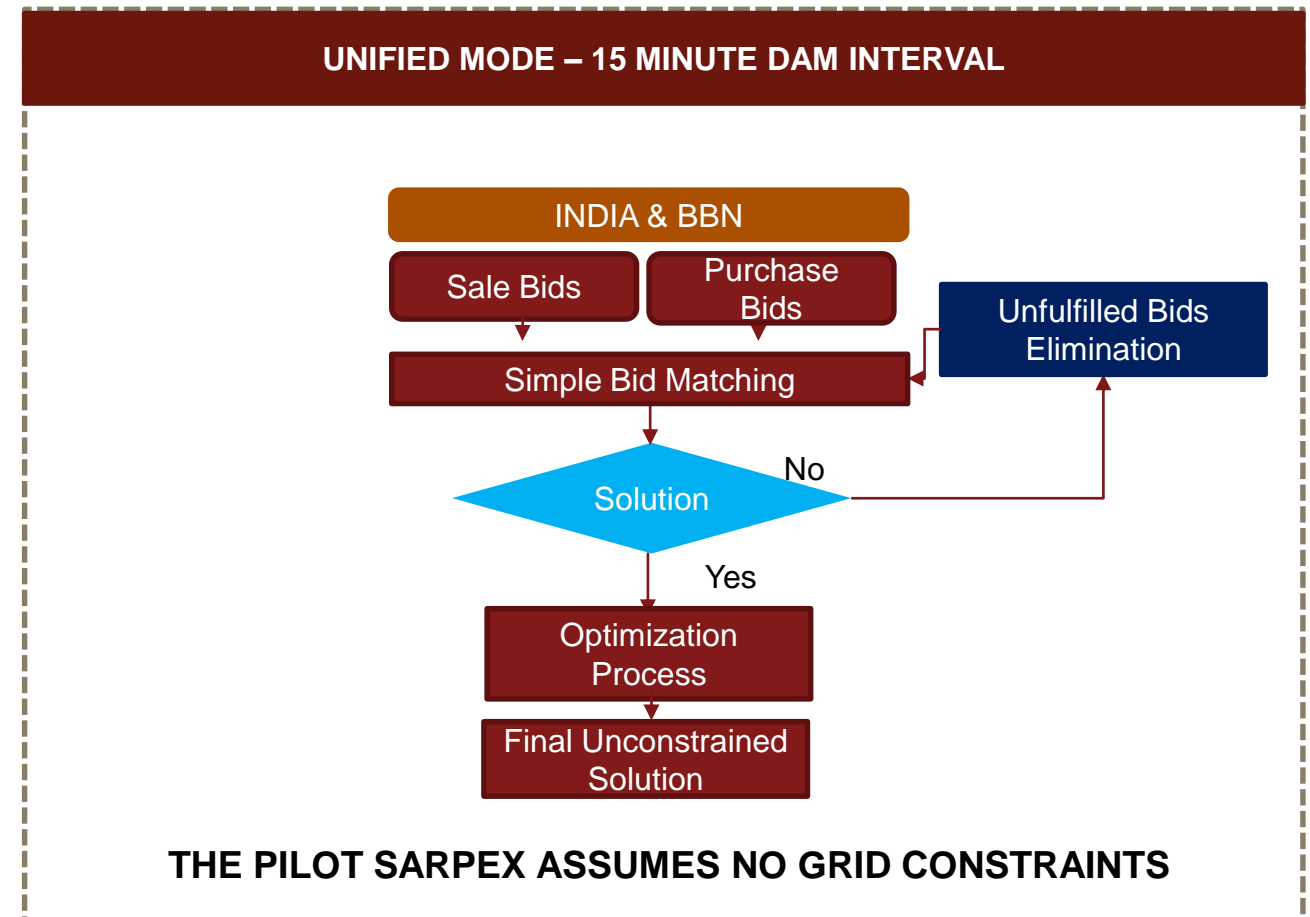
Conduct:

- Uniform Pricing
- Step-wise algorithm
- Extrapolation method in case of non-convergence of curves

Performance:

- The total SW of the Indian and BBN's market changes
- There may be a redistribution of the SW in terms of consumer surplus and producer surpluses for India and BBN

SARPEX's CLEARING ALGORITHM



SEQUENTIAL (RESIDUAL) MODE

Structure:

