USAID FROM THE AMERICAN PEOPLE

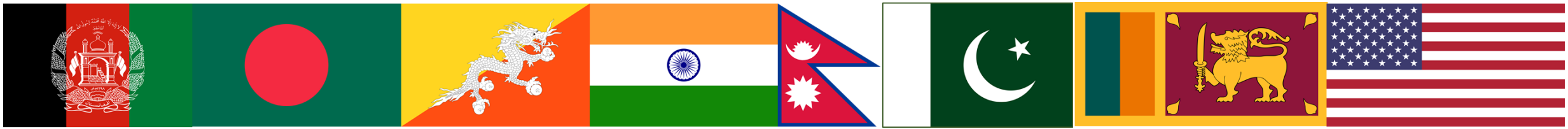
SARI/EI

15 Integrated Research and IRADe Action for Development

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

Presented by- Gaurav Jain, Senior Research Analyst, SARI/EI, IRADe

23rd July, 2019



Contents

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

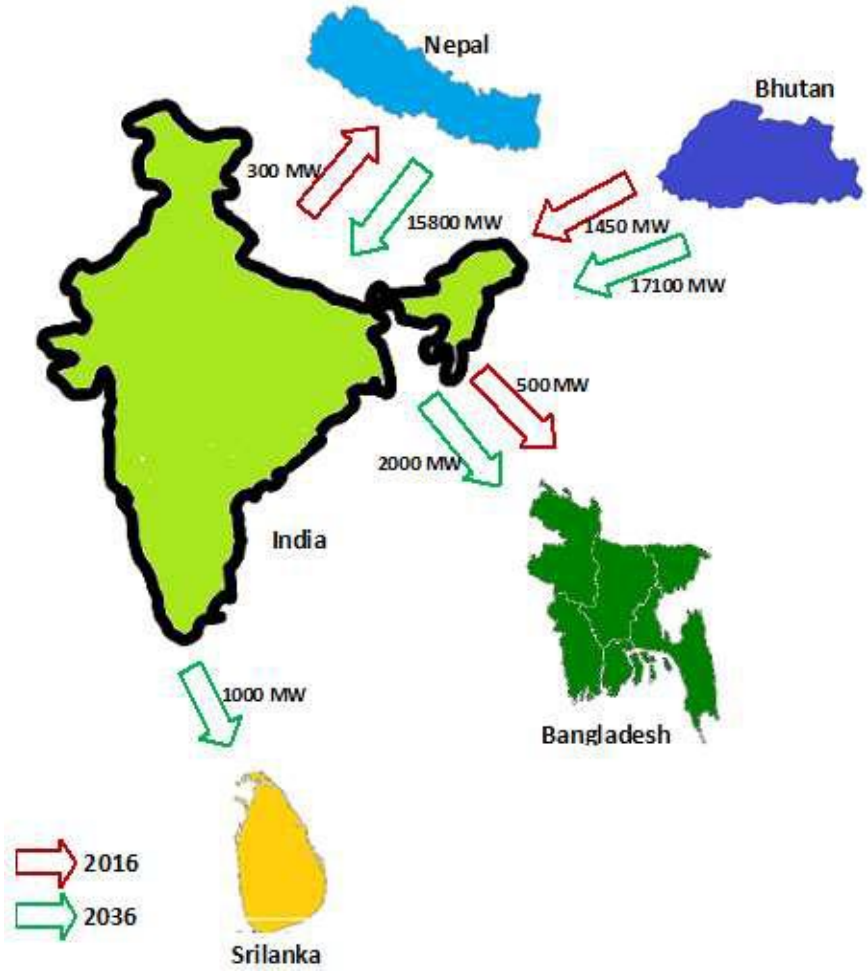
USAID FROM THE AMERICAN PEOPLE

SARI/EI

15 IRADe Integrated Research and Action for Development

Existing and Future Trade in South Asian region

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



Source- Ministry of Power, Govt. of India

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

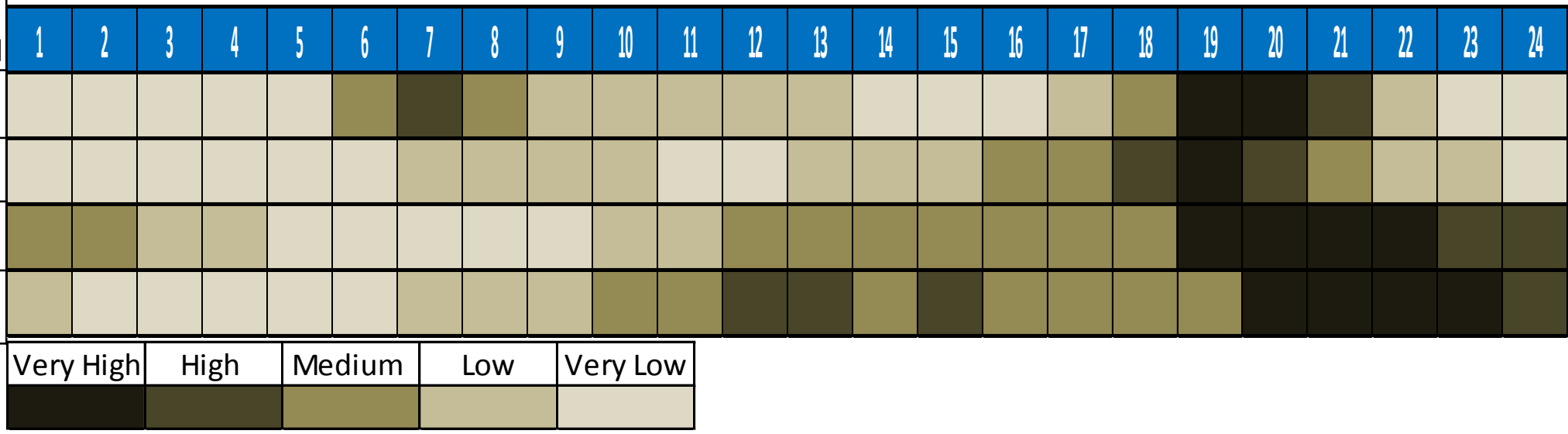
USAID FROM THE AMERICAN PEOPLE

SARI/EI

15 IRADe Integrated Research and Action for Development

Hourly complementarities- DAM may reap this opportunity

Country	Min Demand	Max Demand
Bhutan	220	276
Nepal	589	1065
Bangladesh	5269	6884
Indian-Px's	4242	7872



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

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

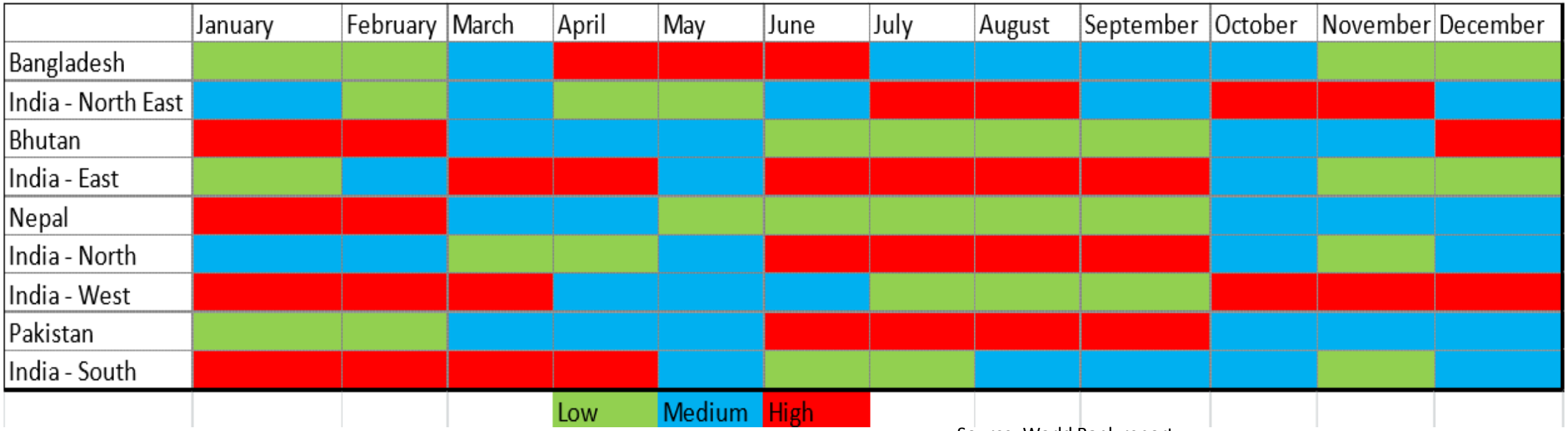
Source: SARI/EI analysis based on FY 2015 Electricity Met Demand nos.

