



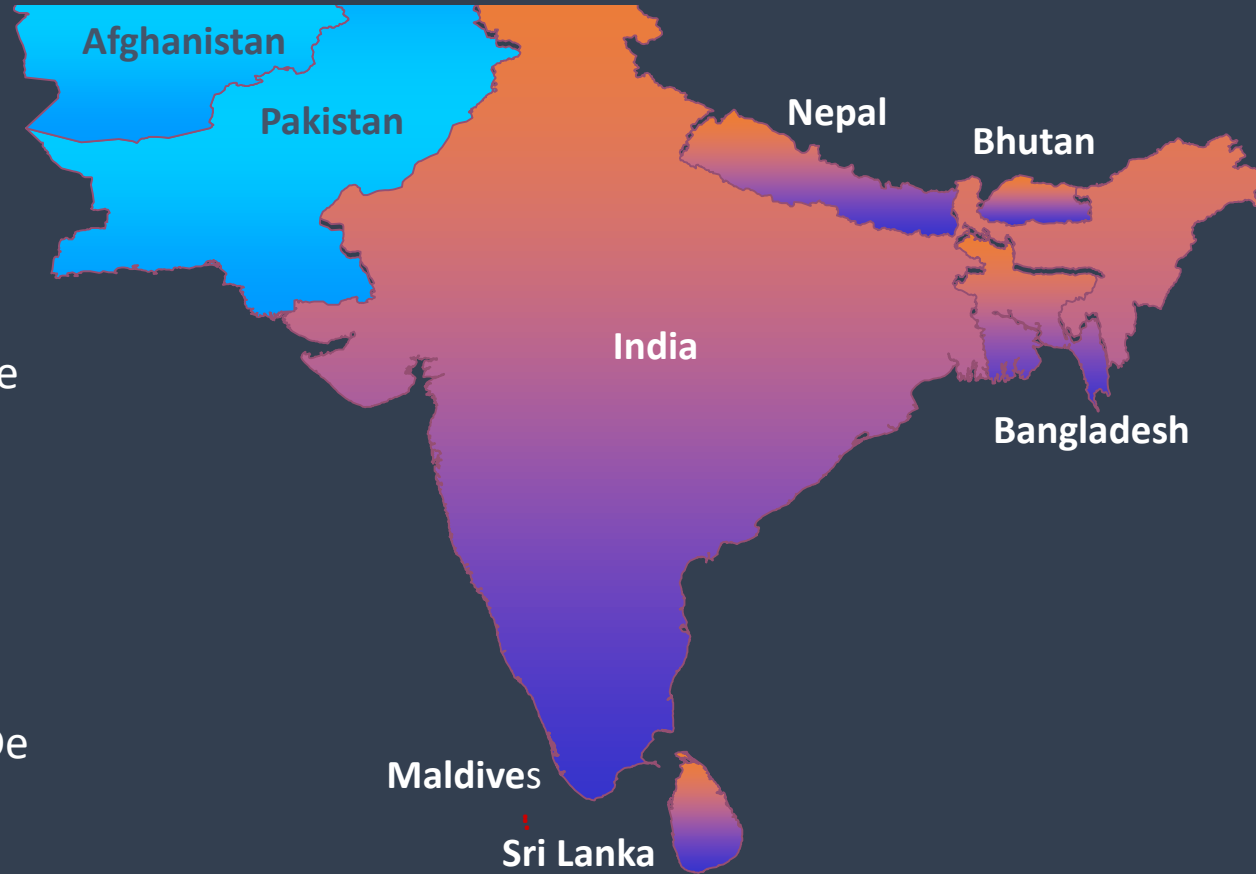
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Integrated Research and
IRADe Action for Development

South Asian Regional Power Exchange (SARPEX) Mock Exercise



6th Project Steering Committee
Meeting
8th and 9th, March, 2018

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





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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

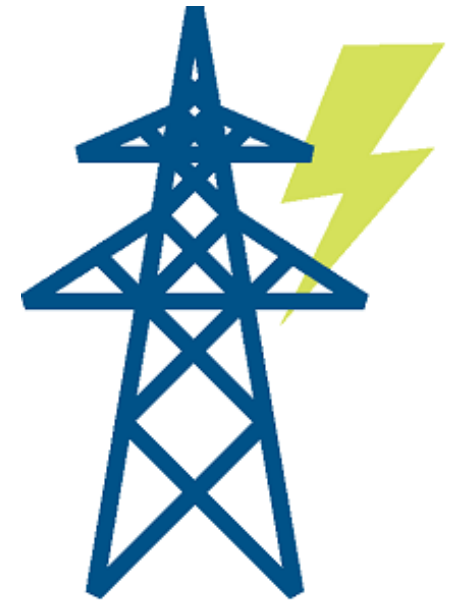
Sub-Regional Cooperation between Bangladesh, Bhutan, India and Nepal (BBIN)

Center Electricity Regulatory Commission, India draft notification on CBTE

Objectives of SARPEX Mock Exercise

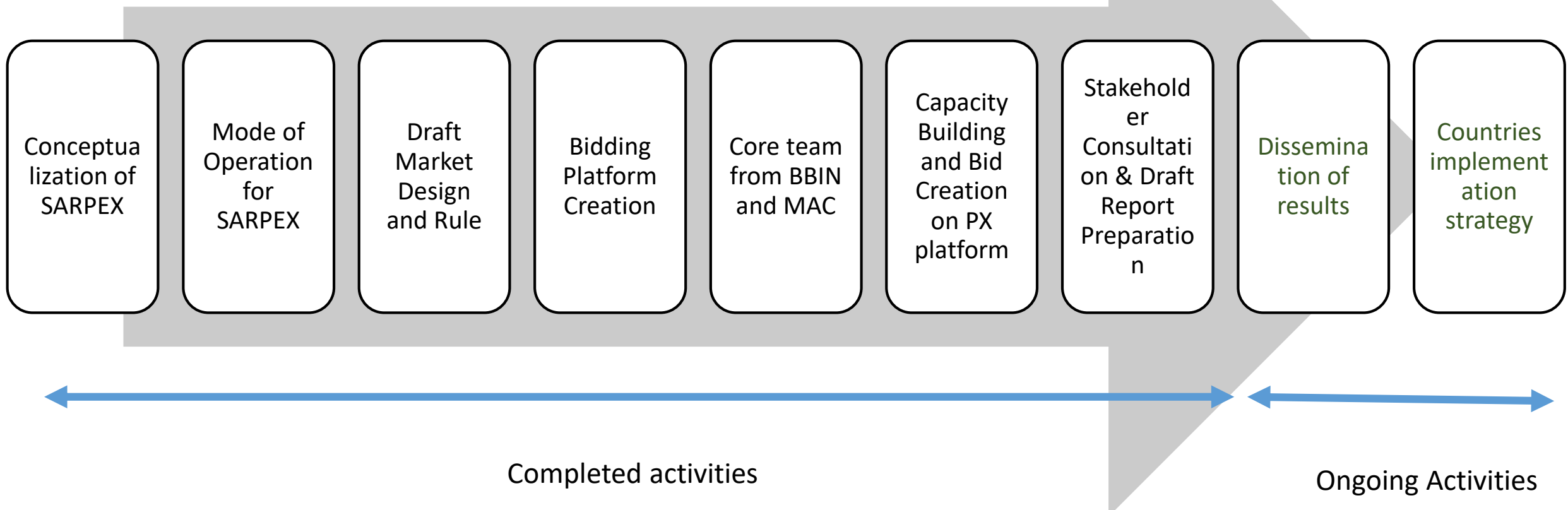
Objective :