- Same as Unified Mode

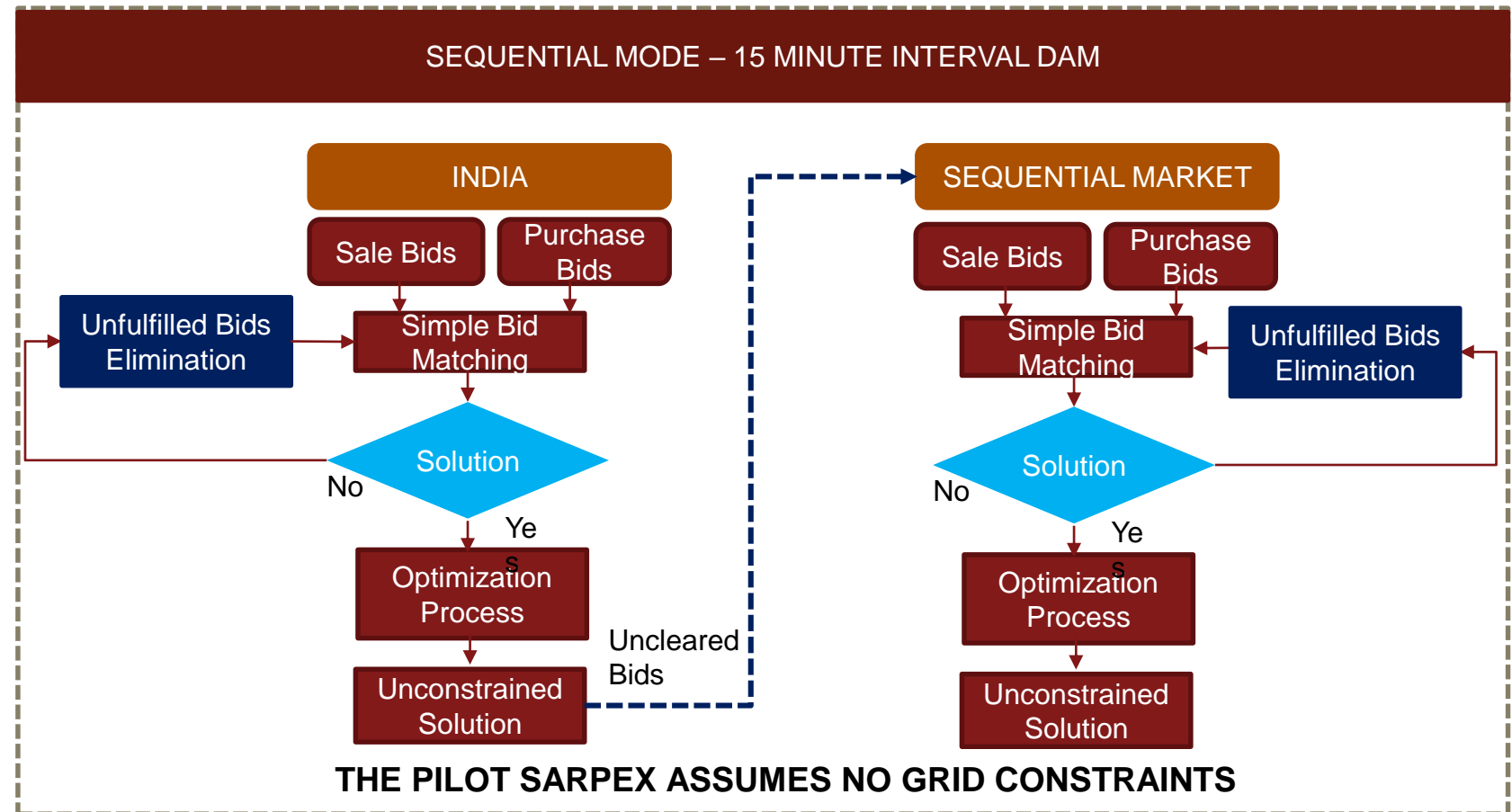
Conduct:

- Price discovery same as in Unified Mode.
- Exchange's simulation engine modified to initiate another round of iteration
- Price discovery occurs in two steps, one for each market

Performance:

- SWM and its distribution needs to be applied to both markets
- Minimal Impact on the Indian Market

