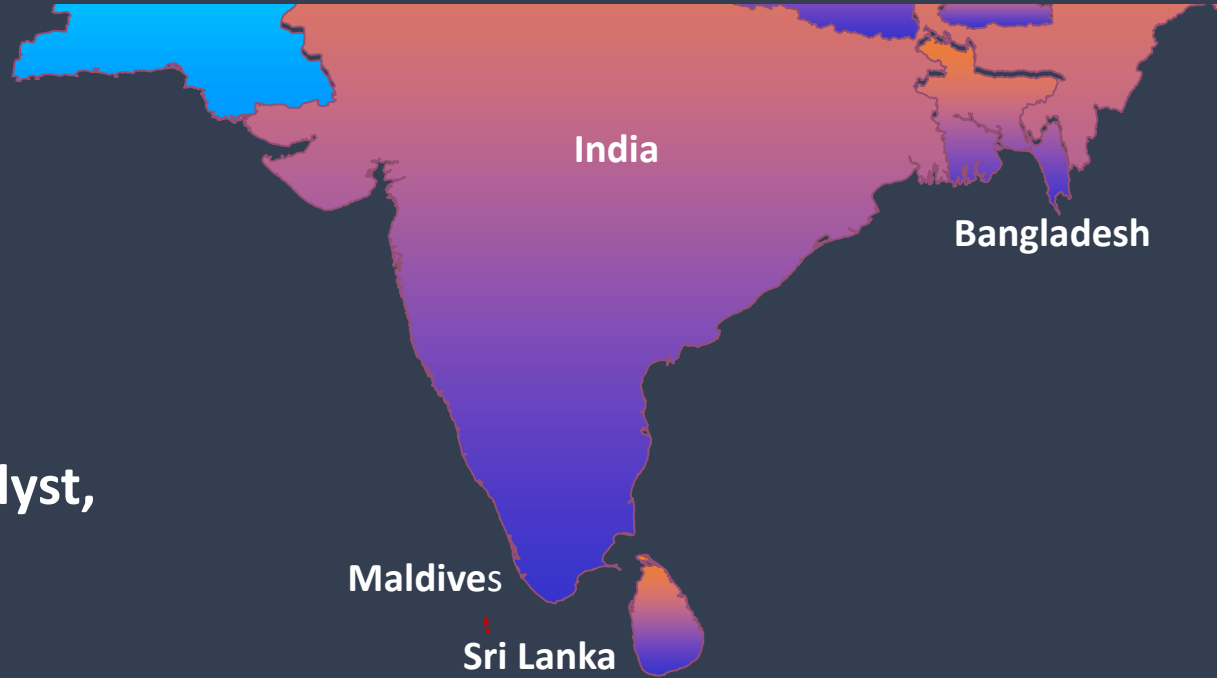




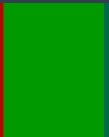
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South Asian Regional Power Market Development & Learning from International Power Exchanges/Pool



Gaurav Jain,
Senior Research Analyst,
IRADe, SARI/EI



System Operation and Settlement Mechanism, Cross Border
Power Market in South Asia



Content

- Aspiration behind regional trade
- Recent guidelines, orders and agreements related to CBET
- Existing system operation and Commercial arrangement
- Regional Power Market Development- Learning (Evolution, Ownership, Power Market growth etc.)
- Power market development phases- Expected in South Asia
- Need of Power Exchange
- Possible market design for Power Exchange
- Progress Update- Key Activities undertaken

Aspiration Behind the Regional Integration

Technical and Operational Benefits:

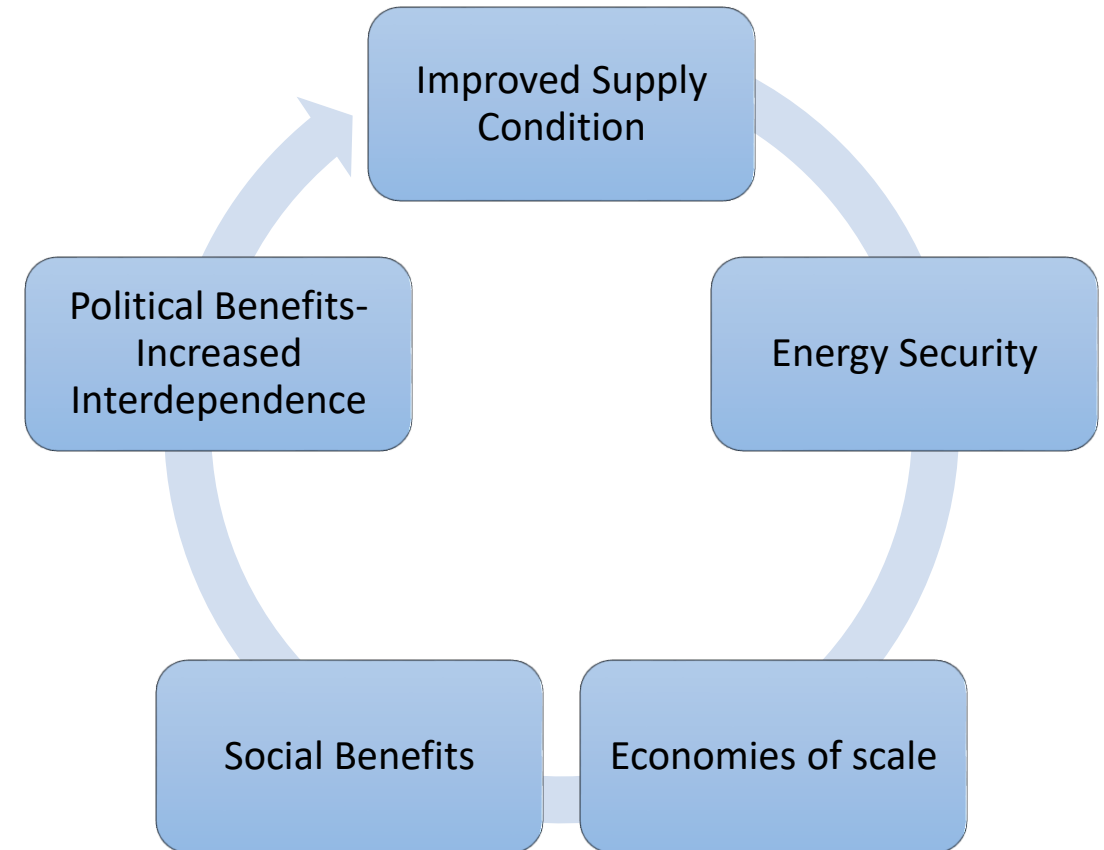
- ❖ Optimal Use of Regional Resources and System Operation
- ❖ Economies of scale in the development of regional resources
- ❖ Improved energy security and reliability of respective power systems
- ❖ Optimized transmission network
- ❖ Reduce environmental impact
- ❖ Reduce fossil fuel imports

Economic and Financial Benefits:

- ❖ Cost effective power system
- ❖ Better return to investors in generation assets
- ❖ Improvement in industrial productivity and competitiveness
- ❖ Less exposure to volatile international energy prices
- ❖ Economic Growth
- ❖ High export income

Environmental Benefits:

- ❖ Less Impact on Local and Global environment
- ❖ Reduce Adverse Impact of Indoor Air Pollution
- ❖ Improvement in Social Indicators
- ❖ Renewable Energy Development