- To ascertain the feasibility of the South Asian Regional Power Exchange (SARPEX) with Bangladesh, Bhutan, India and Nepal (BBIN) as the participants. (These are presently interconnected and other neighboring countries will be added as and when grid connectivity happens)
- To build capacity of concerned stakeholders in all participating nations
- To develop the draft set of Market Rules and Design

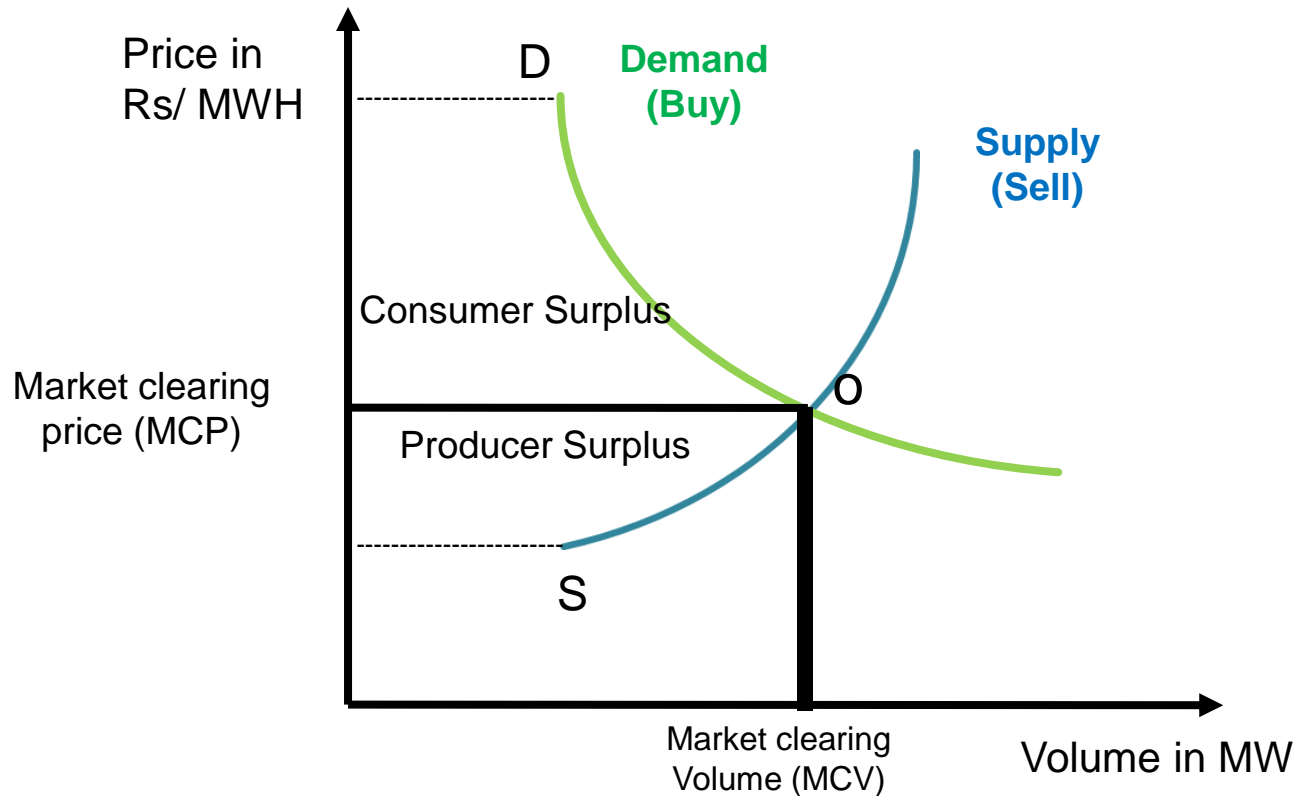




SARPEX- Mock Exercise activities



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.

Brief about SARPEX Mock Exercise

- The exercise covers the period from April'2015 to March'2016.
- 71 days were selected in this one year period to cover all kind of demand situation and various other crucial factors as per the approved Sampling methodology.
- The mock trading platform was run to generate results for all these 71 days.
- The mock trading platform was run in two modes of operation, “Unified mode” and “ Sequential Mode” as explained further in this presentation.
- The market rules and design for running of the mock exercise were approved by the TF-3 members.
- The transmission losses and charges have been factored in as in case of a regular day ahead market.
- The result of the matching engine yielded the unconstrained solution.
- The result for the 71 days were 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 were worked out in both the modes .

Average Transmission Charges and Losses Figures for BBN used in the mock exercise

#	Country	Transmission Charges	Transmission Losses	Comments
		(Rs/kWh)	(%)	
1	Bangladesh	0.117	0.3%	The cross-border transmission network for India-Bangladesh has been included in the POC charges and transmission Withdrawal Charges and Losses are published for Bangladesh
2	Nepal	0.301	4.1%	The cross-border transmission network for India-Nepal has not been included in POC and therefore the transmission charges of Bihar and Cross-border line are assumed for Nepal
	Bihar Withdrawal	0.257	1.6%	
	Muzzafarpur Dhalkebar Line	0.044	2.5%	
3	Bhutan	0.089	1.1%	The cross-border transmission network for India-Bhutan has been included in the POC charges and transmission Injection Charges are published by NLDC for Bhutan

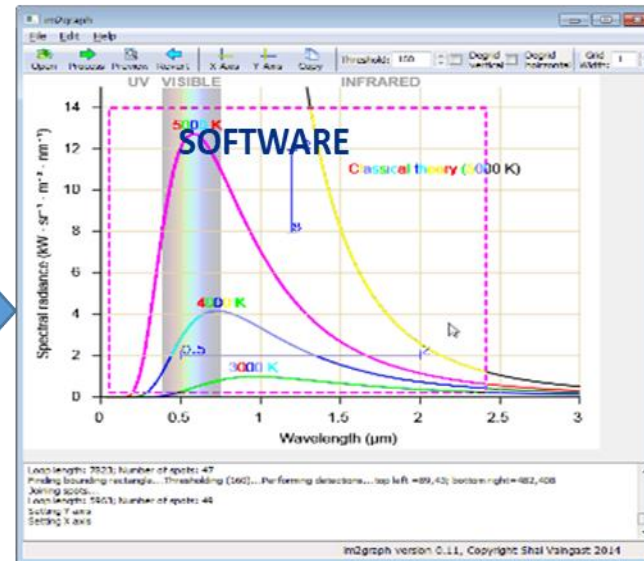
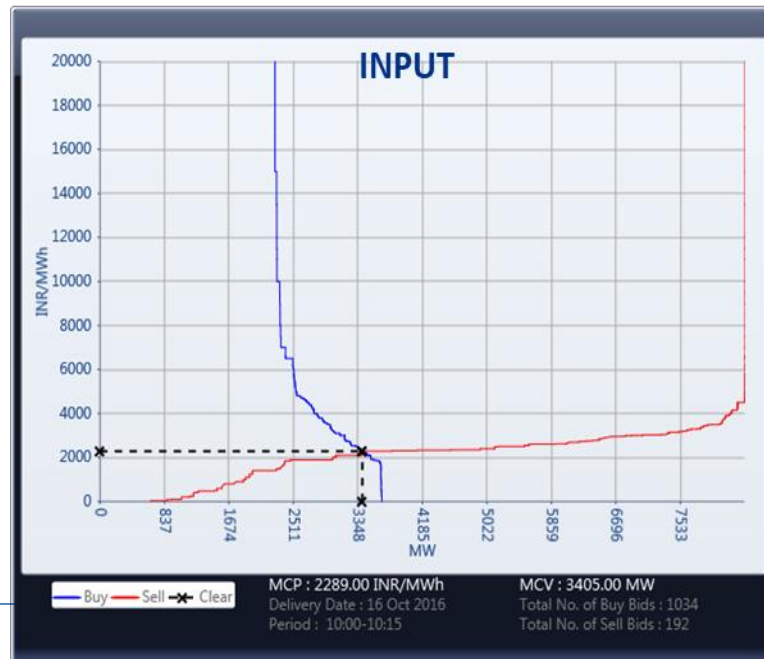
Modified Buy Bid Price = Bid Price – (Transmission Charges) / (1 - % Losses)