SARPEX's CLEARING ALGORITHM



UNIFIED AND SEQUENTIAL MODE COMPARISON

UNIFIED MODE	SEQUENTIAL MODE
<ul style="list-style-type: none"> Level of price impact on Indian market will be ascertained through pilot market simulations 	<ul style="list-style-type: none"> Impact on Indian market may be reduced.
<ul style="list-style-type: none"> Efficient resource utilization 	<ul style="list-style-type: none"> Resource allocation may be lower
<ul style="list-style-type: none"> Efficient price discovery and single pricing signals 	<ul style="list-style-type: none"> Bid-ask spread increase and lowering of liquidity Multiple price signals for the market participants
<ul style="list-style-type: none"> Business Rules and Bye-laws extension to accommodate BBN 	<ul style="list-style-type: none"> The Business Rules, Bye-laws modifications to accommodate BBN.
<ul style="list-style-type: none"> Minimal modifications to the standard trading software to accommodate new bid areas 	<ul style="list-style-type: none"> Software modifications required to add bid areas and produce a sequential solution

The extent of impact on BBN welfare is contingent on several factors and would be evaluated through detailed modeling and market simulations through Pilot Market Runs for both modes of operation

SARPEX OPERATIONAL CONSIDERATIONS

GRID OPERATION – BID AREAS AND TRANSMISSION CAPACITY ALLOCATION

Bid Area Formation:

- Bid areas determine the price paid/charged in a specific geographical location in keeping with grid constraints and congestion.
- When bid areas are formed purely based on congestion considerations they are called congestion zones.
- Key considerations in Bid area formation
 - Physical Considerations: separate markets are formed in the congested areas which in turn necessitates the creation of separate bid areas or congestion zones for the Member Countries.
 - Other Considerations: Economic, political, geographical or technical in nature. For example: Indian generators JITPL and Sterlite are physically located in Eastern Region, but included in the Western Region bid area-W3, due to the transmission network topology

Transmission Allocation:

- Highest priority for transmission access is accorded to the long term PPAs
- Indian Exchanges are allocated only the residual transmission capacity

Bid Area Formation on SARPEX:

- Formation of separate bid areas for BBN is proposed
- Joint Country Power Development Fund proposed to be set-up for management of the Congestion Revenues

Transmission Capacity Allocation:

- Each member country's transmission corridor allocation methodology is proposed to be retained, and transmission capacity allocated to SARPEX is the residual capacity after accounting for the long term, medium term and short term transactions.

“THE GRID CONSTRAINTS & TRANSMISSION CAPACITY ALLOCATION PROCEDURES DON'T APPLY TO PILOT MARKET “

PROPOSED OPERATIONAL RULES

Participation Pre-Requisites

- Provision for NOC in the absence of standardized OA regulations within BBIN
- As a long-term recommendation, formation of a Joint Association of System Operators to foster efficient electricity trade and congestion monitoring

Scheduling

- Existing bilateral delivery point retention
- International periphery as the delivery point i.e. interconnection of the cross-border transmission line and the inter-state transmission network of India
- Nodal Agencies for each member country to coordinate trading on Exchange

Deviation Settlement

- Retention of existing deviation settlement mechanisms of each member country
- Settlement paid by Nodal Agency, to the respective authorities, on behalf of all market participants.
- Settlement pro-rated in the case of multi Nodal Agency involvement.

Transmission Charges & Losses Treatment

- Existing transmission charges and losses related regulations retention
- Transmission charges and losses to be made through the nodal agency specifically to the Indian counterparts