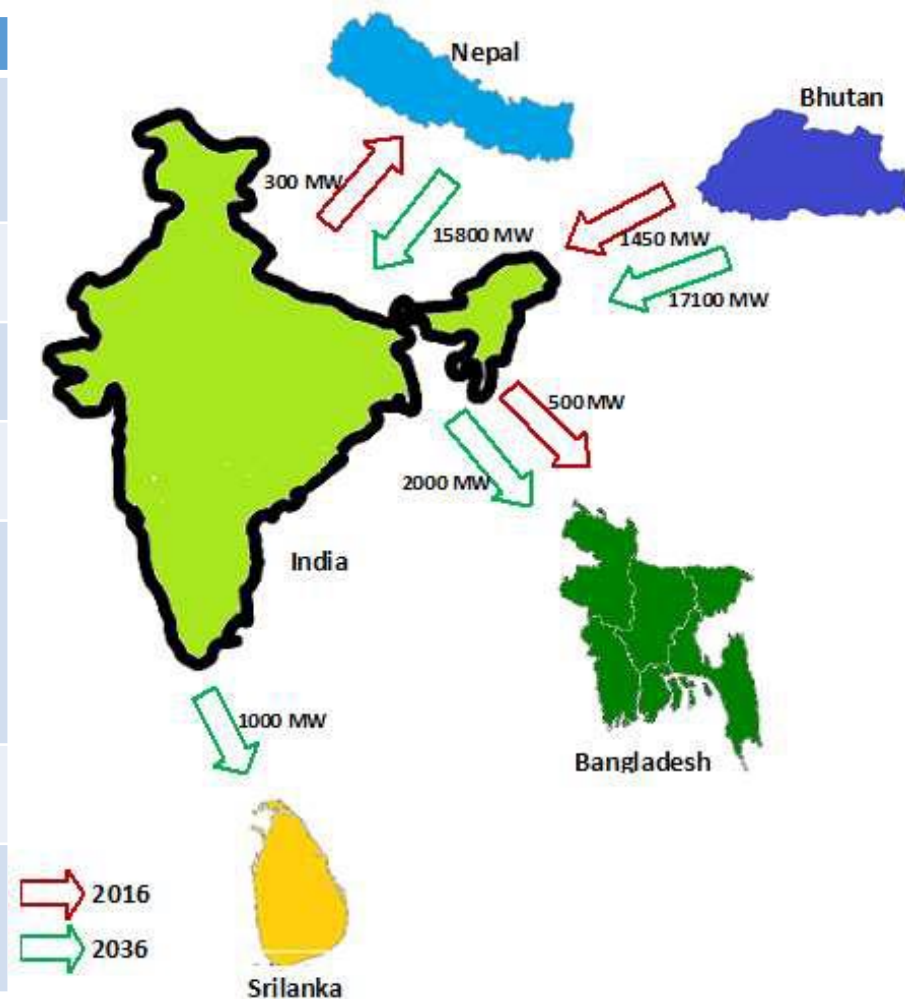


SOUTH ASIA- BRIEF OVERVIEW

System Operation and Settlement Mechanism

Existing and Future envisaged Power trade in South

Country	Contracts quantum and duration	Type
Bhutan → India (1450 MW)	Contract with PTC for Chukka (336 MW), Kurichhu (60 MW) Hydro Projects (Long Term)	G to G
	Contract with PTC for Tala (1040 MW) Hydro Project (Long Term)	G to G
	Contract with TPTCL for Dagachhu (126 MW) Hydro Project (Long Term)	Commercial
India → Bangladesh (660 MW)	BPDB Long-term contract with NVVNL for 250 MW	G to G
	BPDB Medium-term contract with PTC for 250 MW	Commercial
	Tripura – Comilla 160 MW contract	G to G
India → Nepal (420 MW)	NEA Bilateral contracts / Treaties to the tune of 420-440 MW	G to G
	NEA Past contracts with PTC (2011-2015) during December-April months for ~20-30 MW	Commercial



Commercial Mechanisms of Price Discovery in Power Trading is well established now in all the BBIN countries



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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

Pakistan – Import of electric power regulation

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

System Operation & Settlement Mechanism: Key Provisions/Clauses

- **IGFA Article-11- System Operation and Settlement Mechanism**

- ✓ Member states shall enable the national grid operators to jointly develop coordinated procedures for the secure and reliable operation of the inter-connected grids and to prepare scheduling, dispatching, energy accounting and settlement procedure for Cross- Border trade.

- **PTA between India and Nepal- Article-2**

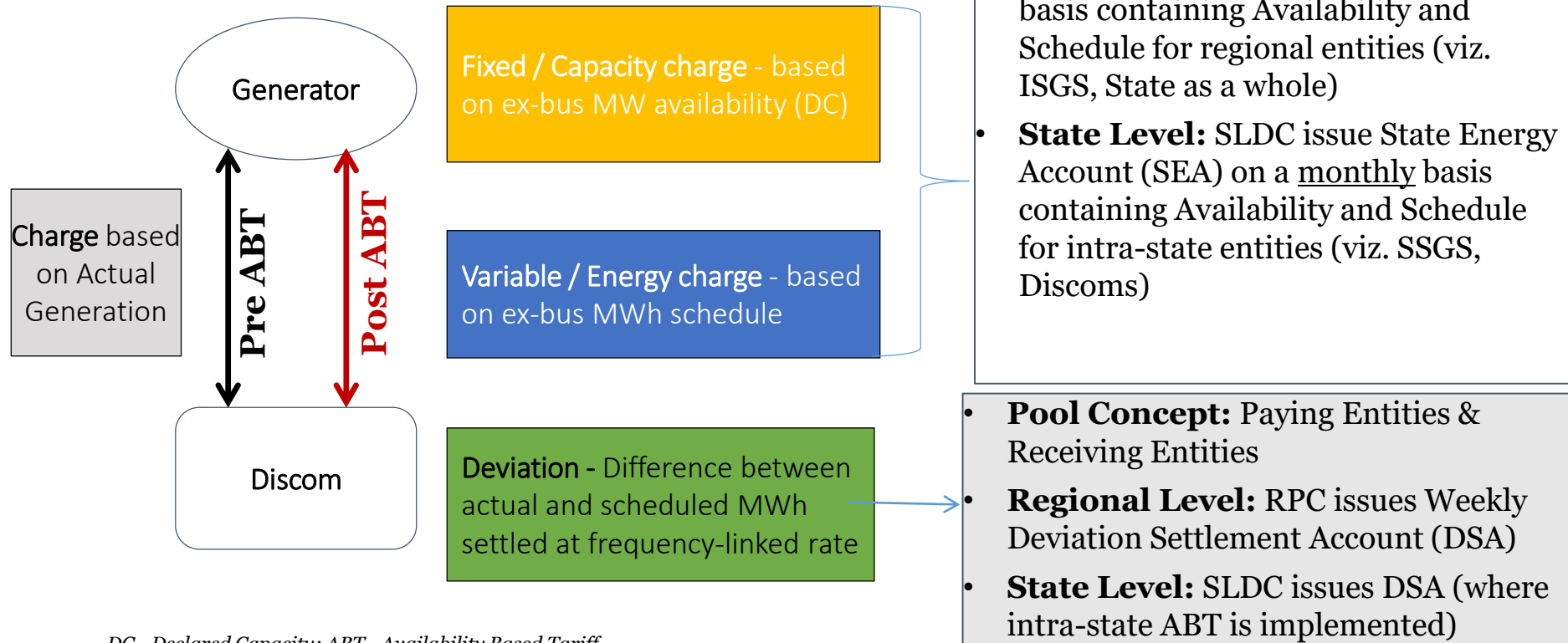
- ✓ a.) Mutually work out a coordinated procedure for secure and reliable operation of the national grids interconnected through cross border transmission interconnection(s) and prepare scheduling, dispatch, energy accounting, settlement and procedures for cross-border power trade and unscheduled interchange.
- ✓ B.) Allow non-discriminatory access to the cross-border interconnection(s) for all authorized/licensed participants in the common electricity market.