USAID FROM THE AMERICAN PEOPLE

SARI/EI

15 Integrated Research and IRADe Action for Development

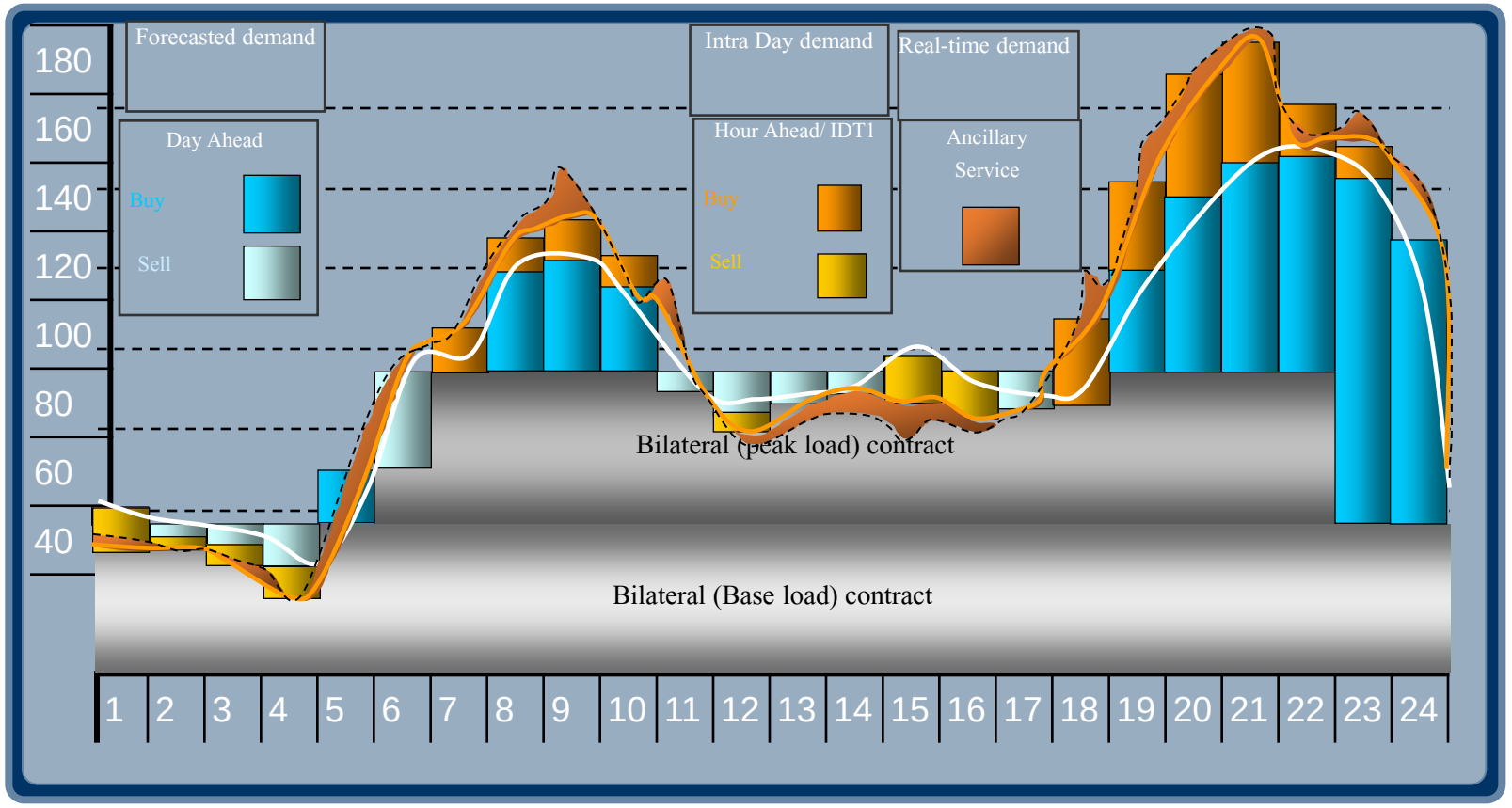
Seasonal Complementarities: Short Term Trade opportunity



Source: World Bank report

Load Profile

Optimal Management of daily Demand Supply Position



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

Forecasted Demand	Demand estimation – Intra day	Real Time Demand

Need of DAM and implication in South Asian Region

Need of Day Ahead Market

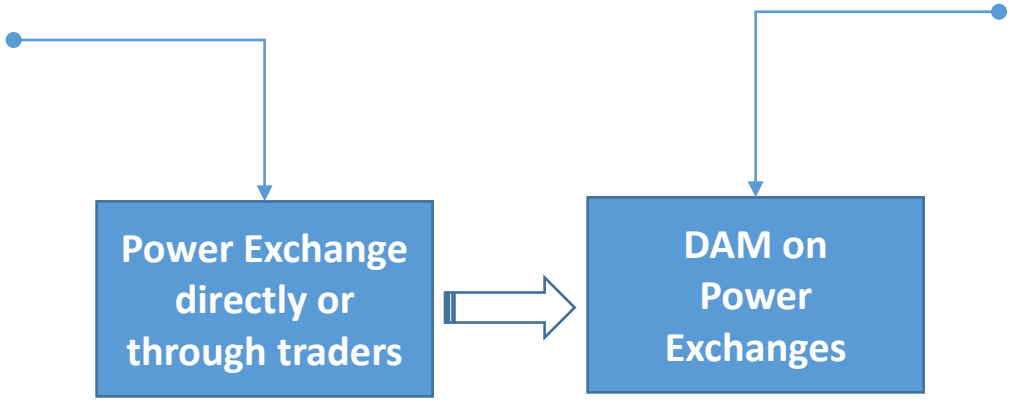
- Reaping the daily demand complementariness of SA countries.
- Demand-supply balancing opportunity near to real time.
- Standardized contract.
- Increase in the investment by providing more market choices.
- Competitive power market platform and market determined prices.

Quantification of benefits in South Asian region

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

Benefits of a DAM through a Power Exchange

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



- Standardized contract structures
  - Centralized trading with easier & faster access to operate closer to real time
  - Low transaction costs, safe counterparty with clearing and settlement service
- More suitable for closer to real time operations

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

USAID FROM THE AMERICAN PEOPLE

SARI/EI

15 IRADe Integrated Research and Action for Development

Steps already taken towards operationalization of SARPEX

SARPEX Concept (January 2016)

Mock Bidding Platform (September 2016)

Guidelines of MoP, GoI- Only TAM was allowed (December 2016)

Market Design and Rules for mock exercise (2017-18)

Core team from BBN and MAC formation (2017-18)

Results discussion and dissemination

(Completed by July 2018)

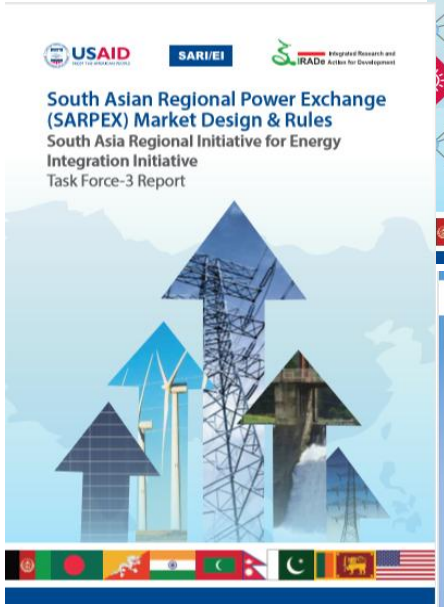
MoP, GoI revised policy - allowed Day Ahead Market

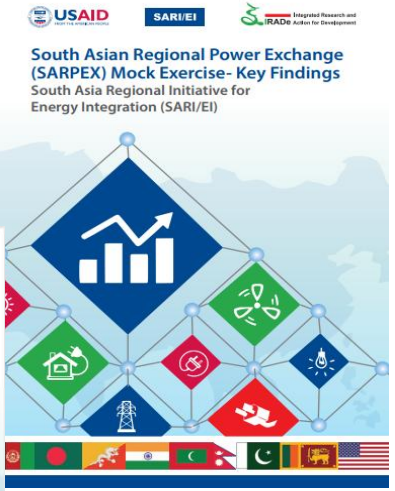
(December 2018)

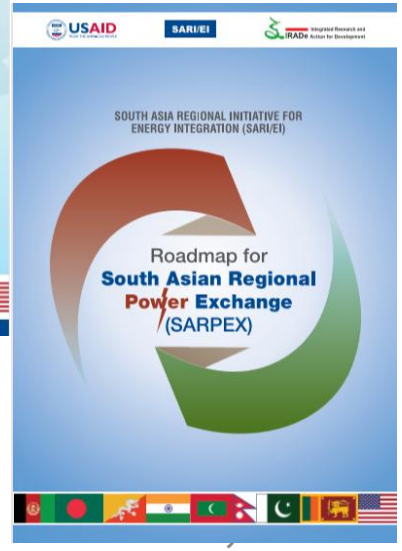
Working towards operationalization of SARPEX

(January 2019)

Nepal- Ministry and NEA representative committee- NVVN







Existing Policy Provision

- Neighboring countries may participate in Indian power exchanges through the electricity trading licensee of India.

- For the specified quantum after obtaining the approval from the Designated Authority.

Operationalization of SARPEX

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

Operationalization of SARPEX

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

Market Participants

Buy

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

Sell

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

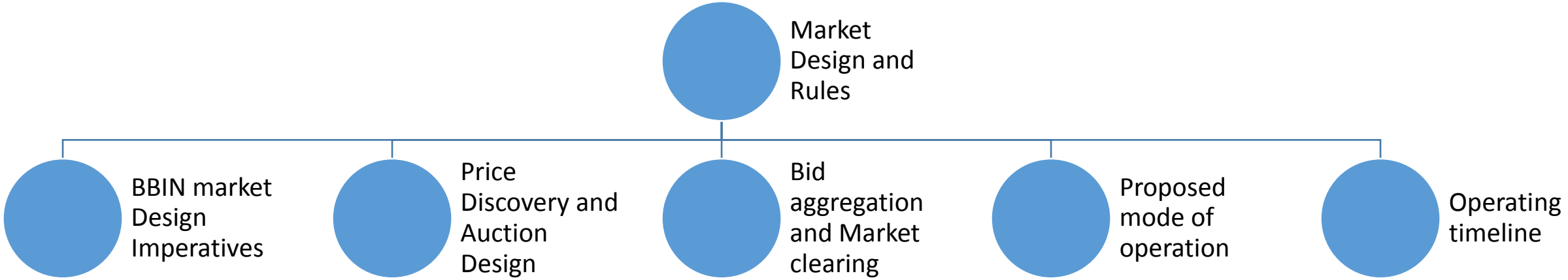
Bidding strategy – Discom and Generator

Long-term	• 25-year PPA - Tariff on cost-plus or competitive bid
Medium Term	• 3 Month- 3 Years • Tariff covers : Fixed Cost + Variable Cost+ Mark Up (< long term)
Short Term (OTC)	• Intraday- 3 Months to be procured through competitive bidding only • Single tariff covering Tariff covers Fixed Cost+
Day-Ahead Market (most preferred)	• Highly liquid and transparent marketplace • More accurate load management
Intra-day	• Last-minute adjustments (Gate closure 4 hours) • Less liquid

Market Design and Rule

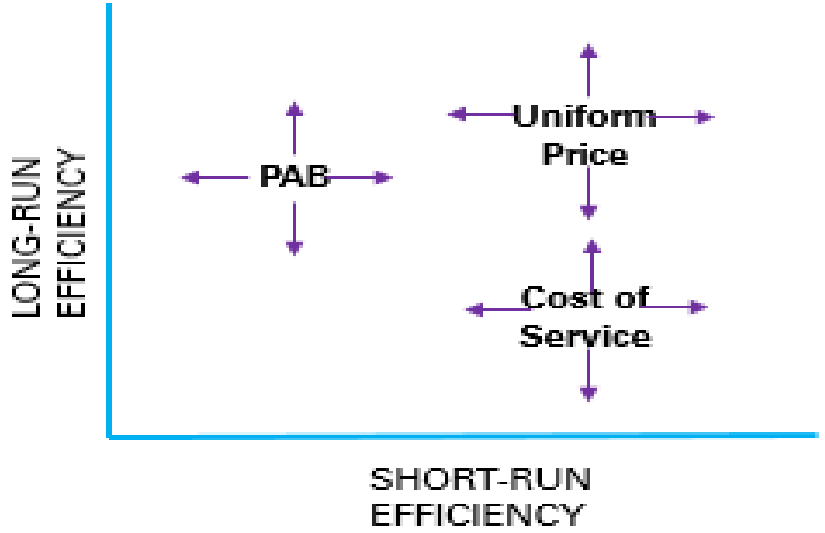
- An efficient market design for Power Exchanges may optimizes the Social Welfare is fundamental to developing and sustaining integration of the SA countries.