THERE ARE NO CONSIDERATIONS SUCH AS PARTICIPATION PRE-REQUISITES, SCHEDULING & DEVIATION SETTLEMENT FOR PILOT MARKET

ILLUSTRATIVE MEMBER COUNTRY TRANSMISSION CHARGES & LOSSES

Parameter	Buy Side		Sell Side		Comments
	Rs/kWh	%	Rs/kWh	%	
Bid Quantity (MW)	108		100		Quantity Bid at SARPEX
Price in SARPEX	2.50		2.50		Price discovered in SARPEX
PoC Withdrawal / Injection Losses		0.02		0.02	POC Charges & Losses applicable on Member Country for using the ISTS network of India
PoC Withdrawal / Injection Charges	0.20		0.20		
Cross Border Line Losses		0.02		0.02	Cross Border Transmission line connecting the delivery point in India with the Member Country
Cross Border Line Charges	0.10		0.10		
Member Country Losses		0.04		0.04	Member Country Transmission Charges & Losses for use of its internal transmission network
Member Country Charges (Rs/kWh)	0.20		0.20		
Operating Charges	0.03		0.03		Operating Charges of NLDC (0.01 Rs/kWh) and Transaction Fee for SARPEX (0.02 Rs/kWh)
Quantum Received / Injected @ Member Country Bus (MW)	100		108		Quantity Received / Injected by the Member Country
Landed/Received Price @ Member Country Bus	3.29		1.81		Landed Price to Member Country / Net back Price to Member Country Generator

Note: The transmission charges and losses etc. used in the above example don't reflect the actual rates and are only for illustration

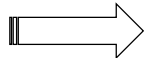
ASSUMPTIONS FOR TRANSMISSION CHARGES AND LOSSES WILL BE DISCUSSED AND AGREED WITH MEMBER COUNTRIES DURING THE TRAINING ON BID FORMATION FOR PILOT MARKET

OPERATING TIMELINES FOR SARPEX

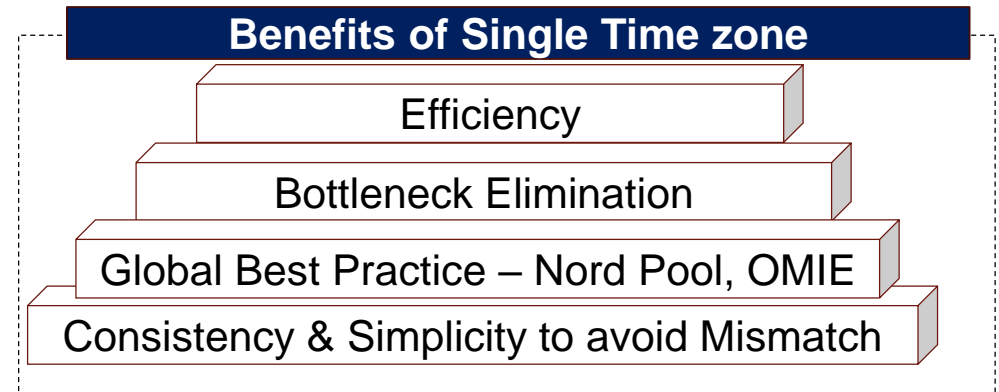
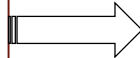
The choice between single and multi time zones needs to be made in keeping with the impact on Operating Timelines

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.



A single reference time zone and operating timeline is recommended for SARPEX.

OPERATIONAL CHALLENGES DUE TO MULTIPLE TIME ZONES IN SARPEX

Electricity Dispatch at the “day boundary” for three consecutive days D-2, D-1 and 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

PROPOSED OPERATING TIMELINES

Key Activities in DAM on SARPEX

Bidding Day “D-1”

Activity	Description	Time	Time zone
a	Bid Start Time	10:00	IST
b	Gate Closure Time	12:00	IST
c	Unconstrained Solution	13:00	IST
d	Corridor Availability	14:00	IST
e	Constrained Solution	15:00	IST
f	Pay-in	15:30	IST
g	Schedule Confirmation	17:30	IST
h	Final Scheduling	18:00	IST

Dispatch “D”

Activity	Description	Time	Time zone
a	Dispatch	Start Time	00:00 IST
		End Time	23:45 IST

Pay-Outs “D+1”

Activity	Description	Time	Time zone
a	Pay-out	14:00	IST

*D – Current Day

INTERNATIONAL PRECEDENCE

All the operations and transactions could be aligned to a single Reference Time Zone of India in order to avoid any mismatch in the operational activities by following the individual country Time Zones

For the Pilot Market, the various activities of SARPEX will be as per the Indian Time Zone only.