Modified Sell Bid Price = (Bid Price/ (1- % Losses)) + Transmission Charges

The bids submitted by BBN were adjusted by the above transmission charges and losses to reflect the true cost of power purchased or sold on the Exchange

Key Assumptions - SARPEX Mock Exercise

- ❖ **The mock exercise was based on unconstrained market clearing principles** i.e. determination of MCP and MCV without taking into account the impact of transmission congestion. The maximum bids were restricted to 300 MW buy by Bangladesh, 350 MW buy by Nepal and 265 MW sell by Bhutan.
- ❖ The Transmission charges and losses as applicable under the current bilateral trade with BBN were assumed for the Mock Exercise as explained in the next slide. The grid operating charges and exchange transaction are not assumed in the Mock Exercise, since these charges are very small (~0.03 INR/kWh).
- ❖ The bids of Nepal and Bhutan were prepared and uploaded by the core team. The bids of Bangladesh were prepared by IRADe and KPMG based on the data submitted by them. The Indian were extracted as below.

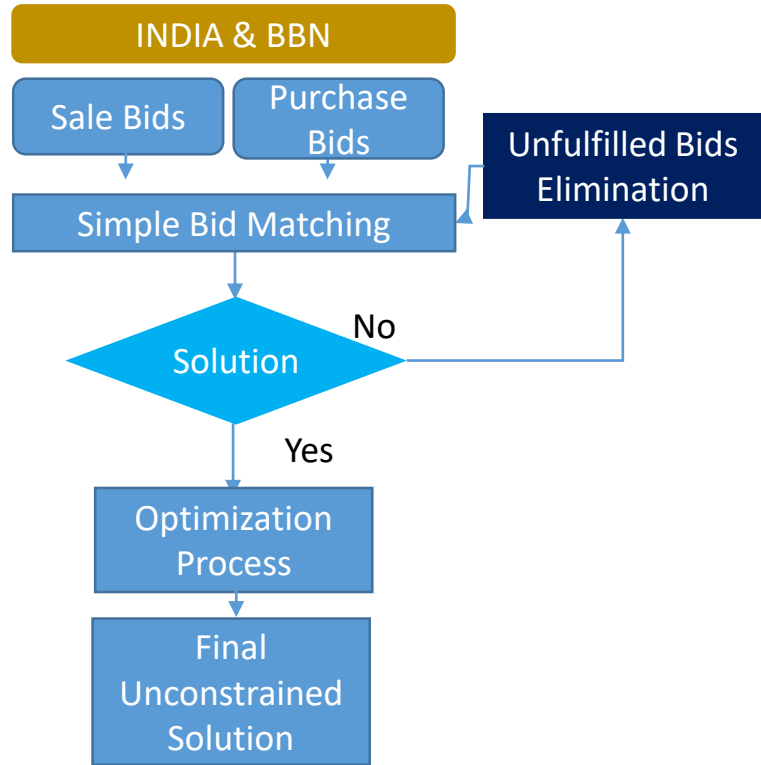


OUTPUT

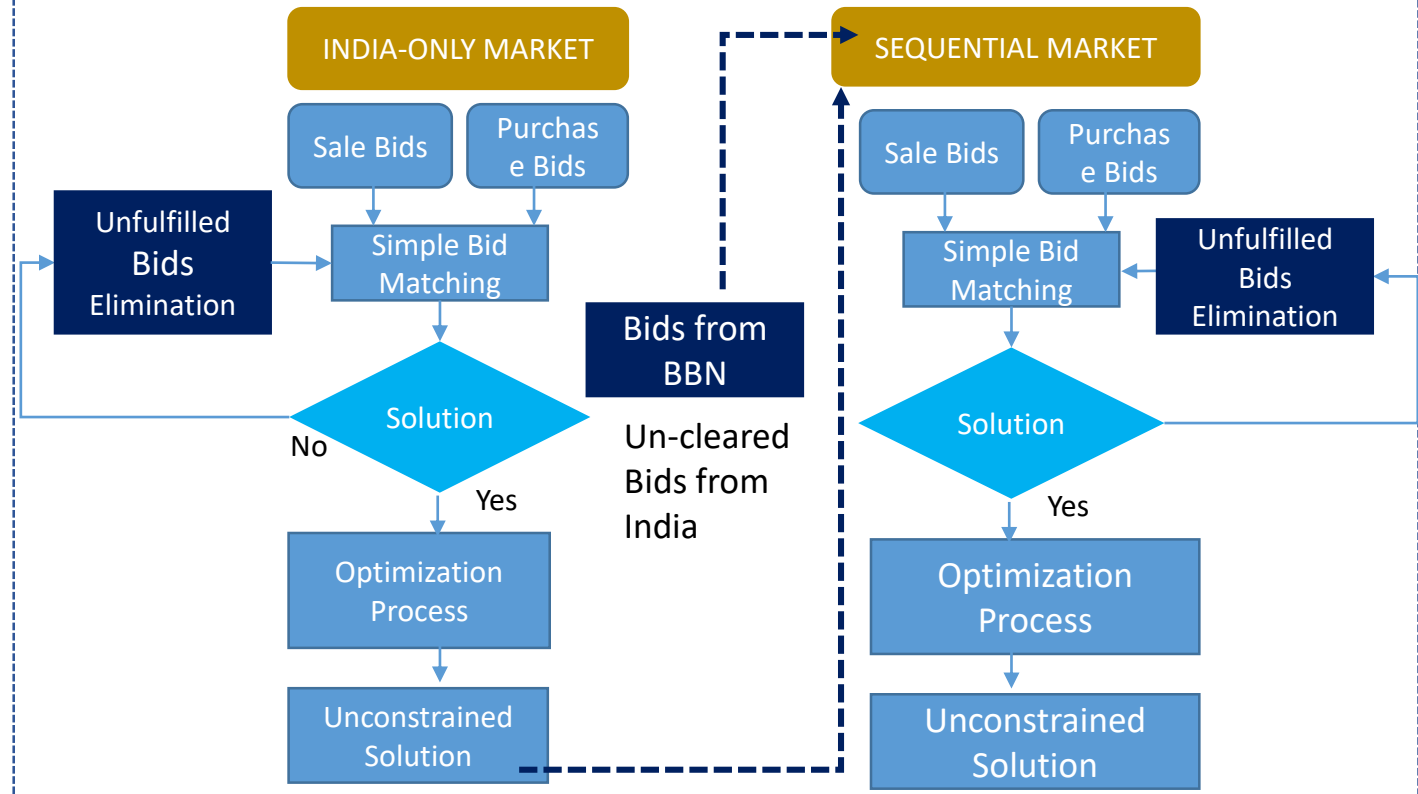
Buy X, Y_0	Sell X, Y_0
2237.49, 17529.8	670.754, 29.9401
2253.3, 13303.6	686.536, 29.9401
2269.11, 10803.6	702.319, 29.9401
2300.74, 9077.38	718.101, 29.9401
2316.55, 7529.76	733.884, 29.9401
2332.36, 7053.57	749.666, 29.9401
2348.17, 7053.57	765.448, 29.9401
2363.99, 7053.57	781.231, 29.9401
2379.8, 6875	797.013, 29.9401
2395.61, 6517.86	812.796, 29.9401
2411.42, 6517.86	828.578, 29.9401
2427.24, 6517.86	844.361, 29.9401
2443.05, 6517.86	860.143, 29.9401
2458.86, 6517.86	875.926, 89.8204
2474.67, 6398.81	891.708, 89.8204
2490.49, 5982.14	907.49, 89.8204
2506.3, 5208.33	923.273, 89.8204
2522.11, 5029.76	939.055, 89.8204
2569.55, 4791.67	954.838, 89.8204
2585.36, 4732.14	970.62, 89.8204