- **CBTE draft notification of CERC, India- Chapter-4: System Operation**

- ✓ Detailed provision of Scheduling, Energy Accounting, Commercial settlement has mentioned

Energy Accounting & Deviation Settlement Mechanism

- Meter data is used for energy billing in all SAC except India
- In India, meter data is used only for deviation settlement



DC - Declared Capacity; ABT - Availability Based Tariff



Deviation Settlement Mechanism

Drawal /Injection
in time block

Drawal
/Injection =
Schedule

Yes

Charges for Deviation

- Linked to grid frequency (in Hz)
- Defined for each 0.01 Hz
- 35.60 paise/kWh (50.05-50.00 Hz);
20.84 paise/kWh (below 50.00 Hz)

No

No deviation
settlement
required

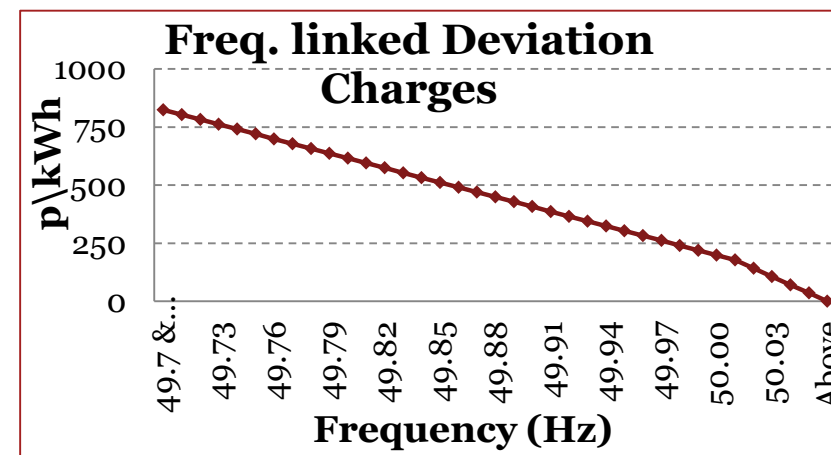
Deviation \leq
12% of Schedule
or 150 MW
(whichever is
lower)*

Deviation
Settlement
Charge

Deviation $>$ 12% of
Schedule or 150 MW
(whichever is
lower)*

- UD/OI - No Deviation Charges in excess of limit; Additional Charges in case Frequency \geq 50.1 Hz
- OD/UI - Deviation Settlement Charge and Additional Charge for deviation (slab-wise)

* If Schedule \leq 400 MW then % limits computed w.r.t 400 MW





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	8 AM	10 AM	12 AM	4 PM	6 PM	10 PM	12 PM	Day of Operation	
INDIA	8.00 AM Generator - DC - RLDC	10.00 AM RLDC - Entitlements - Beneficiaries		3.00 PM SLDC - Requisitions - RLDC	6.00 PM RLDC - Schedule – all entities	10.00 PM Any modification - RLDC	11.00 PM Final schedule - RLDC	12.00 PM Schedules applicable	Revisions allowed
BHUTAN	9.00 AM Generator - assess hourly energy	9.30 AM Licensees - hourly demand - SO		1.30 PM ERLDC - SO - modifications in CBET (SO - ERLDC at 11:30 AM)	6.00 PM SO - hourly schedules – all entities		Before 12.00 PM Revision of schedules; advice ERLDC	12.00 PM Schedules applicable	Revisions allowed
SRI LANKA	Before 10.00 AM SO – previous day deviations (on website; inform PUCSL)			3.00 PM SO – hourly schedule – all entities			Before 12.00 PM SO - Day Ahead Dispatch (on website)		Revisions allowed
PAKISTAN	Before 10.00 AM Generators – 30 min Availability – SO				Before 5.00 PM SO - Day Ahead Notification				Revisions allowed
NEPAL		Before 12.00 AM Generator - hourly availability - SO			Before 4.00 PM SO - day ahead and following day ahead schedules				Revisions allowed
BANGLADESH		Before 12.00 AM Generators - Availability commencing 36 hours ahead - NLDC			Before 5.00 PM NLDC - schedule requirements for the following day				Revisions allowed

Scheduling & despatch activity to a large extent is undertaken on day-ahead basis

NLDC
(Inter-regional, PX, cross border trades)

DC: Declared Capacity
 SCH: Schedule
 REQ: Requisition
 ISGS: Inter-state Generating Station
 SSGS: State Sector Generating Station
 N/R/SLDC: National/Regional/State Load Despatch Centre
 PX: Power Exchange

D-1

08:00

10:00

15:00

18:00

22:00

23:00

D
00:00 -
24:00

ISGS

Declare Availability (DC)

Despatch Schedule

Revise DC, if any

Final Despatch Schedule

Revisions during day

RLDC

Entitlements

Requisition incl. Bilateral trades

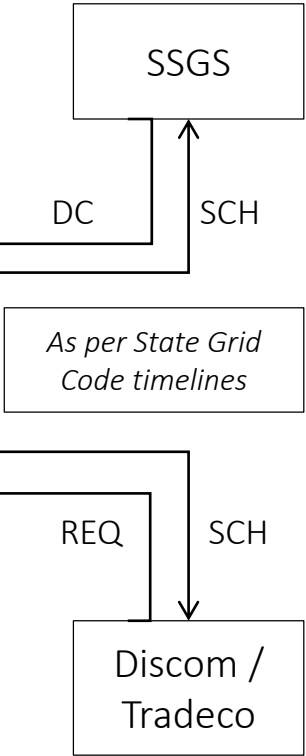
Drawal Schedule

Revise Schedule, if any

Final Drawal Schedule

Revisions during day

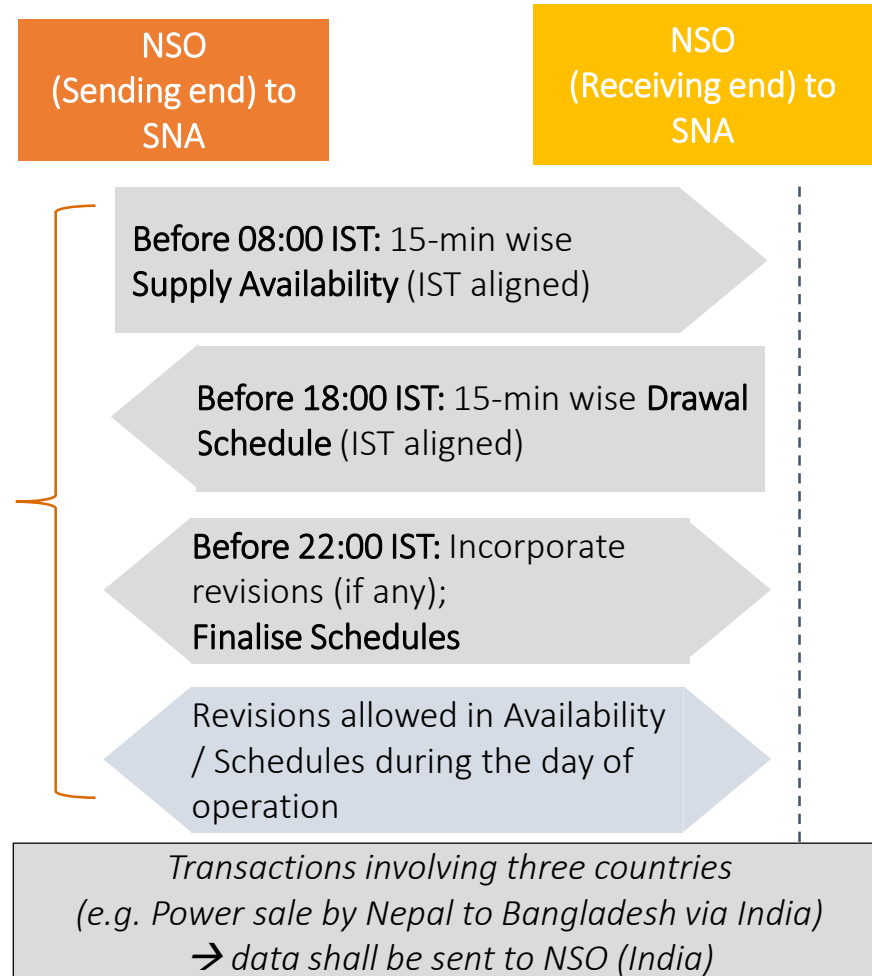
SLDC



Implemented Schedules issued by RLDC and SLDC after the day of operation (basis for commercial accounting viz. Regional/State Energy Accounts)