- Harmonisation of the market rules across the SA countries through an appropriate market design will likely lead to efficient utilization of available resources and infrastructure.



BBIN Market Design Imperative

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



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

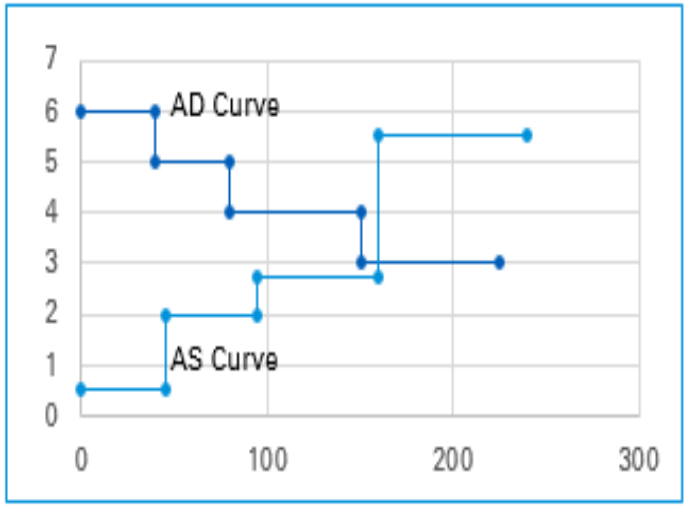
Bid Aggregation and Market Clearing

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

Sample Bids for a time period

Bids		Offers	
Price	Quantity	Price	Quantity
6	40	0.5	45
5	40	2.0	50
4	70	2.75	65
3	75	5.5	80

AD-AS Curves

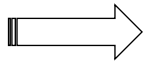


Disclaimer: This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Time Zones and deviation in BBIN

Time zones observed in BBIN relative to UTC

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



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

Coordination required in operating SARPEX due to Time Mismatches

Electricity Dispatch at the "day boundary" for three consecutive days

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

Coordination Issues

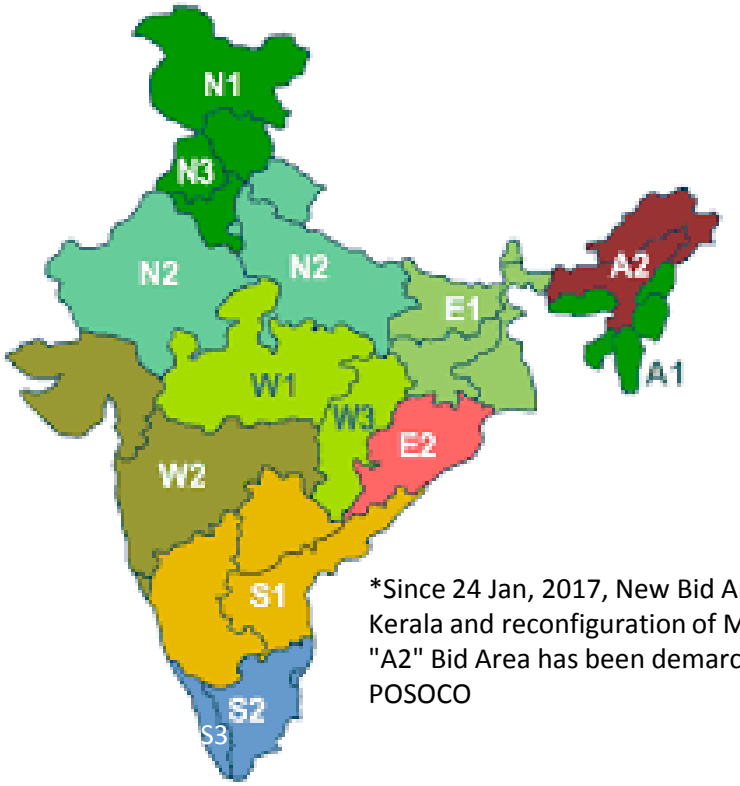
Day D-2 Day D-1 Day D

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

Key considerations in the formation of Bid Areas

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

Existing Bid Area definitions in India*

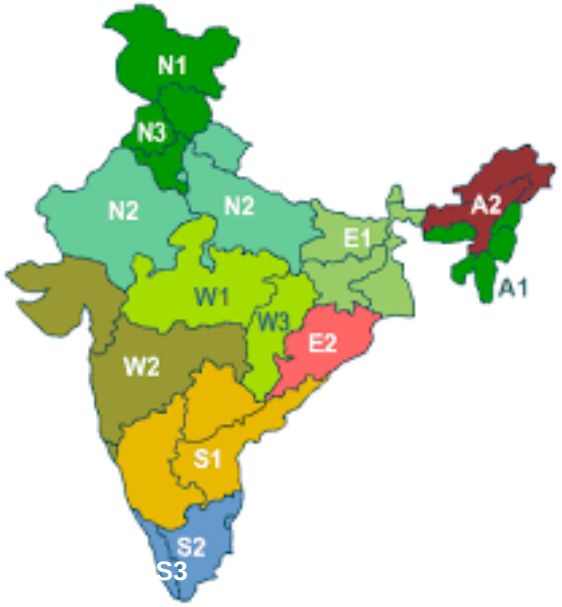


*Since 24 Jan, 2017, New Bid Area "S3" for Kerala and reconfiguration of Meghalaya in "A2" Bid Area has been demarcated by POSOCO

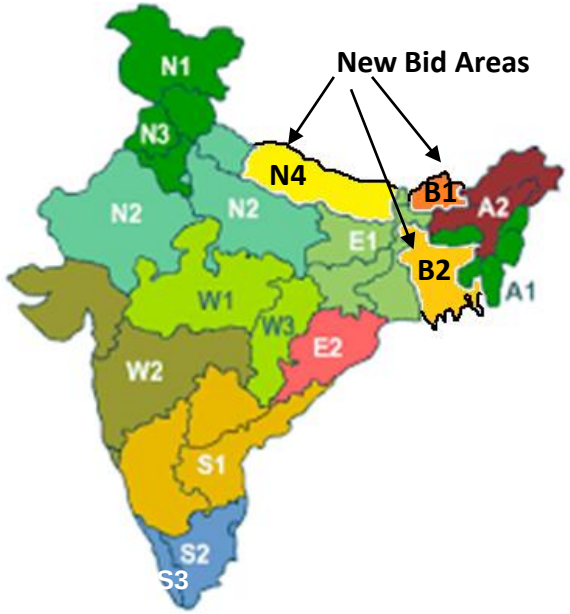
Disclaimer: This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Bid Areas

Retaining the Indian Bid Areas



Additional Areas for each new country at later stage



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

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

Existing Bid Areas in India

USAID
FROM THE AMERICAN PEOPLE

SARI/EI

15 Integrated Research and IRADe Action for Development

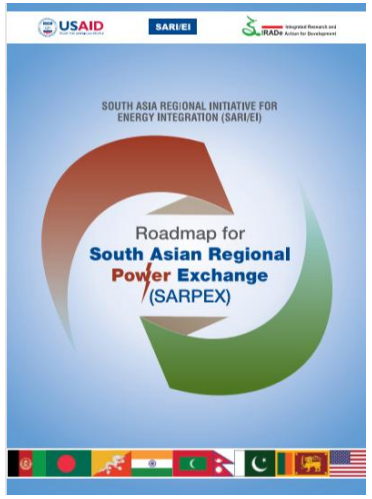
Pictures of Events

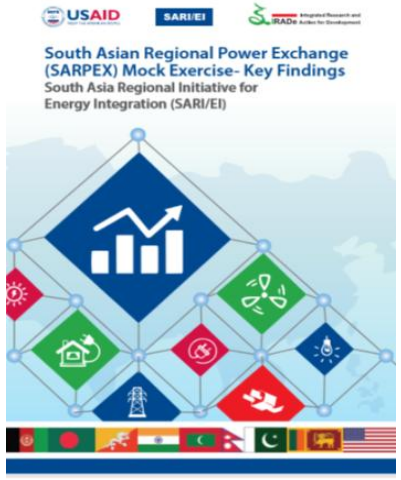
USAID FROM THE AMERICAN PEOPLE

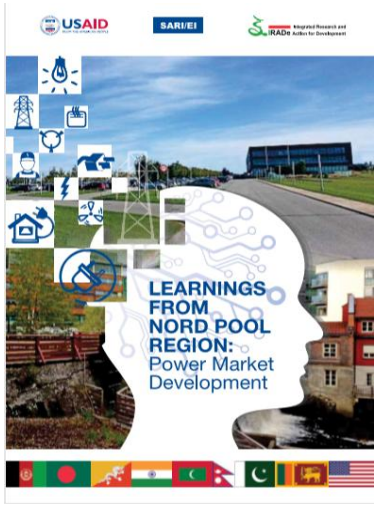
SARI/EI

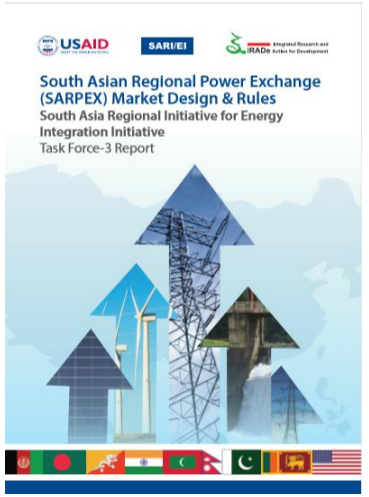
15 Integrated Research and IRADe Action for Development

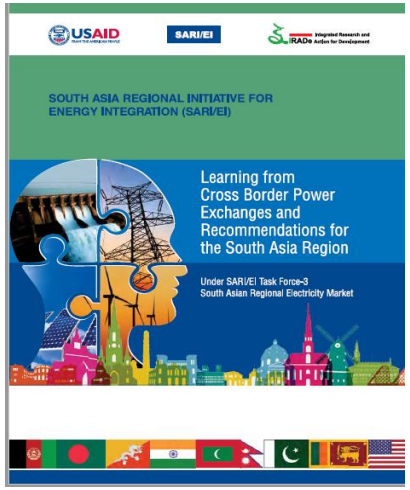
REPORTS
Power Exchange and Regional Power Market











USAID
FROM THE AMERICAN PEOPLE

SARI/EI

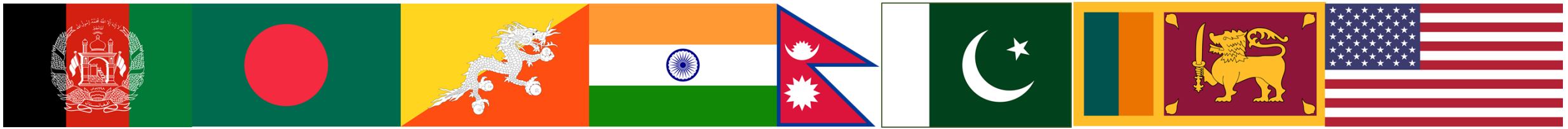
15
IRADe Integrated Research and Action for Development

Thank You!