The Two Modes of Operation for SARPEX

UNIFIED MODE



SEQUENTIAL MODE



Web portal for SARPEX Mock Exercise Link

<http://mocksarpex.eu.ai>

Web Portal has, among other the following :-

- All documents related to SARPEX mock Exercise.
- Provision for submission of bids and viewing of results
- The access to the above is password protected. Rest of the sections are open to all.
- FAQ
- Various presentations related to SARPEX Mock Exercise
- Details of Stakeholder Consultations.
- Details of past and planned events
- Contact details.
- A link for submission of queries.

Core Team Members

S.No	Name	Country	Designation	Organization
1	Mr. Mohammad Hossain,	Bangladesh	Director General	Power Cell
2	Mr. Shiekh Faezul Amin -	Bangladesh	JS (Dev)	Power Division
3	Mr. Golam Kibria	Bangladesh	Director IPP 1	Bangladesh Power Development Board (BPDB)
4	Md. Nuruzzaman	Bangladesh	SE (Plg)	Power Grid Corporation of Bangladesh (PGCB)
5	Mr. Karma Namgyel	Bhutan	Chief Engineer, DHPS	Ministry of Economic Affairs
6	Mr. Denkar	Bhutan	Engineer, DHPS	Ministry of Economic Affairs
7	Mr. Ugyen Chopel	Bhutan	Engineer, DHPS	Ministry of Economic Affairs
8	Mr. Nima Tshering	Bhutan	Bhutan Power System Operator (BPSO)	Bhutan Power Coporation (BPC)
9	Mr. Anil Rajbhandary	Nepal	Director	Nepal Electricity Authority (NEA)
10	Mr. Nutan Prakash Sharma	Nepal	Senior Divisional Engineer	Department of Electricity Development, NEA
11	Mr. Tej Krishna Shrestha	Nepal	Asst. Manager, Power Trade Department	NEA
12	Mr. Narendra Shrestha	Nepal	Assistant Manager	Load Dispatch Centre, NEA

Market Advisory Committee

Role Of Market Advisory Committee.

- Advice on the design of the pilot market.
- Advice on the draft set of market rules for the pilot market.
- Reviewing 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 implementation team and the core team.

S.No	Name	Country	Designation	Organization
1	Mr. Anil Razdan	India	Ex- Secretary Gol	Earlier from Ministry of Power
2	Mr. Hans-Arild Bredesen	Norway	CEO	Nord Pool Consulting
3	Mr. Peter Jogersen	Denmark	Vice President	Energinet
4	Mr. Musara Beta	South Africa	Chief Market Analyst	South African Power Pool
Mentors				
1	Dr. Kirit Parikh	India	Chairman	IRADe
2	Dr. Jyoti Parikh	India	Executive Director	IRADe

Consultations and Disseminations – India

- **Meeting with Joint Secretary, Deputy Secretary and others in Ministry Of Power in India on 26th Feb'2018**
- **Central Electricity Authority:** One-to-one meetings in Central Electricity Authority (CEA) with Principal Chief Engineer, Chief Engineer and Director etc. and with Member Power System who is the Designated Authority as per the MoP India Notification for Cross Border Electricity Trade.
- **POSOCO:** The SARPEX mock exercise stakeholder consultation was held at POSOCO. The same was attended by CEO POSOCO and other high level officers. Mr Soonee, earlier CEO POSOCO and current Advisor.
- **Central Electricity Regulatory Commission:** One-to-one meetings in Central Electricity Regulatory Commission (CERC) with Members and other senior officials of CERC. **Submission to CERC draft notification were presented to CERC. The same are also available on CERC website.**
- Meeting with other senior officials like MD& CEO of IEX and MD of TPTCL.



Nepal Stakeholder Consultation

- The Stakeholder Consultation on SARPEX Mock Exercise for covering various aspects of SARPEX exercise objective, mode of operations, power exchange operation and participation in the context of the SARPEX mock exercise was held on 11th and 12th April 2017.
- Mr. Dinesh Kumar Ghimire, Joint Secretary, Ministry of Energy, Nepal delivered the key note address and mentioned about the Nepal's long term plan for mitigating energy deficit.
- Dr. Kirit Parikh, Chairman, IRADe has given special address and mentioned the SARPEX objective and relevance in the cross border electricity trade.
- More than 30 participants from various organization has participated in the Workshop.
- The one to one meeting has been conducted in Ministry of Energy, Nepal Electricity Authority (NEA) and Load Dispatch Centre etc. to discuss the concept of SARPEX and its relevance for Nepal.



Bhutan Stakeholder Consultation

- The stakeholder consultation on SARPEX Mock Exercise for Bhutan Stakeholders covering various aspects of SARPEX exercise objective, mode of operations, power exchange operation and participation in the context of the SARPEX mock exercise was held on 29th-30th July 2017.
- Keynote address has been delivered by Mr. Sonam P Wangdi Director General, DHPS, MoEA Bhutan and more than 20 participants from different organization has participated in the Workshop.
- The one to one meeting has been conducted in the Ministry of Economic Affairs (MoEA) with Mr Dasho Yeshe Wangdi and others, Druk Green Power Corporation (DGPC), Bhutan Power Corporation (BPC), Druk Holding & Investment etc.