CURRENCY

KEY CONSIDERATIONS – SINGLE V. MULTI

Stakeholder's Preference

Volumes traded based on currency

Physical Market Structure

Market Efficiencies

Consumer Distribution

Nature of Products

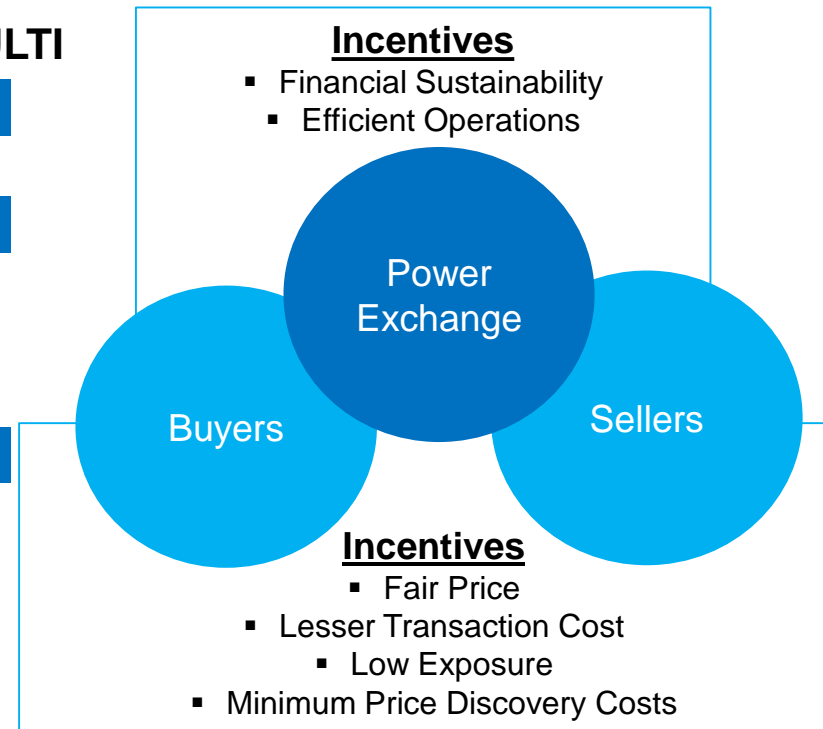
Financial Market

Currency Liquidity

Market Liquidity

Infra Development

Trade Balances



SINGLE CURRENCY ALLOWS FOR:

- Clear, non-discriminatory, transparent information dissemination
- Liquidity and price stability
- Exchange's financial exposure reduced
- Lower transaction costs due to fewer intermediaries

Examples: Nord Pool, OMIE, APX, EPEX

APPROPRIATE APPROACH FOR SARPEX

Currency Scenario: Trade Agreements and Treaties between BBIN recommend the use of a mutually agreeable currency

Option 1 - Single Currency

- Banks take on fluctuation exposure
- Ease of pricing – lowers chance of currency arbitrage through power exchange

Option 2 – Currency Service

- Exchange takes on fluctuation exposure
- Convenience to Buyers and Sellers
- Enhanced market infrastructure to enable efficient and timely operations