Gaurav Jain (gjain@irade.org)

SARI/EI/IRADe PROJECT SECRETARIAT

B-44, Shivalik, Malviya Nagar, New Delhi-110 017, India



USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

South Asia Regional Initiative for Energy Integration (SARI/EI)

Existing Policy and Regulatory frameworks on Cross Border Electricity Trade in the Region

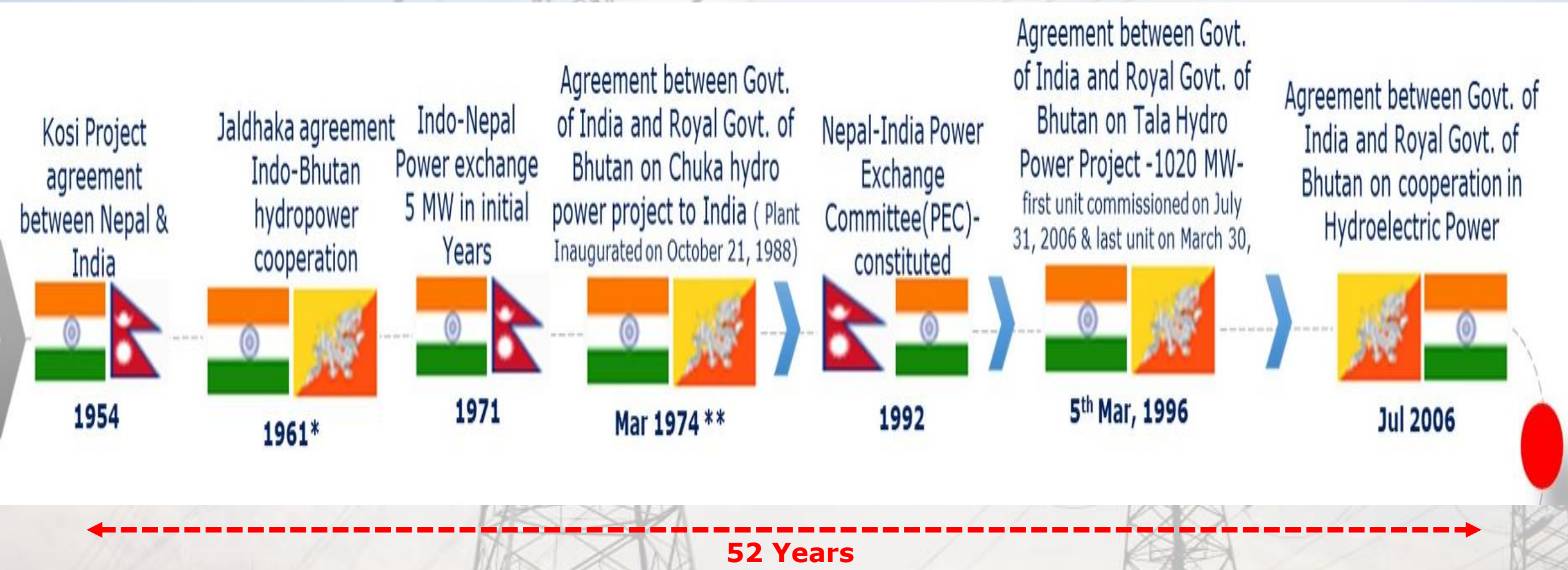
Mr. Pankaj Batra, Project Director & Mr. Rajiv Ratna Panda, Technical-Head
SARI/EI/IRADE

Workshop on Power Trade through Power Exchange
23rd July 2019 at Hotel Radisson, Kathmandu, Nepal

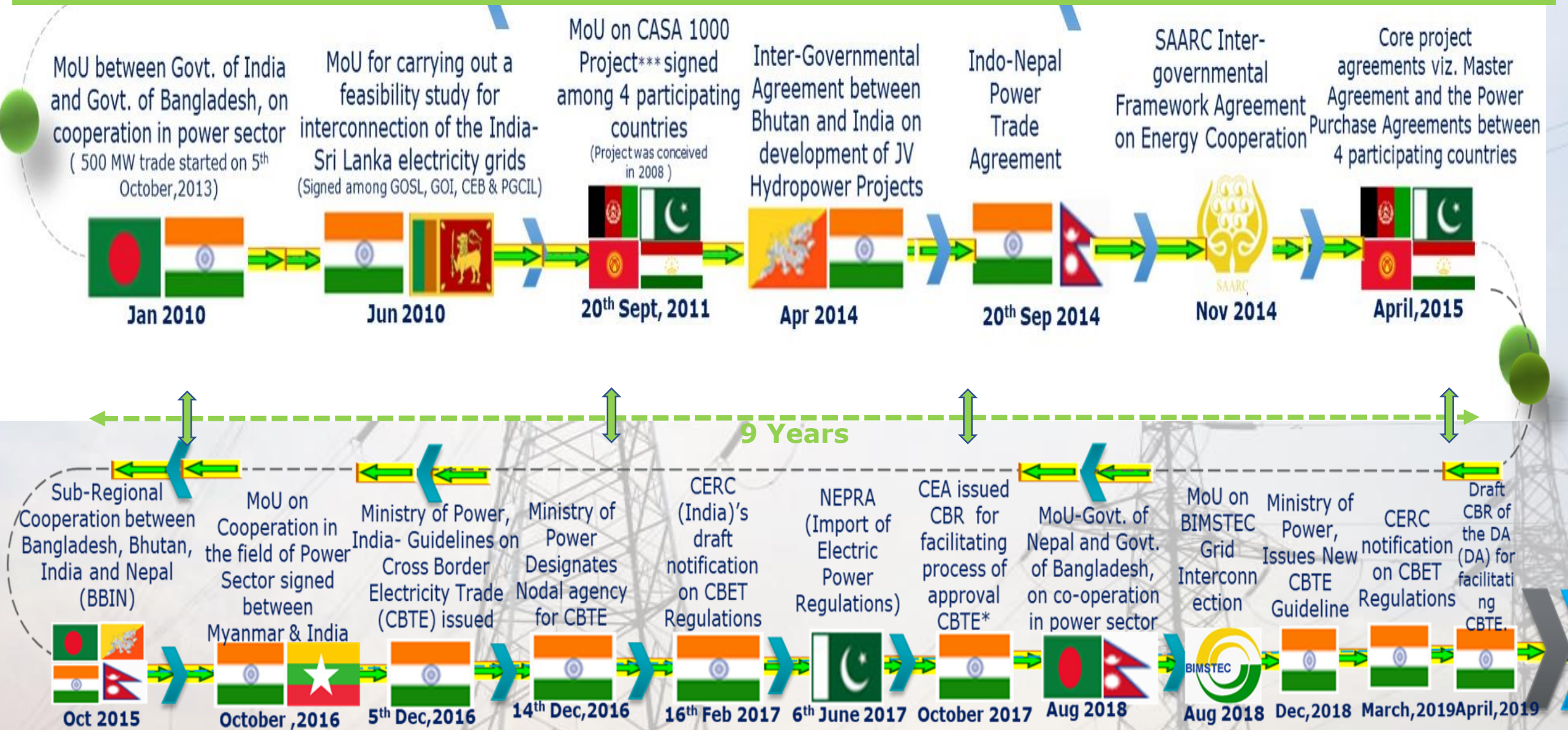
Outline

- Evolution and Existing Policy and Regulatory Framework CBET.
- Key Policy ,Regulatory Challenges & Risks for CBET.
- GoI guidelines for import/ export (cross border) of electricity- 2018
  - Key features
- Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019
  - Definitions , Designated Authority
  - Transmission Planning , Planning and Settlement Nodal Agency
  - Responsible Authority for transmission access and System Operation
  - Trading on Power Exchange
  - Open accesses and Connectivity
  - Technical Compliances
  - System Security, event information
  - Available Transfer Capability, Scheduling and Energy Accounting

Evolution of Energy Cooperation, CBET- Existing Key Policy & Regulatory Development



Evolution of Energy Cooperation, CBET- Existing Key Policy & Regulatory Development



USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Key Developments on CBET during 2012-19

2012-13

- India-Bangladesh 500 MW HVDC link commissioned

2013-14

- India-Nepal Power Trade Agreement Signed

2014-15

- SAARC framework agreement on energy (electricity) cooperation signed

2015-16

- Tripura - Commilla 400 KV transmission interconnection commissioned & 100 MW power transfer

2016-17

- Government of India issued guidelines for CBET
- Nepal-NERC Act passed
- National transmission plan of South Asia updated with CBET link

2017-19

- Government of India issued revised guidelines for CBET.
- CERC issued the Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019
- BIMSTEC MoU on grid interconnection signed
- India - draft amendment in Electricity Act -2003 with CBET provision
- Cross- Border Power Trade increased by 1500 MW since 2012