Bangladesh Stakeholder Consultation

- The stakeholder consultation on SARPEX Mock Exercise for Bangladesh Stakeholders covering various aspects of SARPEX exercise objective, mode of operations, power exchange operation and participation in the SARPEX mock exercise was held on 9th-10th August 2017.
- Keynote address has been delivered by Mr. Mohammad Hossain, Director General, Power Cell, Bangladesh
- More than 30 participants from different organization has participated in the Workshop.
- The one to one meeting has been conducted with the minister of power Mr Ahmad Kaikus and other officials in the Ministry of Mineral and Energy Resource, Bangladesh Electricity Regulatory Commission, Bangladesh Power Development Board, Dhaka Power Distribution Company.



Sri-Lanka Stakeholder Consultation

- The stakeholder consultation on SARPEX Mock Exercise in Sri-Lanka covering various aspects of SARPEX exercise objective, mode of operations, power exchange operation and participation in the SARPEX mock exercise was held on 9th-10th January 2018.
- Keynote address has been delivered by Dr. B.M.C. Batagoda, Secretary to the Ministry of Power & Energy, Sri Lanka
- More than 30 participants from different organization has participated in the Workshop from Ministry of Power, Lanka Electricity Company, PUCSL etc.



Results for BBIN

Total Yearly Surplus in the 3 Modes for FY'16

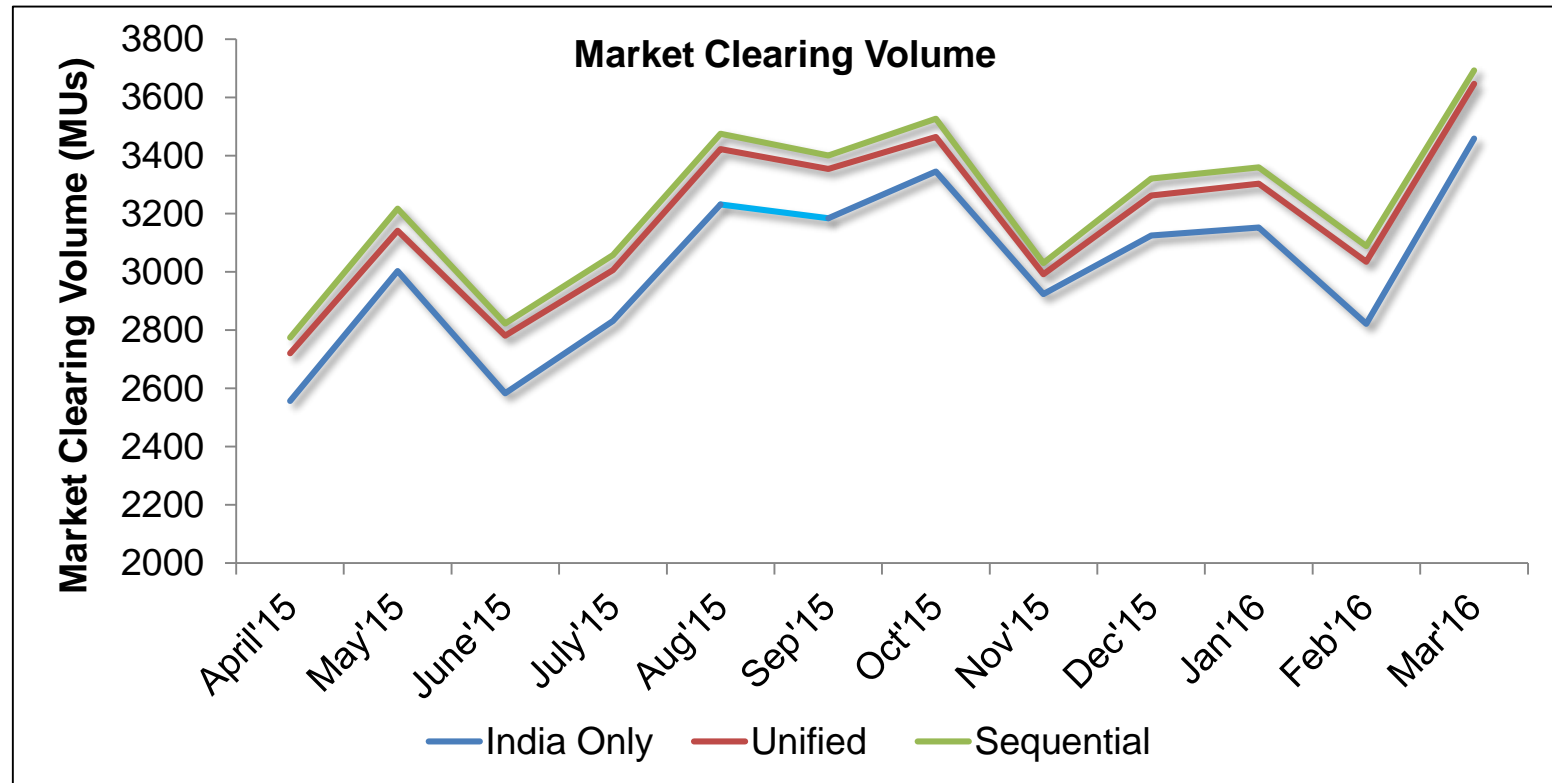
	Surplus (Rs Billion)	Additional Surplus Generated Over India Only Mode(Rs Billion)
India Only	313.53	
Unified	323.63	10.1
Sequential	323.24	9.71

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

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

	Total Yearly Market Clearing Volume (in MUs)	Incremental Volume India-Only Mode
India-Only	36219	-
Unified	38137	1918
Sequential	38769	2550