Scheduling & Deviation Settlement for existing CBET transactions

Bhutan → India	India → Bangladesh	India → Nepal
<ul style="list-style-type: none"> Bhutan hydro stations (Chhukha, Tala and Kurichhu) exporting power to India are not covered under ABT/DSM mechanism Scheduling done by ERLDC at India-Bhutan border point. DSM charges as per prevailing mechanism in India are computed and borne by beneficiaries Dagachhu: <ul style="list-style-type: none"> Delivery Point same as Tala Interim arrangement proposed by CERC TPTCL is responsible for scheduling and imbalance settlement TPTCL has become Eastern Region DSM pool member 	<ul style="list-style-type: none"> NVVNL designated as Nodal Agency for CBET between India and Bangladesh (including PTC trades) NVVNL shall coordinate with NLDC India and NLDC Bangladesh for scheduling NVVNL is made Eastern Region DSM pool member Any DSM liability on NVVNL to be passed on to BPDB Scheduling is done at 400 kV Baharampur S/S 	<ul style="list-style-type: none"> Treaty/Bilateral: Billing on actual energy. No scheduling or DSM settlement PTC: NEA used to send daily schedules to PTC and PTC coordinated with NRLDC. DSM charges were levied on NEA



- Scheduling to a large extent is on a day-ahead basis in SACs
- Timelines may consider intra-country scheduling timelines
- Transactions among SACs are likely to be through India by virtue of its geographical position
 - ✓ Time variation in SACs → Scheduling mentioned here are as per IST
 - ✓ Scheduling in each 15-min block (as scheduling & deviation settlement are 15-min block based in India); To begin with, hourly MW value may be used in all four time blocks
- SNA shall co-ordinate with System Operators of respective countries for scheduling of cross border transactions and revisions during the day of operation.
- SO shall declare the quantum of electricity to be scheduled over the cross border transmission link on a day-ahead basis for the next day at the interconnection point.
- Transmission System Losses shall be borne in kind by the buying entity/selling entity as per the quantum declared by the concerned System Operator of India or the neighboring country.

Deviation settlement mechanism may consider for CBET transactions

Scenario-A: Dedicated transmission interconnection

- Deviation (difference between Actual Injection/Drawal and Scheduled Injection/Drawal) to be attributed to either generator or buyer

Scenario-B: Common transmission interconnection (same sub-station used for multiple transactions)

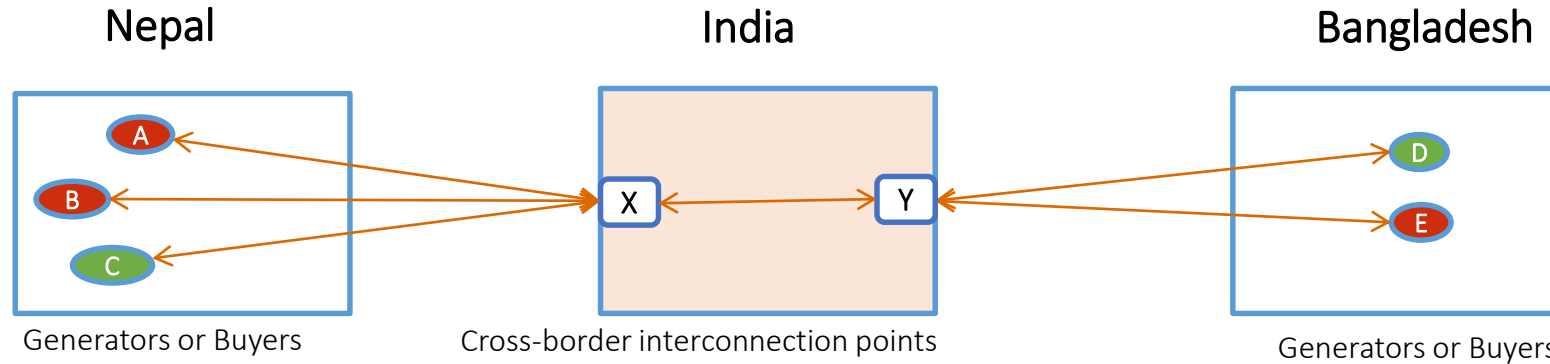
- Deviation to be apportioned to individual generators and buyers based on in-kind & pre-agreed principle

Scenario-C: Multiple transmission interconnections (multiple lines/sub-stations used for multiple transactions)

- Envisaged that Scheduling would be carried out separately for each transmission link → Deviation would also to be settled separately for each link

• Key considerations

- Deviation settlement essential from both commercial and grid security point of view
- Recent cross-border transactions between India and other SACs are already subject to deviation settlement mechanism (DSM)
- SACs (except India) do not have intra-country deviation settlement mechanism; Hence, interim methodology can be adopted for upcoming CBET transactions
- Going forward, other SACs shall evolve a tailored deviation settlement mechanism best suited to local conditions (e.g. generation mix, tariff framework, number of entities, maturity of market, grid discipline issues etc.)

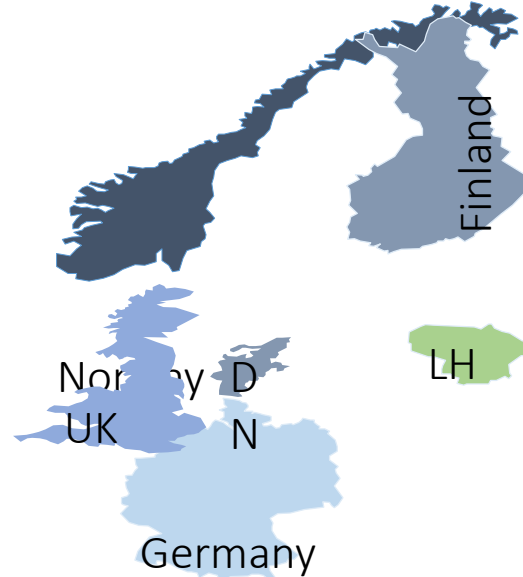


Contract	Schedule at Generator / Buyer end	Schedule at Nepal boundary (Loss: 5%)	Schedule at X (POC Injection / Drawal Loss: 1.5%)	Schedule at Y (POC Injection / Drawal Loss: 2%)	Schedule at Buyer / Generator end (Loss: 4%)
A (Generator) - D (Buyer)	100.0 MW	95.0 MW	93.6 MW	91.7 MW	88.0 MW
B (Generator) - D (Buyer)	50.0 MW	47.5 MW	46.8 MW	45.9 MW	44.0 MW
C (Buyer) - E (Generator)	-20.0 MW	-21.1 MW	-21.4 MW	-21.8 MW	-22.7 MW
Total Schedule	130.0 MW	121.4 MW	119.0 MW	115.7 MW	109.3 MW
Actual			121.0 MW	118.0 MW	
Deviation			2.0 MW (excess injection)	2.3 MW (excess drawal)	

GLOBAL BEST PRACTICES FOR CREATION OF REGIONAL POWER EXCHANGE

Evolution

- Norway was first amongst Nordics to deregulate power markets
- In 1996, Norway & Sweden established Nord Pool
- By 2000, Finland & Denmark joined the pool
- Germany (2006), UK (2010) & Baltic countries (2013) joined



Products

- Elspot: Day-ahead market (DAM)
- Elbas: Intra-day market (IDM)

Currencies for settlement

- EUR, NOK, SEK & DKK for DAM
- EUR for IDM
- To trade in a specific currency, a pledged/non-pledged account in that currency is required