USAID FROM THE AMERICAN PEOPLE

SARI/EI

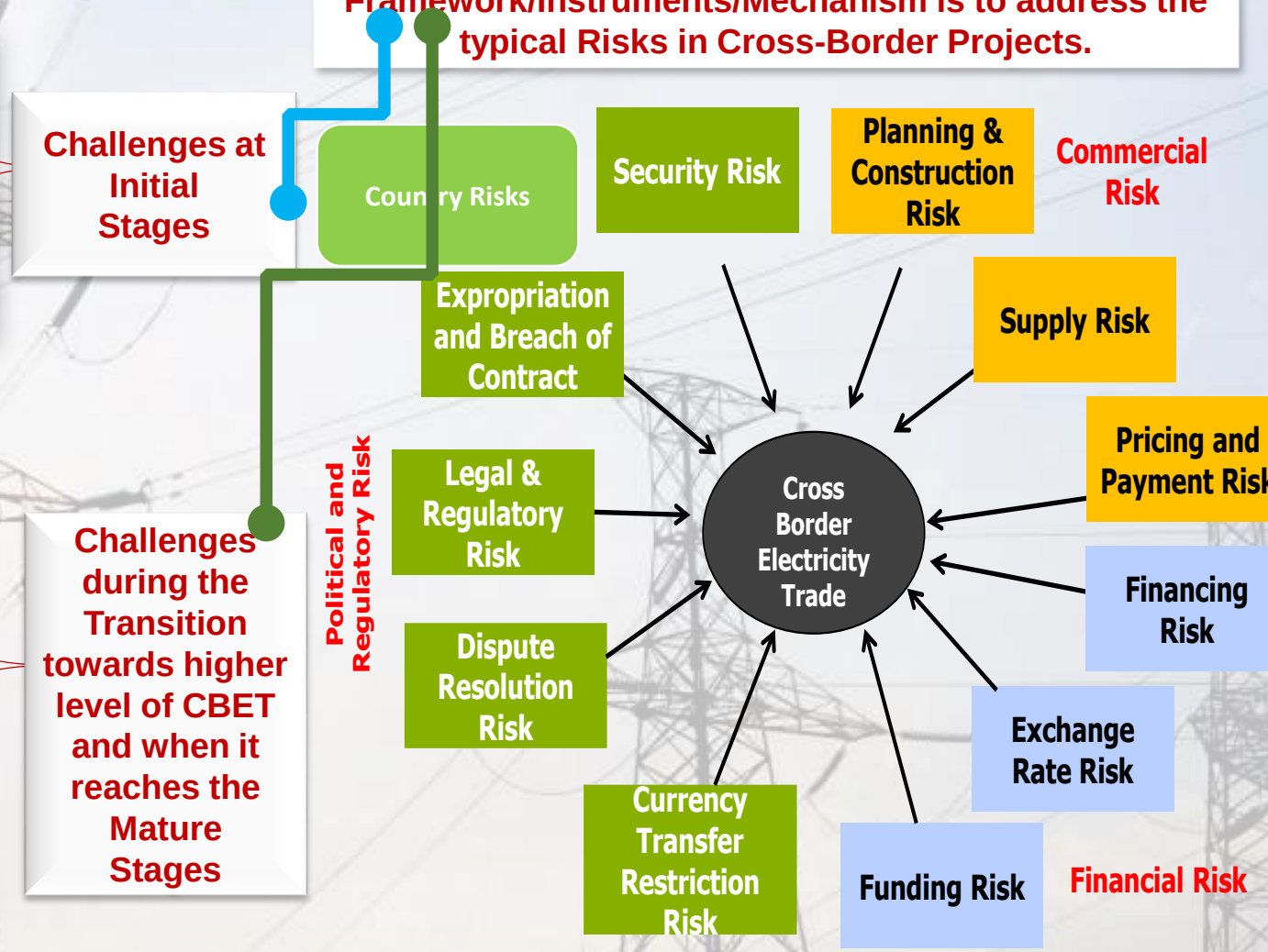
Integrated Research and Action for Development

SARI Assessment -Key Policy ,Regulatory Challenges & Risks for CBET

Need for Policy Framework/Instruments/Mechanism

1. Political Conesus: Need of Bilateral Treaties, Regional Cooperation and Recognition of CBET/Trade in the National Policy, Law etc.
2. Government Commitment & Policy Coordination
3. Financial Challenges, Investment, Technical and Financial Viability
4. Mechanism of Inter-connection
5. Market form of Trade
6. Regional Cooperation on Regulatory and Contractual Aspects
7. Open Access in Transmission
8. Transmission Charges/Pricing
9. Transmission Plan
10. Commercial Mechanisms to Settle Imbalances
11. Dispute Resolution

Motivation behind these Policy Framework/Instruments/Mechanism is to address the typical Risks in Cross-Border Projects.



USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

GOI GUIDELINES FOR IMPORT/ EXPORT (CROSS BORDER) OF ELECTRICITY- 2018

Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi-110001

Dated, 18th December, 2018

OFFICE MEMORANDUM

Subject: Guidelines for Import/Export (Cross Border) of Electricity-2018- regarding

The undersigned is directed to enclose herewith a copy of the "Guidelines for Import/Export (Cross Border) of Electricity -2018" approved by the competent authority, for taking necessary action. This is in supersession of the Guidelines on Cross Border Trade of Electricity issued by the Ministry of Power on 5th December 2016. These Guidelines will be effective from the date of issue of this Office Memorandum.

Encl: As above.

(D K Srivastava)
Director
Tele No. 011-23716674

1. Chairperson, CERC, New Delhi.
2. Chairperson, CEA, New Delhi.

Copy for information to:
1. CEO, Niti Aayog, New Delhi.
2. Foreign Secretary, Ministry of External Affairs, New Delhi
3. Secretary, Ministry of Commerce, New Delhi
4. Secretary, Ministry of New and Renewable Energy, New Delhi
5. Joint Secretary (BM), Ministry of External Affairs, New Delhi.
6. Joint Secretary (North), Ministry of External Affairs, New Delhi.
7. Secretary, CERC, New Delhi.
8. CMD, POWERGRID, Gurgaon.
9. CMD, NTPC, New Delhi.
10. MD, EESL, New Delhi.
11. CEO, NVVN, New Delhi.
12. CMD, POSOCO, New Delhi.
13. Energy Secretaries of all the States/UTs.
14. PS to MoSP(I/C)
15. Sr. PPS to Cabinet Secretary
16. PPS to Secretary (P) / PPS to AS (SNS)

Objective : GOI guidelines for import/ export (cross border) of electricity- 2018

Facilitate import/ export of electricity between India and neighbouring countries

a)Evolve a **dynamic and robust electricity infrastructure for import/ export** of electricity;

a)Promote ***transparency, consistency and predictability*** **in regulatory mechanism** pertaining to import/ export of electricity in the country;

a)Reliable grid operation and transmission of electricity for import/ export.

Basic Governing Requirements for CBET and Trade Agreements

- **Import/ export of electricity:** Allowed **through mutual agreements between Indian Entity(ies) and Entity(ies) of the neighbouring country(ies) under the overall framework of agreements** signed between India and the neighbouring country(ies) **consistent with the provisions of the prevailing laws** in the respective country(ies), including :

  (a) through **bilateral agreement** between two countries
  (b) through **bidding route**; or
  (c) through **mutual agreements** between entities

- **Trilateral Trade :** Provided that in case of ***tripartite agreements***, the cross-border trade of electricity across India shall be allowed under the **overall framework of bilateral agreements signed between Government of India and the Government of respective neighbouring country(ies)** of the participating Entity(ies).

Overall Institutional Framework

- Import/ export of electricity by Indian entities shall be governed by the **rules/ regulations and policies framed and notified by Government of India/ Central Electricity Authority (CEA)/ Central Electricity Regulatory Commission (CERC).**
- MoP, GoI shall appoint ***Designated Authority (DA)*** for facilitating the process of approval & laying down the procedure for import/ export.

- Import or Export electricity only after ***taking approval of the* DA.**
- Approval of DA, however, **not be necessary** where the **import/ export** is taking place **under the Inter Government Agreement*.**
- ***Member (Power System), CEA has been designated as the Designated Authority.***

Need complementing Policy and Regulatory frameworks among Countries

* Signed by India and neighbouring country for specific project(s).

Eligibility of participating entities

Import of Electricity

(a) Indian entities may **import electricity** from the generation projects located in neighbouring country(ies) **directly or through Government or a Government Company or a licensed trader of that country** after taking approval of the Designated Authority as laid down in para 4.4 of the Guidelines; provided that the generation project(s) has the **permission to export** power to India from the respective **Government of the neighbouring country.**

(b) In case of import through bilateral agreement between two countries, the Government of India may designate an Entity for import of power.

5.2 **Export of Electricity**

(a) Generating Companies/ Distribution Companies of India may export electricity generated by coal* or renewable energy or hydropower, to Entities of neighbouring country(ies) **directly or through trading licensee(s) of India**, after taking approval of the Designated Authority*.

(b) In case of export through bilateral agreement between two countries, the Government of India may **designate an Entity for export of power.**

However, in case of electricity generated from coal based generating plants, export of electricity from India by a generating company/ distribution licensee directly or through trading licensee shall be allowed only where such electricity is generated utilizing imported coal or spot e-auction coal or coal obtained from commercial mining.

Tariffs

Tariff for import:

- Tariff for import of electricity can be **competitive bidding as per India's Tariff Policy, or as per mutual agreement**. For import from hydropower plants, tariff can be determined by CERC**, if the generator approaches CERC through the exporting country's Government, and if the Indian entities agree for such tariff determination**. (7.1.1)*
- For import of power based on G2G Agreements, tariff agreed in such Agreements will be applicable. (7.1.2)

Tariff for export:

- Tariff for export of electricity can be **through negotiations, or competitive bidding**. (7.2.1). However, for export of power based on G2G Agreements, tariff agreed in such Agreements will be applicable. (7.1.2)

* Determination of the Tariff after the expiry of agreements can be determined under either provision of prescribed under 7.1

Tripartite arrangements, power exchanges and dispute resolution

Tripartite arrangements:

- The guidelines (3.1) allow trade under mutual agreements with countries, including trilateral agreements, subject to there being bilateral agreements between Indian and the other two countries.

- Where tripartite agreement is signed for transaction across India, the **participating entities shall sign transmission agreement with Central Transmission Utility of India for obtaining the transmission corridor access***.

Trade through power exchanges:

- Any **Indian power trader** may, after obtaining approval from the Designated Authority, **trade in Indian Power Exchanges** on **behalf of any Entity of neighbouring country**, for **a specified quantum** as provided in the Approval and complying with CERC Regulations.(5.3)

Dispute resolution

- For disputes between entities in different countries, arbitration will be conducted in a **mutually acceptable arbitration centre.** (9.2)

* Further, the transmission system in India for transmission of electricity across the territory of India under cross border trade of electricity shall be built after concurrence from Government of India and necessary Regulatory approvals. (8.6)

Difference between old and New Guidelines

Old (2016)

- Investment Restriction
- Only TAM in Power Exchange
- No explicit provision for Trilateral Power trade

New (2018)

- No Investment Restriction
- All products of PX are allowed in cross border through Power Exchange
- Provisions for Trilateral Power trade

The Government / Indian ownership linked eligibility criteria for Participating Entities specified in the 2016 guidelines is removed in the new version. However The Designated Authority shall consider the application for approval of participating Entity(ies) only after the receipt of the equity pattern of ownership of the said Entity(ies) along with other details as prescribed by the Designated Authority. In case where there is a change in the equity pattern, the participating Entity shall intimate the Designated Authority within thirty days from such change in equity pattern for continuation of the approval.