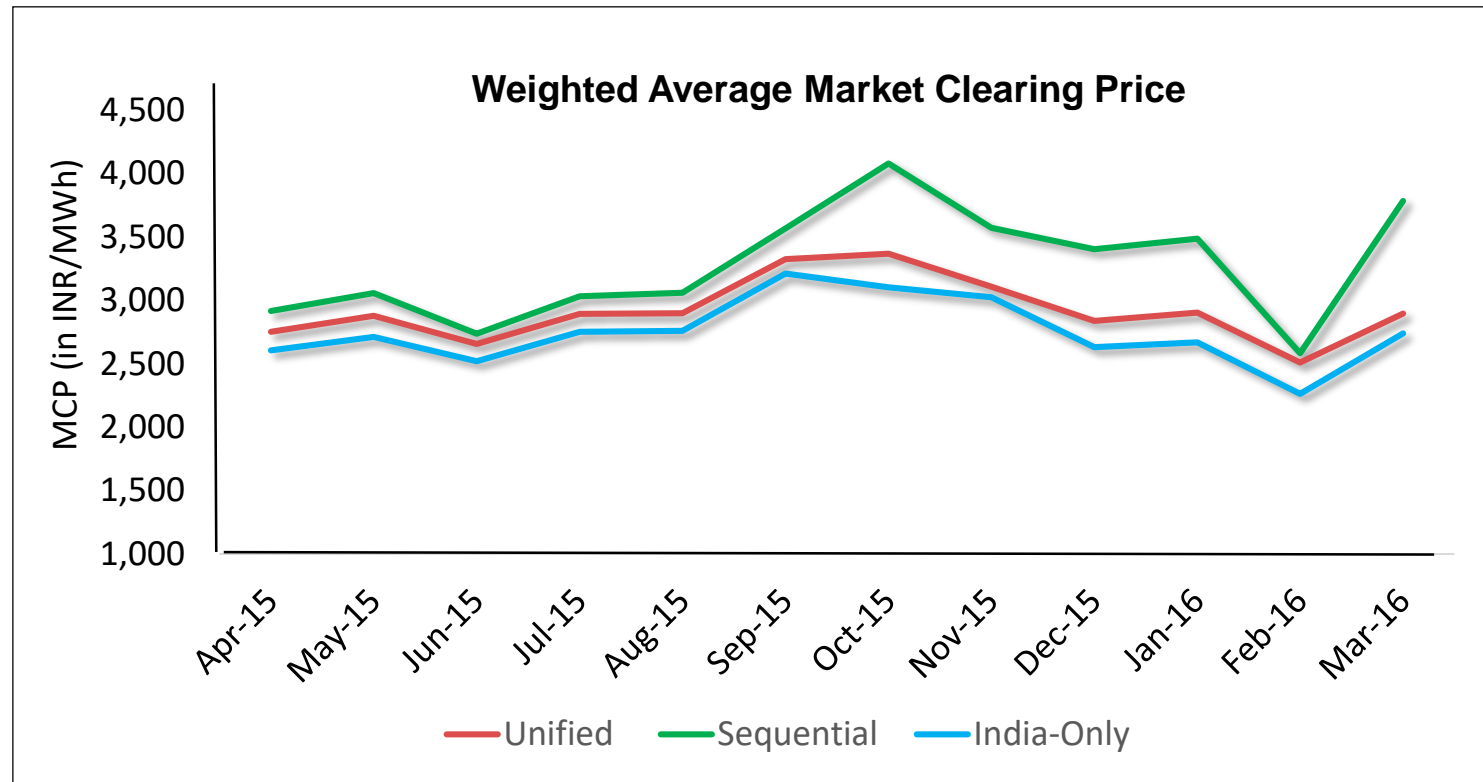


The figures for Unified and Sequential Mode include the existing DAM operations in India, referred as India-Only Mode

The additional volume over India only mode gives **the volume of the Cross Border DAM** which is 1997 Mus in case of Unified mode and 2549 Mus in case of sequential mode. **Roughly 6-7 Mus per day (Unconstrained Volume)**

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

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 for the Region and the India.

Additional Surplus accrued to each nation on SARPEX (over the surplus of Indian DAM) for FY'16 in 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 (87.6%)	0.7 (6.93%)	0.3 (2.97%)	0.25 (2.48%)
Sequential	9.71	8.23 (81.4%)	0.63 (6.24%)	0.42 (4.16%)	0.43 (4.26%)

Bangladesh gained the highest Consumer Surplus of INR 8.85 Billion and INR 8.23 Billion in Unified and Sequential Mode respectively since the cost of electricity displaced by Exchange was highest at INR 10,000/MWh. This is much higher than those in the other Nations

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

	India	Bangladesh	Nepal	Bhutan	Total
India-Only	36219	-	-	-	36219
Unified (Increase/ Decrease*)	35406 (-812*)	2011	719	0.09	38136 (1997*)
Sequential (Increase/ Decrease*)	36219 (0*)	1920	630	0.04	38769 (2550*)

The volume bought by India actually reduces in the Unified mode. This is because the bids from Bangladesh and Nepal displace the bids of low cost Indian buyers

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

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

Volumes sold by each nation on SARPEX for FY'16 (UCV) In MUs

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

The volume sold by India is higher in Sequential mode by about 50%. This is because the bids from Bangladesh and Nepal DO NOT displace the bids of low cost Indian buyers as was the case in Unified mode

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*

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

UMP

In Rs/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 predominantly seller on the Exchange*

Annual Weighted Average Sell price for each nation

In Rs/MWhr

	India	Bangladesh	Nepal	Bhutan
India-Only	2745	-	-	-
Unified	2918	-	2000	2983
Sequential	2965	-	3000	3339

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

** Nepal is predominantly a buyer in the Exchange*

Total Cost incurred by buyers from each nation in FY'16

INR Billion

	India	Bangladesh	Nepal	Bhutan
India-Only	99.4	-	-	-
Unified	103.32	5.90	2.08	0.0003
Sequential	99.4	5.95	1.81	0.0001

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

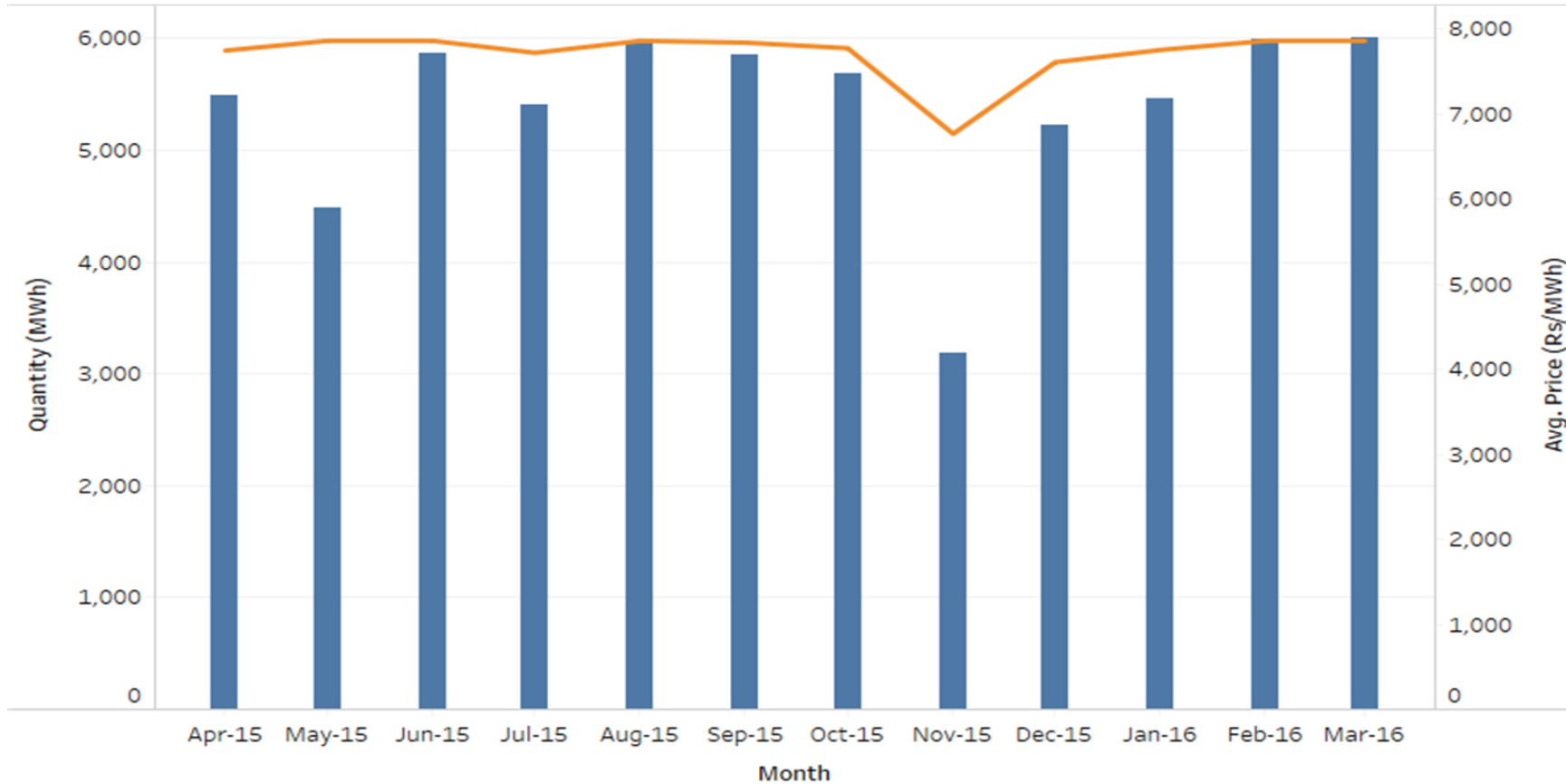
Total Revenue earned by sellers from each nation in FY'16