Ownership

- Nord Pool Spot AS is owned by Nordic & Baltic TSOs

Governance

- Governance includes Board of Directors and Customer Advisory Board

Regulator

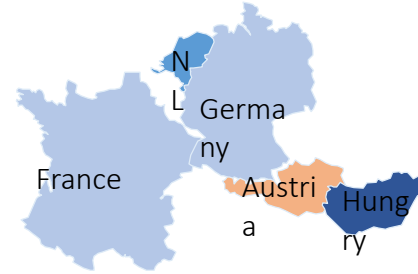
- Nord Pool Spot AS is licensed by Norwegian Water Resources and Energy Directorate (NVE) and by Norwegian Ministry of Petroleum and Energy

Structural features:

- TSOs of Norway and Sweden established Nord Pool
- Renaming of Nord Pool after all Nordic countries joined
- Separation of Energy & Derivatives markets; NPS to handle Energy market

Evolution

- Inspired by experience by Nordic countries, France (2001) & Germany (2002) established their national PXs
- In 2008, French & German PXs merged to form EPEX Spot
- Subsequently, Switzerland and Austria joined



- In 2015, HGRT took-over 36.7% of shareholding of EEX
- In 2014, EPEX spot also started operating Hungarian PX

Salient features:

- Nord Pool Spot made active contributions in establishment of national PXs in France & Germany
- Powernext SA (France) and EEX AG (Germany) merged in 2008 to form EPEX Spot with 50% equity each
- In 2014, EPEX Spot also started operations in Hungarian power market on behalf of Hungarian PX (HUPX)
- 2015, HGRT (holding of TSOs of Belgium, France & Netherlands) took over 36.7% share of EEX AG (Germany)

Products

- Day ahead auction (~DAM)
- Intra-day auction (~IDM)

Currencies for settlement

- EUR

Ownership

- 2015: Powernext (50%), EEX (13.3%) and HGRT (36.7%)

Governance

- Shareholders of EPEX spot appoint a Supervisory Board
- An Exchange Council comprising of 16 members & 5 permanent guests is the governing body
- A Market Surveillance Office reporting to board & council also set up. It monitors the market regularly

Evolution

- OMEL, national PX of Spain, operated day-ahead market since 1998
- In 2007, Portugal joined OMEL; renamed as OMIE



Products

- Day ahead auction (~DAM)
- Intra-day auction (~IDM)

Currencies for settlement

- EUR

Salient features

- National Electricity Market Act of Spain ensured significant volume was traded on Spanish national PX – all power not traded bilaterally had to be sold through PX
- Portuguese market opened and joined OMEL in 2007 – resulting in restructuring of OMEL to OMIE
- Spanish Operator OMIE takes care of physical market operation; while Portuguese OMIP handles futures market

Ownership

- Spanish company OMEL (50%) & Portuguese company OMIP SGPS SA (50%)

Governance

- OMIE is regulated by the Santiago International Agreement between Spain & Portugal on implementation of an Iberian electricity market (MIBEL)

Regulator

- CNE (Spain) & ERSE (Portugal)

OMIE – OMI-Polo Espanol S.A. (OMIE); CNE - Comision Nacional de la Energia (National Energy Commission); ERSE - Entidade Reguladora Dos Servicos Energeticos (Energy Services Regulatory Authority)

System Operation and Settlement Mechanism, Cross Border

Power Market in South Asia

Disclaimer: Use of map is for demonstration purpose only and not to define, emphasise or justify political or statutory boundaries



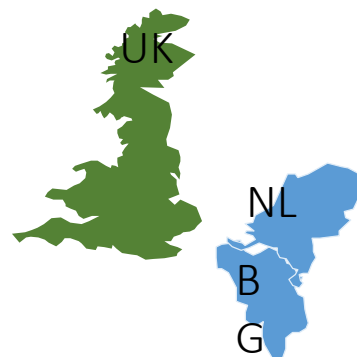
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Evolution

- Amsterdam and UK launched national PXs in 1999 and 2000, respectively
- In 2001, UK launched APX-UK Spot later integrated with Amsterdam PX in 2003 to constitute APX
- National PXs were launched in the Netherlands (2005) and Belgium (2006)
- In 2008, APX-ENDEX company was formed after APX acquired energy derivatives exchange ENDEX
- In 2010, APX-ENDEX and Belgian PX got merged
- In 2013, APX-ENDEX got separated into two exchanges- APX (power) and ENDEX (gas)



Salient features

- Concept of one European power exchange is next step of evolution with existing regional PX like APX being merged with others
- In 2015, APX got merged with EPEX Spot
- Next step is creation of Integrated Europe

Products

- Day ahead auction (~DAM)
- Intra-day auction (~IDM)
- UK Half-hour DAM

Currencies for settlement

- EUR & GBP

Ownership

- TenneT Holding BV (70.84%) & Elia System Operator NV (29.16%)

Governance

- Multi-layered governance structure comprising of Supervisory Board, Management Team & Market Development Advisory Board

Regulator

- ACM (the Netherlands), OFGEM (UK) & CREG (Belgium)

ACM – Authority for Consumers & Markets; OFGEM – Office of Gas and Electricity Markets; CREG – Commission for Regulation of Electricity & Gas

System Operation and Settlement Mechanism, Cross Border
Power Market in South Asia

Integrated Europe – evolving market structure:

European Commission aims to create a pan-European market with closer connection of power markets to improve efficient use of energy across national borders :

• **Creation of ENTSO**

- In 2011, 41 TSOs from **34 countries** came together to develop network codes to facilitate integration and harmonisation of European electricity market
- It will include system connection codes, market codes and system operations codes
- Each code will be submitted to European Commission for approval
- Subsequently, it will be voted into EU Law and implemented across member states

• **Cross-border Intra-day (XBID) Market**

- PXs and TSOs from 12 European countries (*Austria, Denmark, Germany, Belgium, Finland, France, UK, Italy, Luxembourg, Norway, Switzerland and Netherland*) initiated XBID project to cater to Intra-Day cross-zonal market
- This initiative will assist members to trade imbalances not only through available intra-day liquidity in national market but also from available liquidity in other areas
- It is expected to be operative from 2017

• **Price coupling of regions (PCR)**

- In 2009, 7 European PXs (APX, Belpex, EPEX SPOT, GME, Nord Pool Spot, OMIE and OTE) launched PCR initiative to calculate electricity prices across Europe and allocate cross-border capacity on a day-ahead basis
- PCR Cooperation and PCR Co-ownership Agreements were signed in June 2012
- In Feb 2014, TSOs & PXs in North-Western Europe (NWE) launched PCR for NWE

Evolution

- Inter-Governmental MoU signed in 1994 established SAPP
- In 1995, 2 network links set-up via Botswana
- SAPP started short term market in 2001
- 2009: Launched competitive electricity market - DAM
- 2010: Operating guidelines finalized; SAPP fully operational

Salient features:

- Inter-Governmental MoU gathered all national power utilities throughout region and defined the management & operating interactions
- Agreement between members defines operating rules and pricing



Products

- DAM, IDM & FPM (Forward Physical Market)

Settlement currency

- USD or ZAR

Governance

- Presently comprises of 16 utilities, independent transmission companies and IPPs from Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe
- Each member contributes an amount annually as agreed in Inter-Governmental MoU

Key takeaways

Evolution history

- Initially, PXs may start operations in one or two countries. Subsequently, they may be expanded to other countries as RPX through merger & demerger or through acquisition of equity stake in national PXs

Ownership

- RPXs may have TSOs, national PXs, market operators and private parties as owners

Governance Structures

- RPXs should have robust, multi-level governance structures including supervisory boards, management team/board and advisory committees

Products

- Day Ahead Market (DAM) and Intra Day Market (IDM), a variant of Term Ahead Market (TAM), are the main products offered on all national and RPXs around the world

Settlement

- Popular practice of commercial settlement is through advance margins and collaterals as per the governing rules of the PX concerned

WHY POWER EXCHANGES IN SOUTH ASIA??