ANNEXURE

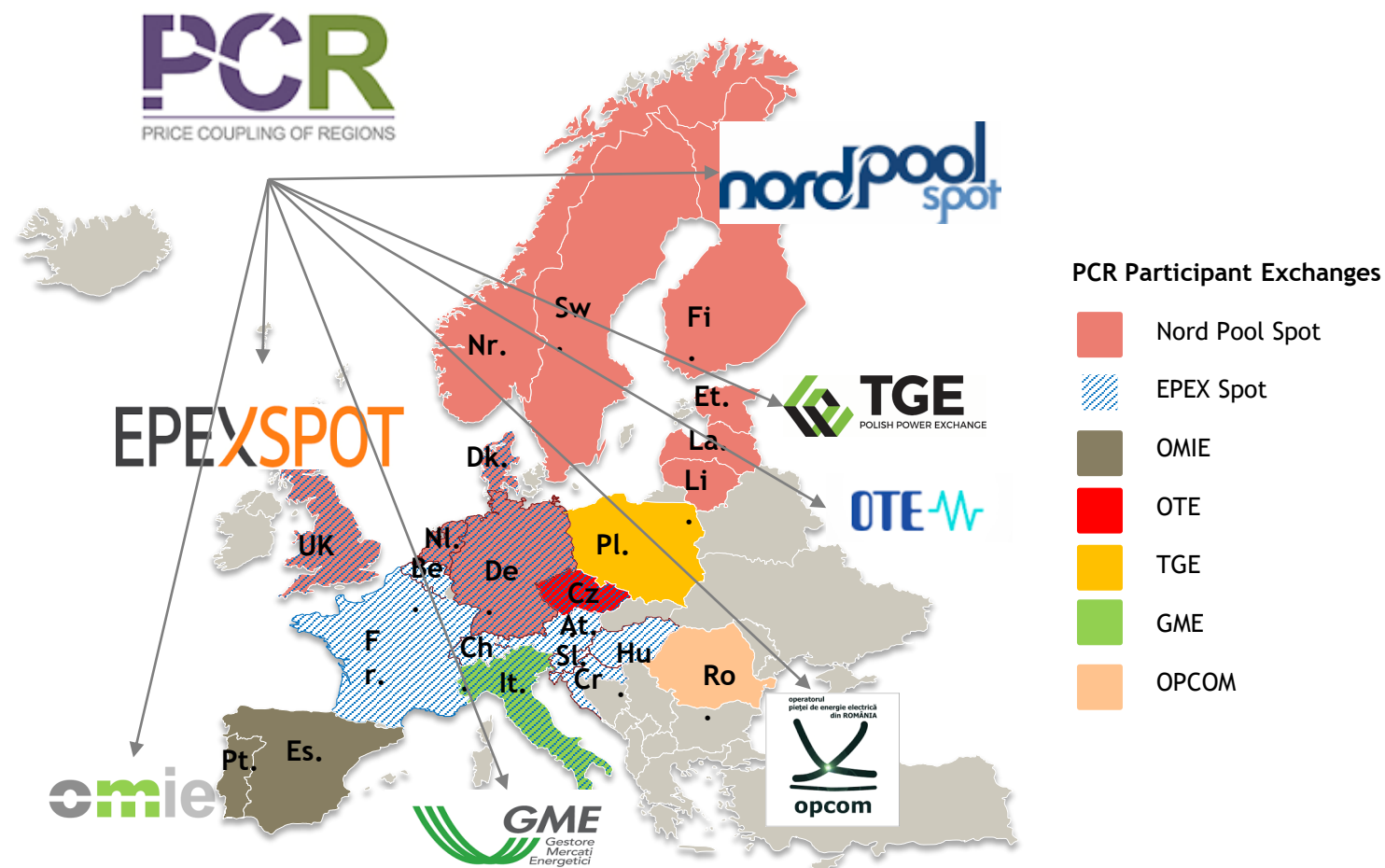
EXISTING INTERCONNECTIONS BETWEEN THE SARPEX's MEMBER COUNTRIES

As on date, the following interconnections exist

India & Nepal	A 400 kV DC line exists from Dhalkebar (Nepal) to Muzaffarpur (India) in addition to some 11, 33 and 132 kV links that are not-operational owing to high transmission losses.
India & Bhutan	Interconnections up to 400 kV exist between these countries. A 400 kV DC line from Punatsangchu-I HEP (in Bhutan) to Alipurduar (in India) has been in operation.
India & Bangladesh	Interconnections between these countries exist at Bahrapur (India) – Bheramara (Bangladesh) through a 400 kV DC line and 500 MW HVDC back-to-back link at Bheramara. Further, a 400 kV D/C Surjyamaninagar (Bangladesh) transmission line has been commissioned in March 2016. (India) to Comilla

PRECEDENCE FROM OTHER EXCHANGES - HARMONIZING THE TIME-ZONES

- Europe operates in four time zones - Western European Time (WET), Central European Time (CET), Eastern European Time (EET) and Further-Eastern European Time (FEET)
- Nord Pool Spot, has participants from the regions with CET and EET **but follows the CET**
- Similarly, OMIE has participants from CET and WET, **but is aligned to CET**, since the major Exchanges in Europe are all referenced to CET
- Similarly, the Price Coupling for Regions (PCR) has participants from almost every time zone of Europe and **is referenced to CET**



Referencing to a Single Time Zone is critical for effective integration of Exchanges

Source: https://www.epexspot.com/en/membership/who_are_our_members; <http://www.Nord.Poolspot.com/About-us/>; <http://www.free-powerpoint-slides.com/powerpoint-maps.php>
Note: This diagram not necessarily depicts all the countries covered by a PX

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