USAID
FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development
IRADe

Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019

Definitions

- Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019, taken out by CERC on 8.3.2019.

- Significant terms :

- '**Participating Entity**' means an entity approved by the **Designated Authority** for the purpose of cross border trade of electricity between India and any of the neighbouring countries or any entity as designated by Government of India for import or export of power through bilateral agreement between Government of India and Government of any of the neighbouring countries;

Designated Authority

- **'Designated Authority'** or 'DA' means the authority designated by Ministry of Power, Government of India in accordance with the Guidelines;

- **Designated Authority** appointed by the Ministry of Power, Government of India shall be responsible for facilitating the process of approval and laying down the procedure for import and export of electricity.

Transmission Planning Agency

- '**Transmission Planning Agency**' or 'TPA' means the Planning Agency for India or neighbouring country as specified under Regulation 4(2) of these regulations;

- **Transmission Planning Agency** shall be responsible for planning of transmission system for the purpose of facilitating cross border trade of electricity and may coordinate with the Transmission Planning Agency of the concerned neighbouring country, wherever necessary. For India, this function shall be discharged by the Designated Authority.

Planning of Cross Border Transmission Link

- The Cross Border Transmission Link between India and any neighbouring country shall be planned jointly by Transmission Planning Agencies of the two countries with the approval of the respective Governments keeping in view the future need for electricity trade between India and the neighbouring country

Application Process and Compliances

- Application fee and timelines specified for connectivity to the Indian Grid, grant of long term and medium term access and for short term open access.
- Compliance with India's Scheduling and Despatch Code as per the Indian Electricity Grid Code.
- Compliance with Technical Standards for Connectivity to the Grid followed in India.
- Compliance with the Deviation Settlement Regulations within India.

Settlement Nodal Agency

- '**Settlement Nodal Agency**' or 'SNA' means the nodal agency as notified by Ministry of Power, Government of India for each neighbouring country for settlement of grid operation related charges;

- **Settlement Nodal Agency** shall be responsible for settling all charges pertaining to grid operations including operating charges, charges for deviation and other charges related to transactions with a particular neighbouring country in the course of cross border trade of electricity.

Responsible Authority for transmission access and System Operation

- **National Load Dispatch Centre** shall act as the **System Operator** for cross border trade of electricity between India and the neighbouring countries and shall be responsible for **granting short-term open access** and **for billing, collection and disbursement of the transmission charges for short-term open access transactions** in accordance with the Sharing Regulations.

- **Central Transmission Utility** shall be responsible for **granting long-term access and medium-term open access** with respect to cross border trade of electricity between India and the neighbouring countries and for billing, collection and disbursement of the transmission charges in accordance with the Sharing Regulations.

Basis of CBET

- Cross border trade of electricity between India and the neighbouring country(ies) shall be allowed through mutual agreements between Indian entity(ies) and entity(ies) of the neighbouring country(ies) under the overall framework of agreements signed between India and the neighbouring country(ies).

Trading in the Indian Power Exchange

- Any **electricity trading licensee of India** may, **after obtaining approval from the Designated Authority**, trade in the **Indian Power Exchanges** on behalf of any Participating Entity of neighbouring country, for the specified quantum as provided in the Approval subject to compliance with the applicable Regulations of the Commission.

Connectivity, Long Term Access, Medium Term Open Access and Short Term Open Access

- A Participating Entity located in a neighbouring country shall be required to seek **connectivity** or **long-term access** or **medium-term open access** or **short-term open access**, as the case may be, through separate applications.

- Applications for grant of connectivity or long-term access or medium-term open access shall be made to **CTU** and Applications for grant of short-term open access shall be made to **NLDC** under these Regulations.

Technical Compliances

- All Participating Entities shall ensure that the ***voice and data communication facilities*** to telemeter power system parameters such as flow, voltage and status of switches or transformer taps etc. is installed in line with interface requirements.

- ***Recording instruments including Data Acquisition System/Disturbance Recorder/Event Logging Facilities/Fault Locator*** (including time synchronization equipment) shall be provided by all Participating Entities and shall always be kept in working condition in the Indian grid and transmission system of the neighbouring country for recording of dynamic performance of the system.

Technical Compliances

- ***Reactive Power compensation and/or other facilities shall be provided*** by Participating Entities connected to Indian grid as far as possible in the low voltage systems close to the load points thereby avoiding the need for exchange of Reactive Power to/from Indian grid and to maintain voltage within the specified range.

System Security Aspects

- The interconnection between India and the neighbouring country shall be ***monitored and controlled by the respective System Operators of the two countries, with proper coordination.***

- Provision of ***protection and relay settings shall be coordinated periodically*** by the Transmission Service Providers of both countries. These settings would be periodically reviewed as and when network configuration changes at either of the ends. If necessary, the respective countries may also put into place ***System Protection Schemes (SPS)*** to take care of any contingencies.

- ***Operational planning including outage plan*** shall be carried out by NLDC and its counterpart in the neighbouring country.

Available Transfer Capability

- ***Total Transfer Capability (TTC), Transmission Reliability Margins (TRM) and Available Transfer Capability (ATC)*** for the cross border trade of electricity shall be assessed in advance by System Operators in India and the concerned neighbouring country and lower of the two values of ATC assessed by the two countries shall be considered for allowing cross border trade of electricity.

Scheduling and Energy Accounting

- ***Scheduling shall be carried out for each 15-minute time block*** or such other duration as may be notified subsequently.

- ***Energy Accounting*** for all the electricity imported from a neighbouring country to India or exported from India to a neighbouring country ***shall be carried out on a net basis for each country by the concerned Regional Power Committee(s) (RPC(s)) in India***.

- The ***Settlement Nodal Agency***, acting on behalf of the selling entity or buying entity ***of the neighbouring country, shall be a member of the Regional Deviation Pool Account.***

Scheduling and Energy Accounting

- ***Weekly meter readings (import or export in terms of MWh and MVArh)*** for actual injection or drawl by entities located in neighbouring country ***shall be provided to the concerned RLDC(s) or NLDC through Settlement Nodal Agency***.

- The ***charges for deviation from schedule at the inter-connection point shall be as per the DSM Regulations in India.***

Event Information

- ***Events like tripping of elements impacting the electricity flow across the Cross Border Transmission Link***, complete or partial blackout or any other such incidents affecting the grid operations ***would be reported by the concerned System Operator of India to the System Operator of the neighbouring country and vice versa.***

USAID
FROM THE AMERICAN PEOPLE

SARI/EI

15
IRADe Integrated Research and Action for Development

Thank You

GOI GUIDELINES FOR IMPORT/ EXPORT (CROSS BORDER) OF ELECTRICITY- 2018

- **Objective** :

a) **Facilitate import/ export** of electricity between India and neighbouring countries;

b) Evolve a **dynamic and robust electricity infrastructure for import/ export** of electricity;

c) Promote *transparency, consistency and predictability* in regulatory mechanism pertaining to import/ export of electricity in the country;

d) **Reliable grid operation and transmission** of electricity for import/ export.

Why the Need for Policy & Regulatory Coor

CERC CBTE regulation relied upon domestic Regulation and Policy Frameworks

1. Tariff Policy
2. Tariff Regulations
3. Open access Regulation
4. Connectivity Regulation
5. Metering Regulation
6. Sharing of Inter State Transmission Charges and Losses
7. DSM Regulations
8. Scheduling and Dispatch rule……..
9. ……..

CBET: Cross-Border Electricity Trade (CBET)
CBTE: Cross Border Trade of Electricity

USAID FROM THE AMERICAN PEOPLE

SARI/EI

Integrated Research and Action for Development

South Asia Regional Initiative for Energy Integration (SARI/EI)

Transmission and System Operation for the Regional Trade and Power Exchange Based Trade : Key Challenges and Possible Solutions

Vinod Kumar Agrawal, Technical Director
SARI/EI/IRADE

Workshop on Power Trade through Power Exchange
23rd July 2019 at Hotel Radisson, Kathmandu, Nepal, India

Table of Content

Regional Transmission System

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Existing Transmission System for Transfer of Power to Nepal

Under Cross Border Transactions power is transferred to Nepal under 3 heads:

Mahakali River Treaty : 70 Mus Annual free energy from Tanakpur HPS, on 132 KV Tanakpur-Mahendragarh ckt. In addition to this, based on requirement and season, power in the range of around 25 MW is also drawn on this line under STOA, with PTC as trading partner;

From Bihar on 132 KV and 33 KV Radial links : There are 4 Nos. of 132 KV and 4 Nos. of 33 KV Radial lines from Bihar to Nepal, on which power is transferred to Nepal. During Year 2018-19, the quantum of power was 107.31 MU [Avg. 144 MW] during July 2018 and 146.06 MU [Avg. 196 MW] during Jan. 2019.

From Muzafarpur (Bihar) to Dhalkebar (Nepal) on Regional Cross Border Link: This is a 400 KV D/C (Presently operational at 220 KV). During Year 2018-19, the quantum of power transferred to Nepal on this line was around 70 MU [Avg. 94 MW] during July 2018 & 200 MU [Avg. 269 MW] during Jan. 2019.