Regional Complementarities

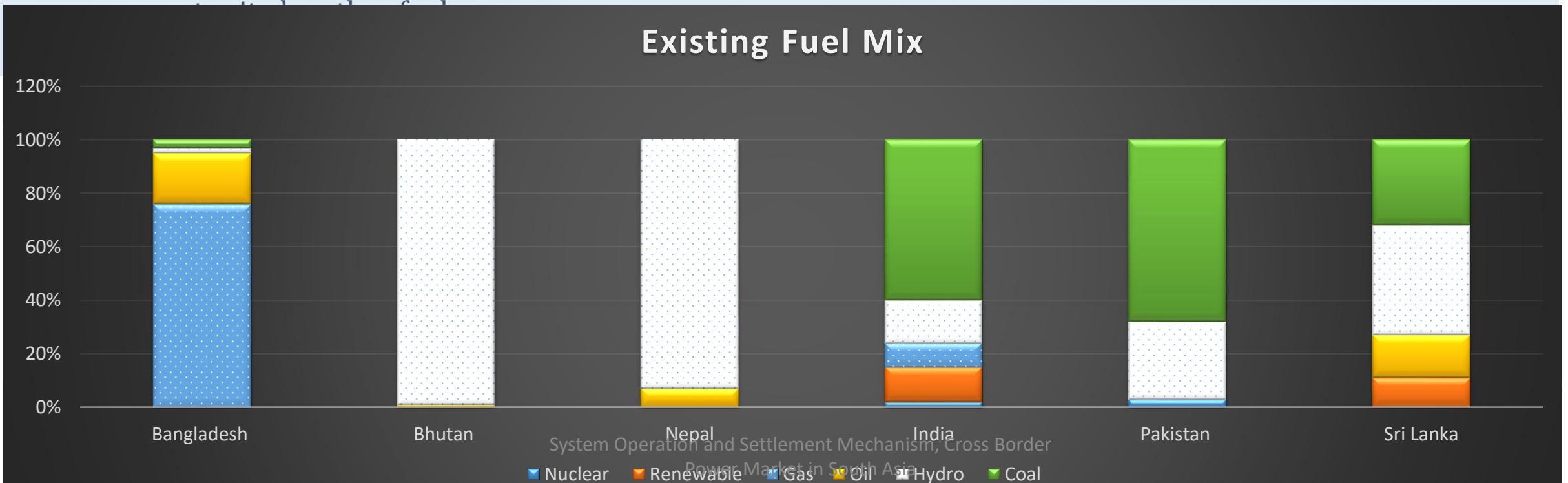
- ❖ **Resource Complementarities:** The degree to which two countries symmetrically contribute dissimilar resources, in terms of both resource type and quantity, to an alliance.
- ❖ The region is blessed with diverse natural resources ranging from the most conventional forms (i.e. coal) to hydro and non-conventional forms (i.e. solar and wind).

Country	Coal (Million tons)	Oil (Million barrels)	Natural Gas (Trillion cubic feet)	Biomass (Million tons)	Hydropower (GW)	Wind (MW)	Solar Power (Kwh/Sq m per day)
Bangladesh	884	12	8	0.08	0.33	Limited	3.8-6.5
Bhutan	2	-	-	26.6	30	4,825	2.5-5
Nepal	-	-	-	27.04	83	3,000	4.0-7.0
India	90,085	5700	39	139	150	151,918	3.6-6.2
Pakistan	17,550	324	33	-	59	24,000	5
Sri Lanka	-	150	-	12	Power Market in South Asia	25,000	NA

System Operation and Settlement Mechanism, Cross Border

Regional Complementarities

- ❖ **Existing Fuel Mix:** Countries are having an skewed fuel mix in the region. By regional power trade, the countries will be able to increase the energy security and reduce the dependency in a particular form of energy.
- ❖ **Key Point:**
 - ✓ Bangladesh's generation is mainly gas based and hence provides a contrast with Bhutan and Nepal which are majorly hydro based electricity generation.
 - ✓ Provide an opportunity to harness the renewable energy by extending an market and provide an balancing



Regional Complementarities- Monthly and Hourly

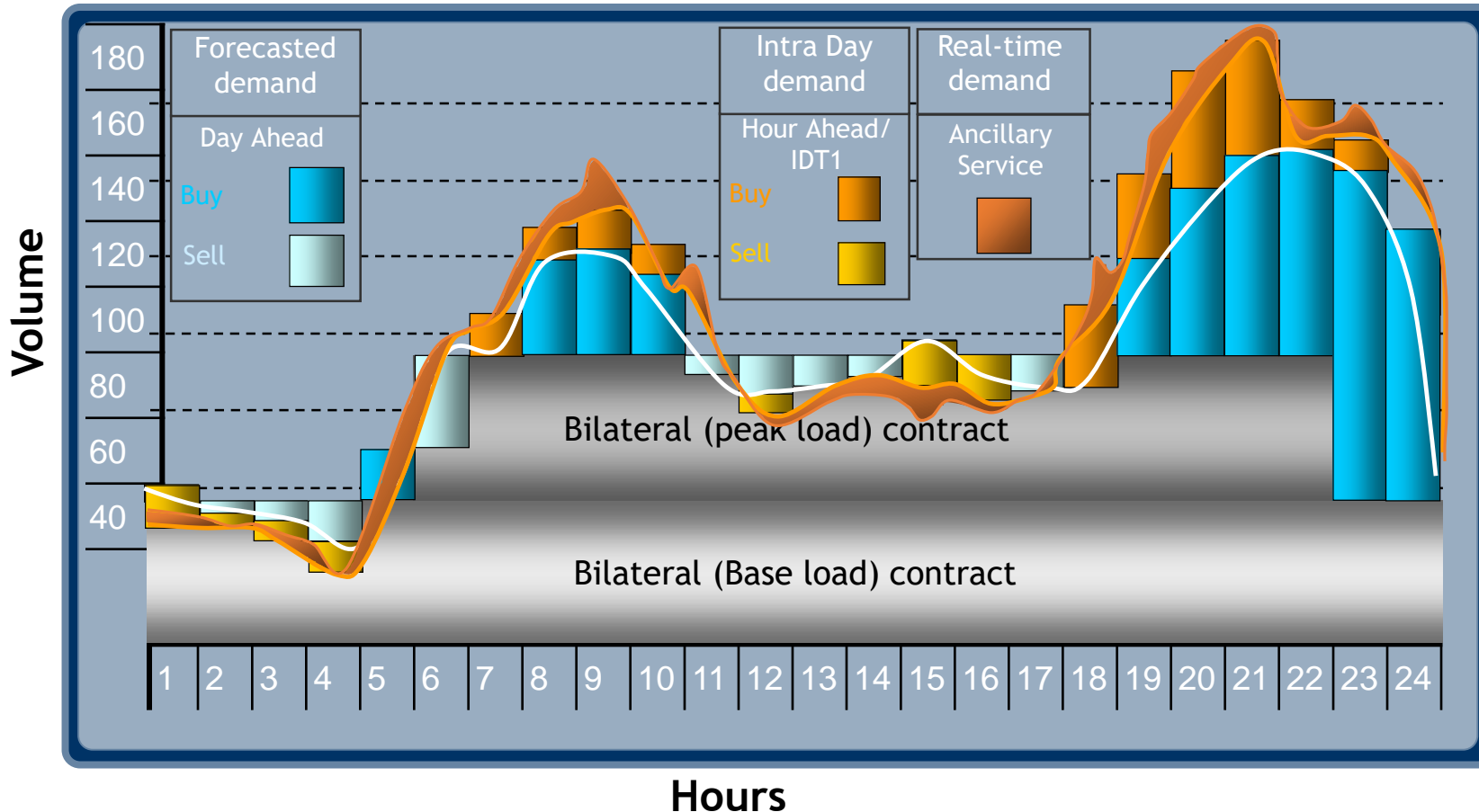
	January	February	March	April	May	June	July	August	September	October	November	December
Bangladesh	Green	Green	Blue	Red	Red	Red	Blue	Blue	Blue	Blue	Green	Green
India - North East	Blue	Green	Blue	Green	Green	Blue	Red	Red	Blue	Red	Red	Blue
Bhutan	Red	Red	Blue	Blue	Blue	Green	Green	Green	Green	Blue	Blue	Red
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	Min+ (Max-Min)*20%
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