INR Billion

	India	Bangladesh	Nepal	Bhutan
India-Only	99.4	-	-	-
Unified	110.05	-	0.02	1.22
Sequential	105.71	-	0.03	1.42

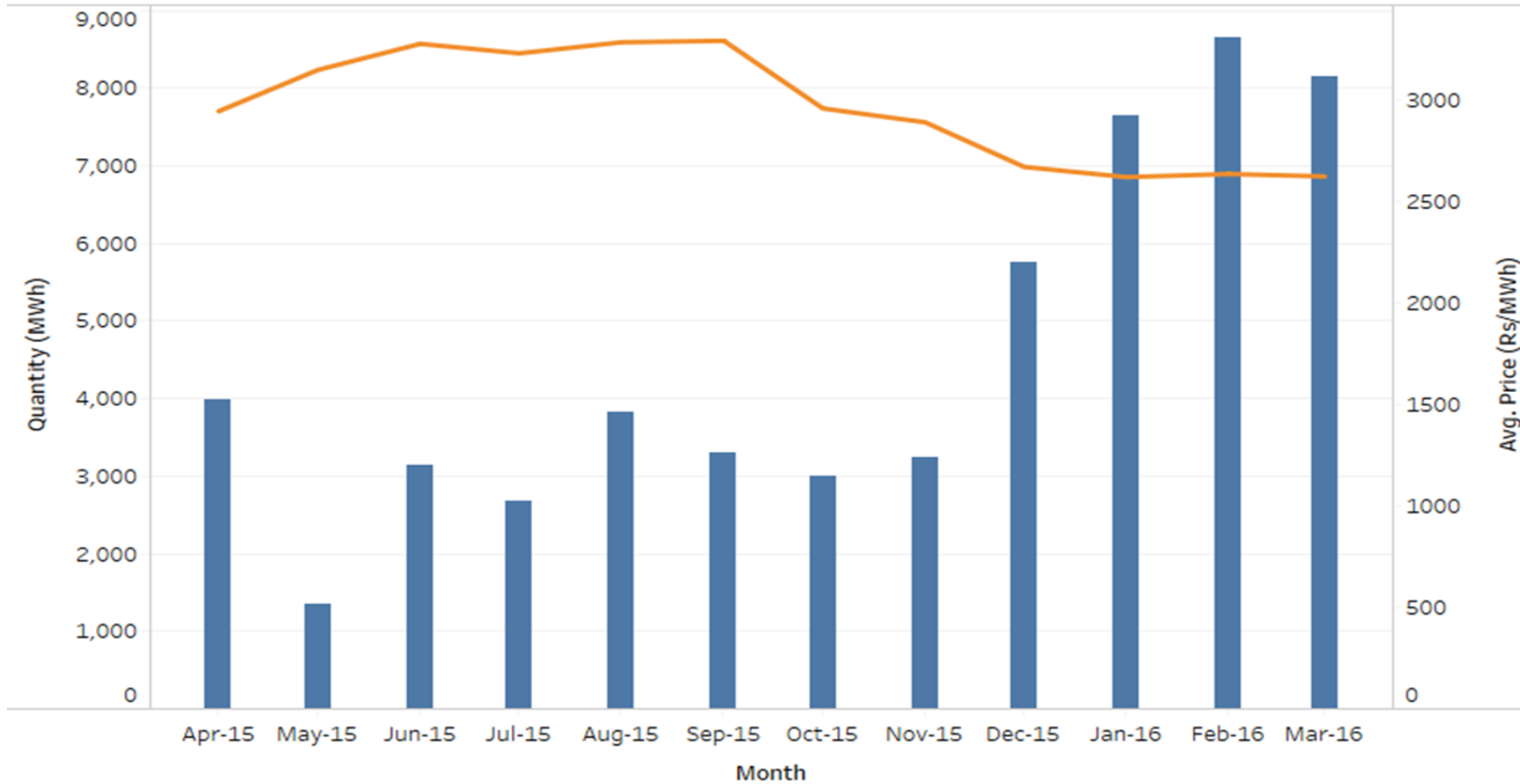
The figures for Sequential Mode include the revenue from the sale of power in domestic (India Only) and residual market (BBN)

Purchase Bids for Bangladesh for a typical day in each month



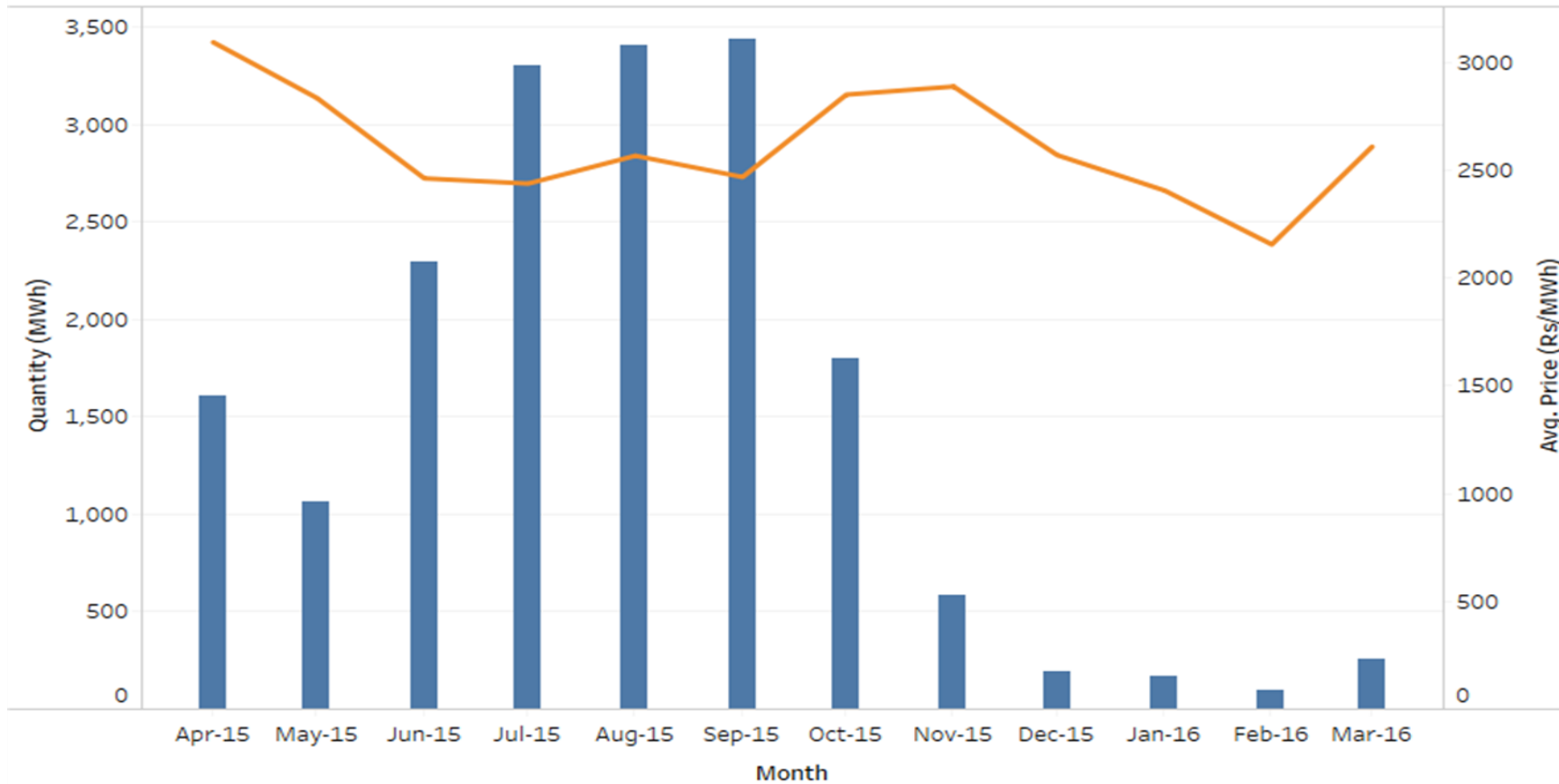
- Price (Rs/MWh)
- Quantity (MWh)