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Nepal Power Supply Position during last 5 Years

Total Peak Demand Met and Available Energy in Nepal

Year	Peak Demand (MW)	Annual percentage Increase	Total Available Energy (GWH)	Annual percentage Increase
2014	1201		4687	
2015	1291	7.49	5005	6.78
2016	1385	7.28	5077	1.44
2017	1444	4.26	6257	23.24
2018	1508	4.43	7057	12.79

Source : NEA Annual Report 2017-18

During last few years the % increase in Total Avail. Energy has been much higher than Peak Demand

Nepal Power Supply Position during last 5 Years

Share of different Sources in Total Energy Avaialble in Nepal

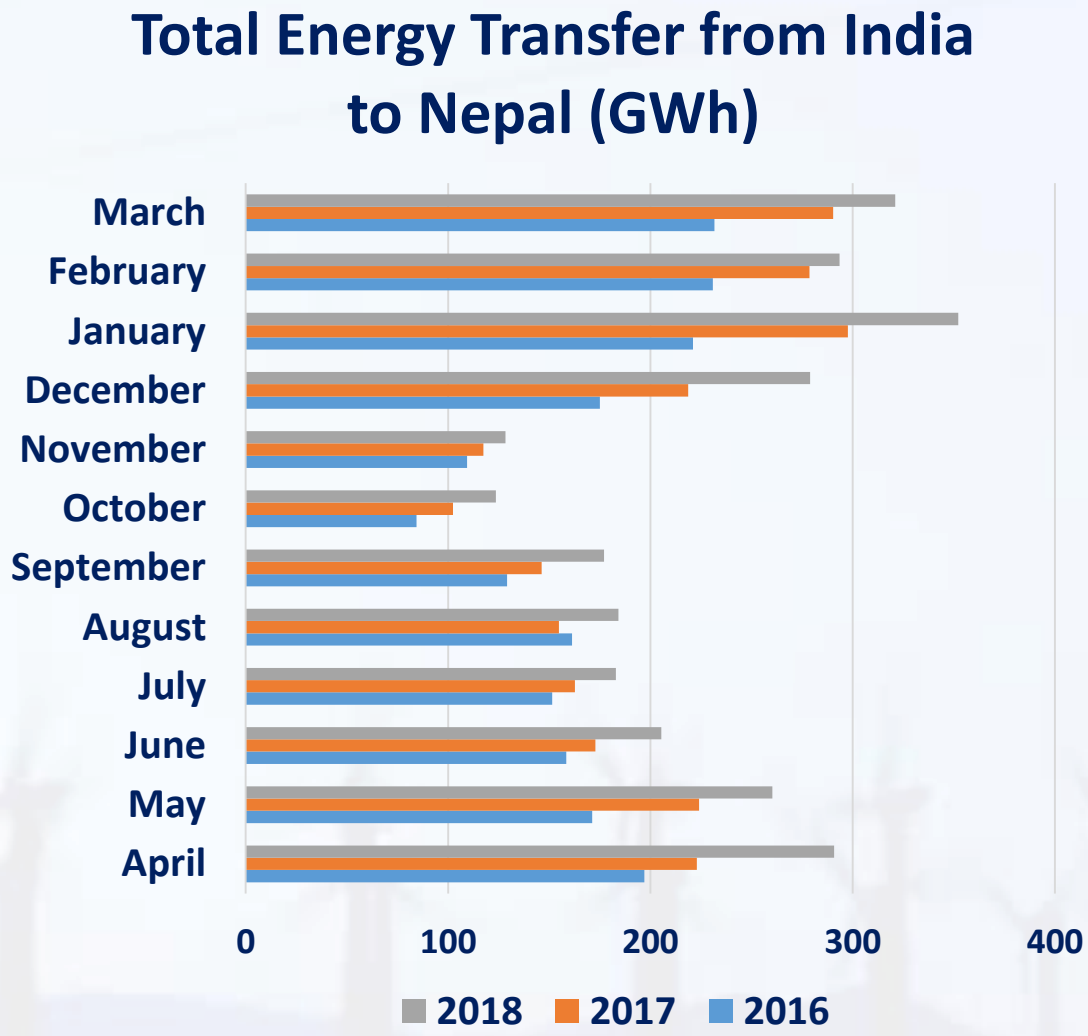
Year	NEA Hydro Gen. (GWH)	NEA Hydro Percentage Share	Power Purchase from IPPs(GWH)	IPPs Gen. Percentage Share	Power Purchase from India(GWH)	CBET Percentage Share	Total Available Energy (GWH)
2014	2288	48.82	1070	22.83	1319	28.14	4687
2015	2367	47.28	1269	25.35	1370	27.37	5006
2016	2133	42.01	1166	22.97	1778	35.02	5077
2017	2305	36.83	1777	28.40	2175	34.76	6258
2018	2308	32.70	2167	30.70	2582	36.58	7058

Source : NEA Annual Report 2017-18

During last few years the % share of CB Energy Trade and Gen. from IPPs is on increasing trend

Total Energy Transfer from India to Nepal

Total Energy Transfer From India to Nepal (GWh)			
Month	2016-17	2017-18	2018-19
April	197	223	291
May	171	224	260
June	158	173	205
July	151	163	183
August	161	155	184
September	129	146	177
October	84	102	124
November	109	118	128
December	175	219	279
January	221	298	352
February	231	279	294
March	232	290	321
Total	2021	2389	2799



During last 3 years trend in total energy during Dry/Wet period has moved from: 150%->180% ->200%

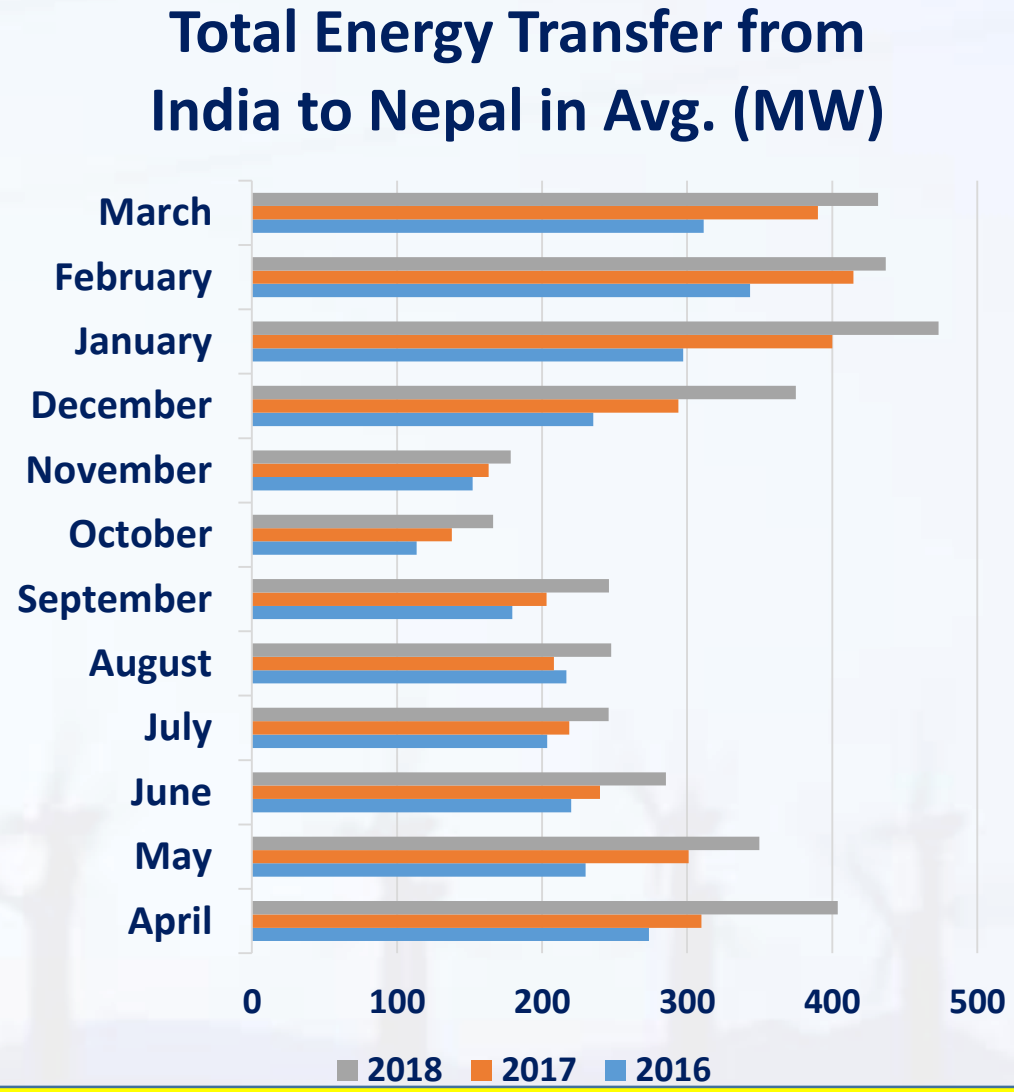
USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Total Energy Transfer from India to Nepal

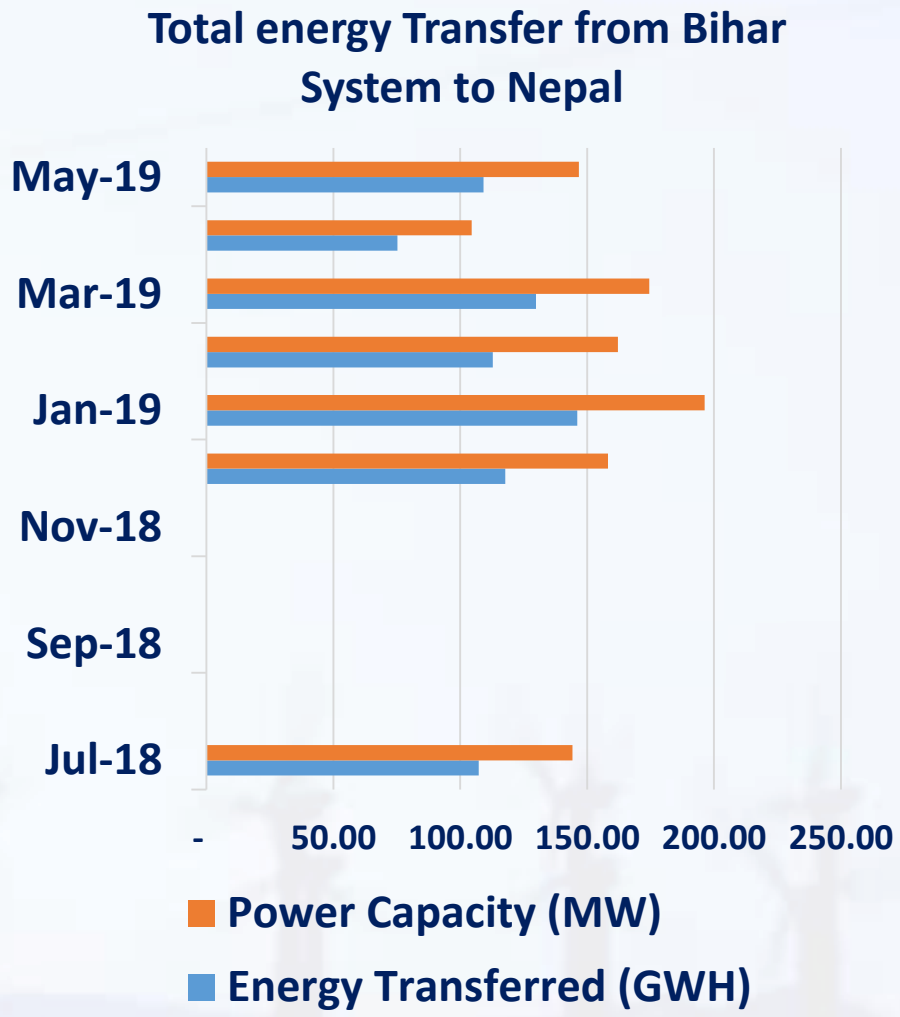
Total Energy Transfer from India to Nepal in Avg. (MW)			
	2016-17	2017-18	2018-19
April	274	310	404
May	230	301	350
June	220	240	285
July	204	219	246
August	217	208	248
September	179	203	246
October	114	138	166
November	152	163	178
December	235	294	375
January	297	400	473
February	343	415	437
March	311	390	432