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

Need and Evolution of Power Exchanges in India

Long & Medium Term Market

- Long term power markets do not meet the full requirements of the market participants:
 - Projecting hourly consumption over long term without forecasting errors is difficult
 - Long term contracts for peak load requirement may be economically inefficient

Short Term Market

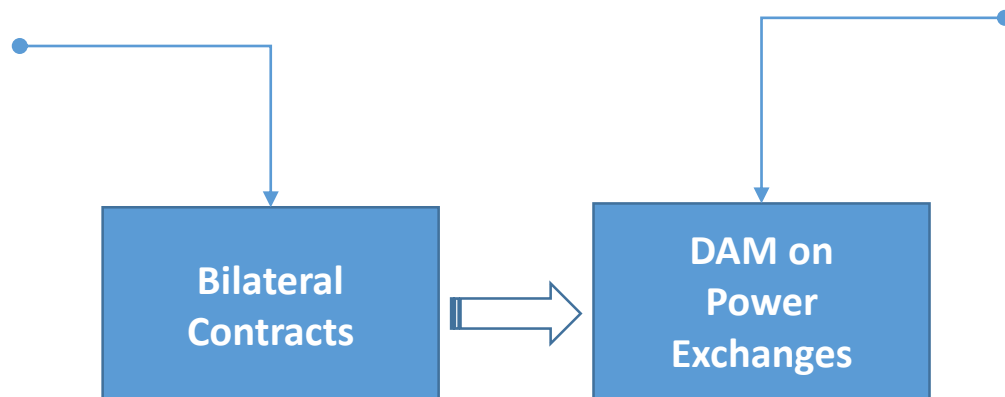
- Similarly, Short-term Markets have the following limitations:
 - Don't permit correction of positions taken by players in long and short term market closer to real time
 - Non-standard and firm nature of contracts
 - Arrangement of separate transmission access – explicit transmission allocation / auction
 - Insufficient price signals for investment growth in requisite generation type

Power Exchange

- Power Exchanges provide a neutral, fair and an efficient platform to mitigate some of these challenges
 - Balancing the buy and sell position near to real time
 - Standardized contracts
 - Counterparty risk is taken care of
 - Competitive and widely acceptable future price signals
 - Signals for Generation and Transmission addition

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

SARPEX would enable closer to real-time balancing and Social Welfare Maximization in the Region

- A cross border exchange will provide a fair, neutral and robust price discovery platform and create an orderly marketplace for all the buyers and sellers in BBIN
 - Market-determined prices - Price transparency, competition and efficient price signals
 - Greater flexibility since trades are on a short-term requirements and production capability basis – better suits the resource type of the countries
 - Allows for absolving the counterparty risk
 - Enhanced grid stability through real-time balancing and better coordination between all operating markets and dispatch schedules
 - Economic dispatch
- Apart from the other benefits of Exchange, it will not only supplement the existing bilateral trade in BBIN but also encourage more choice and investments in the sector

Implementation of a Regional Exchange Market has been delayed on account of multiple factors

Perceived Challenges

- Provisions w.r.t. institutional, legal, policy, market and regulatory framework essential for a **Regional Spot Market development**
 - Provisions with respect to institutional and legal jurisdiction of x-border trades in respective countries
 - Regulatory framework for access to respective grids, x-border capacity allocation & congestion management, trading licenses etc.
 - Commercial mechanism relating to tx charge & loss allocation, imbalance and payment security mechanisms
 - Coordinated policy development for transmission infrastructure and related grid codes
 - Acceptable & neutral Dispute Settlement Mechanisms
- Apprehensions about price increase in the Spot Market
- Impact on Transmission Charges & Losses due to cross-border power flows
- Agreement on redistribution of benefits or losses accrued by the various participants – *“Consumer & Producer Surplus”*

Key issues and apprehension??

- Market Design and Rules for a Regional Day Ahead Spot Market?
- Price convergence and impact on the prices in each country?
- Social Welfare of each country?
- Impact on the DA contingency market, bilateral market?
- Market power - behavior of consumers & producers changing their bidding behavior in the respective countries?
- Capacity Building of BBN countries for initiating DAM transactions through Exchanges

Existing proposed provision: Trading through the Power Exchanges

- The following products are permitted
 - Term Ahead Contracts (Upto 11 days ahead)
 - Intra Day Contracts / Contingency Contracts
- Subject to
 - Approval from the Designated Authority
 - traded volumes to be regulated and reviewed from time-to-time by the Designated Authority
- Cross border trade to be extended to other categories of contracts based on review by MoP and CERC, India

**Primary or the core Product of Power Exchanges i.e. the Day Ahead Market (DAM)
Spot is still not in the list of products to be offered through Exchanges**

Regional Power Exchange- Mock Exercise

- A trading platform mimicking a regional Energy Exchange for the SA Region.
- The mock exchange will provide an answer to various key questions, related to feasibility and desirability and possible volume in 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.



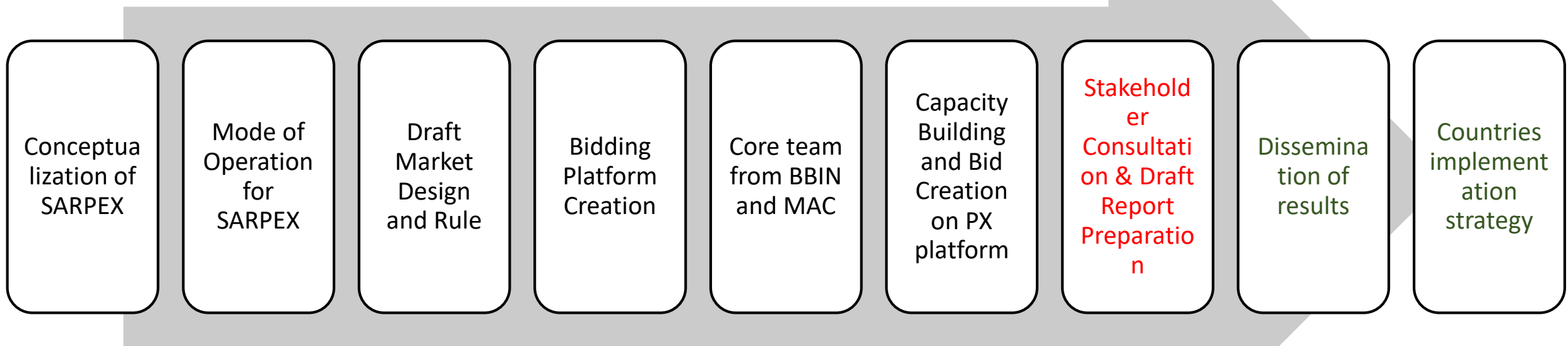
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IRADe Action for Development