Purchase Bids for Nepal for a typical day in each month



- Price (Rs/MWh)
- Quantity (MWh)

Sell Bids for Bhutan for a typical day in each month



- Price (Rs/MWh)
- Quantity (MWh)

Key Takeaways from SARPEX Mock Exercise For SAR

- ❖ **All nations gain significantly from the trade in the DAM on SARPEX.** The difference in the regional surplus between the two modes is insignificant in comparison to the gain accrued to each nation. Thus, the two modes of Operation for SARPEX are practically the same especially considering that the Mock Exercise “simulates” the possible behavior of all bidders in the DAM on SARPEX through inputs (bids) that can be estimated or extracted with a reasonable degree of accuracy only. **Slide – 19, 22 and 23.**
- ❖ The total surplus generated by the Regional Market is about INR 10 Billion (Rs 100 Crs) which is significant. **Slide – 19**
- ❖ **Clearly, the DAM on a regional exchange is desirable and improves the socio-economic welfare of all participating nations.**
- ❖ The sequential market provides for a level playing field for all nations with each having the right to use their own cheaper power first and also the right to use their own national assets like transmission lines for their domestic market first
- ❖ The Surplus Gain in a year to BBIN is far higher than the YTC of the transmission line indicating that relatively small investments in transmission lines may yield surprisingly huge dividends in terms of increased economic gains and social welfare. Thus, **there is also a clear case for having more Cross Border Interconnections. There is enough power available for trading and in whatever manner these trades take place, transmission lines are required.**



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Important Links

- SARPEX Web Portal <http://mocksarpex.eu.ai>
- SARPEX Road- Map <https://sari-energy.org/publications-list/sarpex-road-map/>
- **Ministry of Power, India Guidelines** on Cross Border Electricity Trade
<https://powermin.nic.in/sites/default/files/webform/notices/Guidelines%20for%20Cross%20Boarder%20Trade.pdf>
- **CEA Draft Conduct of Business Rules** - Comments invited from all stakeholders of power sector & general public by 31st December 2017.
http://www.cea.nic.in/cbte_pspa2.html
- **CERC Draft regulation on Cross Border Electricity Trade.**
http://www.cercind.gov.in/2017/draft_reg/Noti16.pdf.
- **IRADe's comment on CERC draft regulation submitted to CERC.**
http://www.cercind.gov.in/2017/draft_reg/CB/IRADe.pdf
- **IRADe's Supplementary Submission on CERC draft regulation**
http://www.cercind.gov.in/2017/draft_reg/CB/IRADe_ss.pdf



For more details please contact:-

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Annexure

SARPEX Web Portal and its Applications

SARPEX Web Portal -Home Page

SARPEX : MOCK EXERCISE - ABOUT

ABOUT SARPEX : MOCK EXERCISE

THE CONCEPT

ABOUT US

MEET THE PEOPLE

SARPEX CONCEPT

The proposed South Asian Regional Power Exchange (SARPEX) aims to provide the following benefits:

- Cross Border Electricity Trade (CBET) that maximizes the social welfare and efficiency through market determined prices.
- Deficit/Surplus power can be bought/sold on a real time basis to optimise resource allocation.

Further, the Ministry of Power (MoP), India recently launched its cross-border power trade guidelines allowing South Asian Countries (SAC) to participate on the Indian Power Exchanges for Term Ahead and Intra Day Contracts/Contingency contracts subject to certain conditions. This makes the concept of SARPEX much more of a reality

SARPEX Web Portal – Login Page

SARPEX : MOCK EXERCISE

[HOME](#)

[LOG IN](#)

Log In

E-mail

sarpex.bhutan.bids@gmail.com

Password

.....

Remember me (for 30 days)

LOG IN

SARPEX Web Portal – Bid Submission Page

BIDS SUBMISSION - SARPEX
Submit your bids on this page in predefined excel formats provided by the administrator.
[View previously bid dates - Click here!](#)

Submit Bids Here!
Step1: Choose Date, Month and Year you want to submit the bid file for.
Step2: Upload the Bids file in xlsx format.
Step3: Confirm the bids submission and wait for success message.

Users can choose a date for which they are uploading the bids

Select day: Select month: Select year:

**** UPLOAD EXCEL FILE CONTAINING BIDS ****
 No file chosen
* Please ensure that data is entered properly in the excel template before submission!

Users can upload their bids by clicking here and choosing the excel file containing bids

SARPEX Web Portal – Results Page

SARPEX : MOCK EXERCISE

[HOME](#)

[BIDS SUBMISSION](#)

[REPORTS](#)

[CONTACT](#)

WELCOME BHUTAN ▾

BIDS SUBMISSION RESULTS - SARPEX

The results of your bids submission are displayed on this webpage.
The default date is today. Please choose a different date for viewing corresponding results.

CHOOSE A DATE TO VIEW RESULTS

Select day: Select month: Select year:

Users can choose a date and see results for the corresponding date

Showing bids submission results for date: 15-04-2015

~~UNIFIED MODE RESULTS~~

Results are shown for unified and Sequential Mode

SARPEX Web Portal – Contact Administrator Page

SARPEX : MOCK EXERCISE HOME WELCOME BHUTAN -

CONTACT APPLICATION ADMINISTRATOR

For queries regarding

1. Bids Submission Issues
2. Results Display Issues
3. Data Discrepancy

Please use the contact form below to send a message to the application administrator.
Your issues will be resolved at the earliest.

Write a message to administrator for issues!

Fill the fields below and click on 'SEND MESSAGE TO ADMIN' button to send the message to application administrator.

QUERY/MESSAGE SUBJECT

Please enter the subject of the query or message here...

QUERY/MESSAGE BODY

Message/Query:

SEND MESSAGE TO ADMIN

Users can contact app administrator for issues.

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