SARPEX- Mock Exercise activities



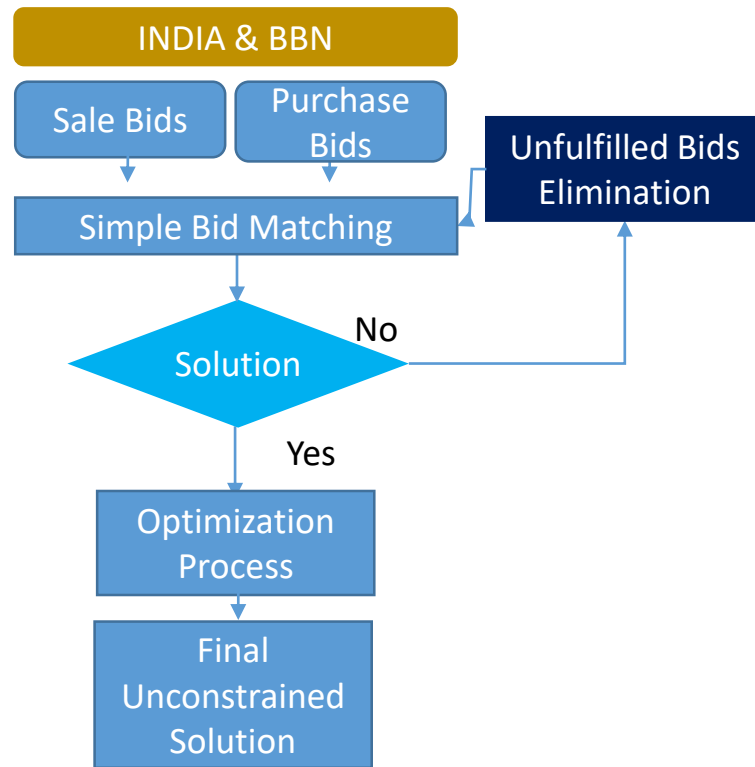
Completed activities

Ongoing Activities

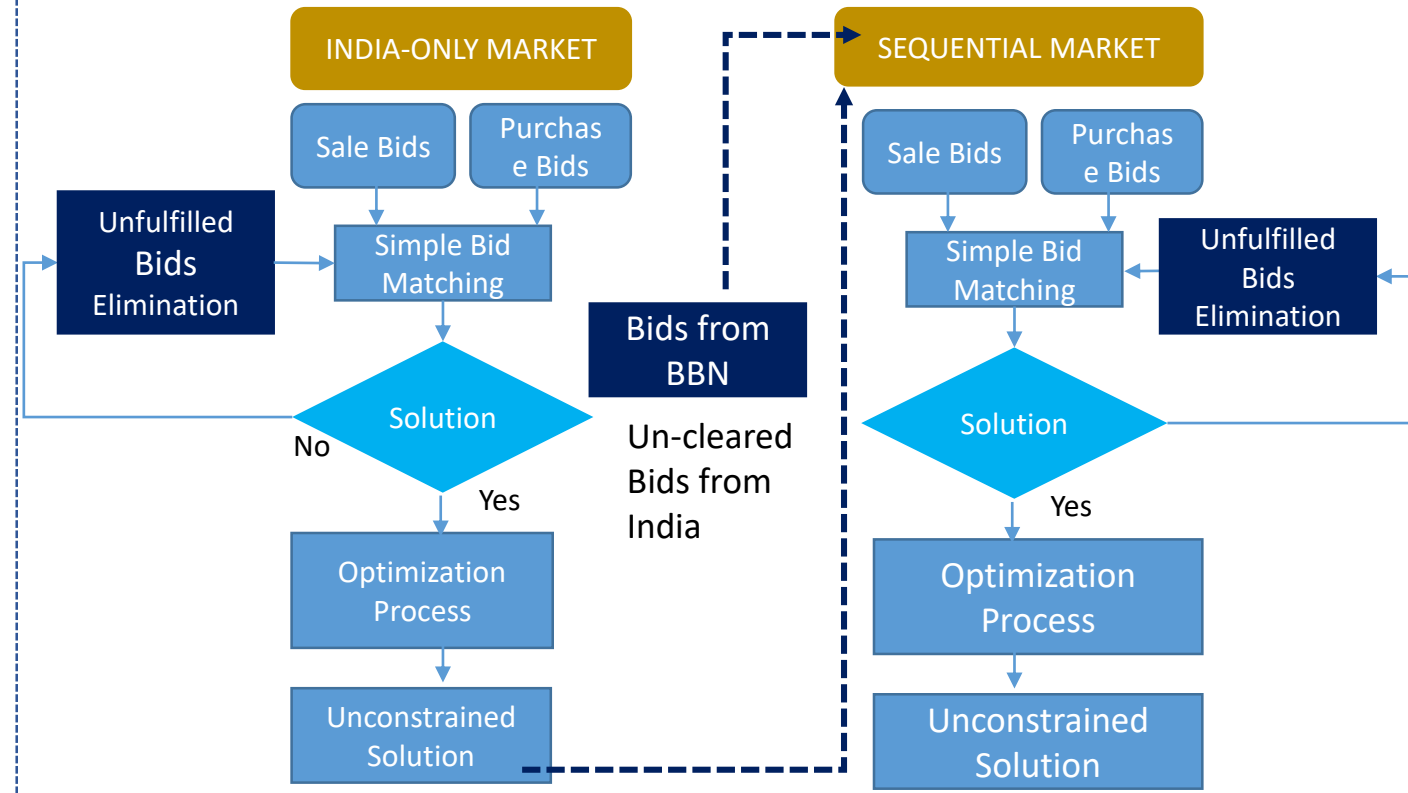
SARPEX's CLEARING ALGORITHM

SEQUENTIAL MODE

UNIFIED MODE – 15 MINUTE DAM INTERVAL



SEQUENTIAL MODE – 15 MINUTE INTERVAL DAM





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SARPEX TEAM



Market Advisory Committee

Name	Country	Designation	Organisation
Mr Anil Razdan	India	Ex- Secretary Power	Ministry of Power
Mr. Hans-Arild Bredesen	Norway	CEO	Nord Pool Consulting
Mr Peter Jogersen	Denmark	Vice President	Energinet, Denmark
Mr Musara Beta	South Africa	Chief Analysts	South African Power Pool

- Core Team Members are Government nominated members for bidding purpose and capacity building.
- Task Force-3 members are the senior level SA countries government representative to provide the directional inputs.
- The Market Advisory Committee (MAC) and Mentors formed to include suitable international experts who can provide guidance to the team for conducting the mock exercise.
- The implementation team members ensure all activities related to mock exercise are implemented and are responsible for following activities

Core Team from BBN

Implementation Team - USAID, IRADe and KPMG

Task Force-3 Members

Market Advisory Committee & Mentors

Key Relevant Stakeholder from BBIN



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System Operation and Settlement
Power Market in South Asia

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LEARNINGS FROM NORD POOL REGION: Power Market

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Transmission Service Agreement for Cross-Border Electricity Trade

Model

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SOUTH ASIA REGIONAL INITIATIVE FOR ENERGY INTEGRATION (SARI/EI)

Working Paper:

Impact of Cross-Border Electricity Trade on Bhutan (Country Series)

September, 2016

SOUTH ASIA REGIONAL ENERGY INTEGRATION

Roadmap for South Asian Regional Power Exchange (SARPEX)

USAID FROM THE AMERICAN PEOPLE SARI/EI Integrated Research and Action for Development IRADe

POWER PURCHASE AGREEMENT
for Cross-Border Electricity Trade (CBET)
Between Seller (New Hydro Generator) & Procurer

SOUTH ASIA REGIONAL INITIATIVE FOR ENERGY INTEGRATION (SARI/EI)

Task Force-3 Report

USAID FROM THE AMERICAN PEOPLE SARI/EI Integrated Research and Action for Development IRADe

SOUTH ASIA REGIONAL INITIATIVE FOR ENERGY INTEGRATION (SARI/EI)

South Asian Countries Power Pricing Mechanism & Recommendation for CBET



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Thanks

gjain@irade.org, +91 9643380643

For further information related to SARPEX you may visit web portal.

<http://mocksarpex.eu.ai>