During last 3 years trend in total energy during Dry/Wet period has moved from: 150%->180% ->200%

Energy Transfer from Bihar (India) to Nepal on 132 KV Radial Lines

Details of energy Transfer from Bihar System to Nepal		
Month	Energy Transferred (GWH)	Power (MW)
Jul-18	107.31	144
Dec-18	117.72	158
Jan-19	146.06	196
Feb-19	112.83	162
Mar-19	129.83	175
Apr-19	75.22	104
May-19	109.18	147



During Dry/Wet period as against the trend of 200% in whole Nepal, in area fed from Radial lines from Bihar it is only 135%

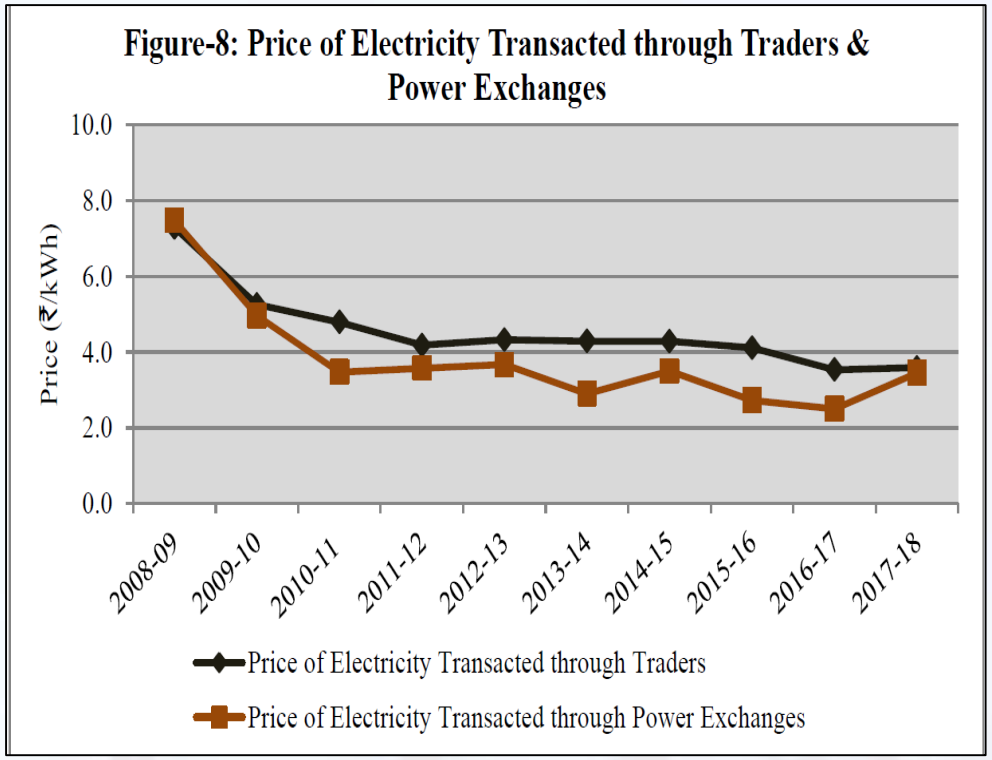
Inferences which can be arrived based on Historical data

- There is an increase in the overall share in the power purchase from IPPs:
  - ✓ A positive development towards markets;
- There is an increase in overall share in Cross Border Trades:
  - ✓ A positive step leading to economy and efficiency;
- Increase in the ratio of energy consumed during dry/wet weather:
  - ✓ A sign of natural load growth and matching transmission network;
- Low ratio of energy consumed during dry/wet weather in certain pockets:
  - ✓ A sign of constrained transmission network;
- Growth in total energy is lower than the growth in peak demand:
  - ✓ A case of suppressed and restricted load during peak conditions;

Market Based Trade in the Region

Prices of Electricity in India transacted through Traders & PXs : Last 10 Years

Year	Price of Electricity transacted through Traders (₹/kWh)	Price of Electricity transacted through Power Exchanges (DAM+TAM) (₹/kWh)
2008-09	7.29	7.49
2009-10	5.26	4.96
2010-11	4.79	3.47
2011-12	4.18	3.57
2012-13	4.33	3.67
2013-14	4.29	2.90
2014-15	4.28	3.50
2015-16	4.11	2.72
2016-17	3.53	2.50
2017-18	3.59	3.45

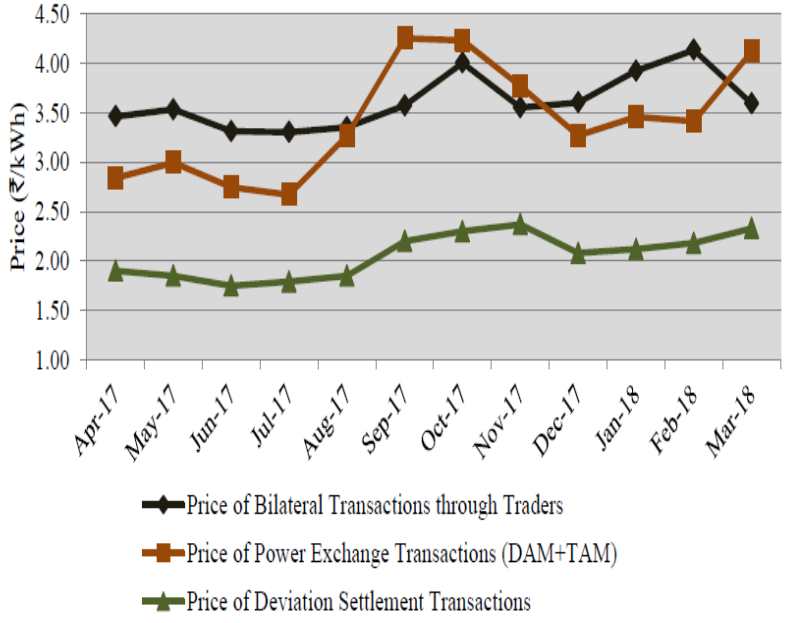


Source : CERC Market Monitoring Cell

Prices of Short Term Transactions of Electricity in India : Year 2017-18

Period	Bilateral through Traders				Power Exchange		DSM
	RTC	Peak	Off-peak	Total	IEX	PXIL	All India Grid
Apr-17	3.57	3.21	2.98	3.46	2.83	2.79	1.90
May-17	3.64	3.47	3.16	3.53	2.98	2.99	1.85
Jun-17	3.25	3.88	3.32	3.31	2.73	3.36	1.75
Jul-17	3.26	4.30	3.38	3.30	2.65	3.52	1.79
Aug-17	3.31	3.77	3.39	3.35	3.24	3.21	1.85
Sep-17	3.70	3.97	3.14	3.57	4.25	4.01	2.20
Oct-17	4.03	4.20	3.93	4.00	4.26	3.94	2.30
Nov-17	3.48	5.54	3.77	3.55	3.76	4.04	2.37
Dec-17	3.65	-	3.37	3.60	3.25	3.38	2.08
Jan-18	4.18	-	3.38	3.92	3.44	-	2.12
Feb-18	4.24	-	4.02	4.13	3.42	2.12	2.18
Mar-18	4.09	5.25	4.58	3.59	4.10	3.90	2.33

Figure-16: Comparison of Prices of Bilateral, Power Exchange and DSM Transactions in 2017-18



Source : CERC Market Monitoring Cell

Prices of Electricity in India transacted through Traders & PXs : April 2019

Table-3: PRICE OF ELECTRICITY TRANSACTED THROUGH TRADERS, APRIL 2019		
Sr.No	**Item**	**Sale Price of Traders (₹/kWh)**
1	Minimum	3.01
2	Maximum	7.30
3	Weighted Average	5.15
Source: Information submitted by trading licensees		

Table-5: PRICE OF ELECTRICITY TRANSACTED THROUGH POWER EXCHANGES, APRIL 2019			
Sr.No	**ACP**	**Price in IEX (₹/kWh)**	**Price in PXIL (₹/kWh)**
1	Minimum	1.80	2.01
2	Maximum	11.84	4.24
3	Weighted Average	3.33	3.71
Source: Information submitted by IEX and PXIL			

Source : CERC Market Monitoring Cell

Key System Requirements _ Market Based Trade

- Metering Arrangements;
- Data & Communication Facilities;
- System Recording Instruments;
- Protocol towards Event Information;
- Reactive Power Compensation;
- Cyber Security;
- Principles towards treatment of transmission losses;
- Provisions towards System Operation Fee & Charges;
- Metering, Energy Accounting & Settlement;

Power Exchange based Trade and related issues

- Stringent time line for submission and clearing of bids
- Market splitting and addressal towards transmission congestion
- Suspension of market in case of unforeseen contingent conditions
- Need towards continuous monitoring of prevailing prices
- Applicability of deviation charges and need for load forecasting

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Deviation Settlement Mechanism (DSM) Price linked to ACP in Power Exchange

DSM Price Vector — P is ACP in PX

Average Frequency of the time block (Hz)		Charges for Deviation (Paise/kWh)
Below	Not Below	
	50.05	0.00
50.05	50.04	**1xP/5**
50.04	50.03	**2xP/5**
50.03	50.02	**3xP/5**
50.02	50.01	**4xP/5**
50.01	50.00	**P**
50.00	49.99	**50.00+15xP/16**
49.99	49.98	**100.00+14xP/16**
49.98	49.97	**150.00+13xP/16**
49.97	49.96	**200.00+12xP/16**
49.96	49.95	**250.00+11xP/16**
49.95	49.94	**300.00+10xP/16**
49.94	49.93	**350.00+9xP/16**
49.93	49.92	**400.00+8xP/16**
49.92	49.91	**450.00+7xP/16**
49.91	49.90	**500.00+6xP/16**
49.90	49.89	**550.00+5xP/16**
49.89	49.88	**600.00+4xP/16**
49.88	49.87	**650.00+3xP/16**
49.87	49.86	**700.00+2xP/16**
49.86	49.85	**750.00+1xP/16**
49.85		800.00

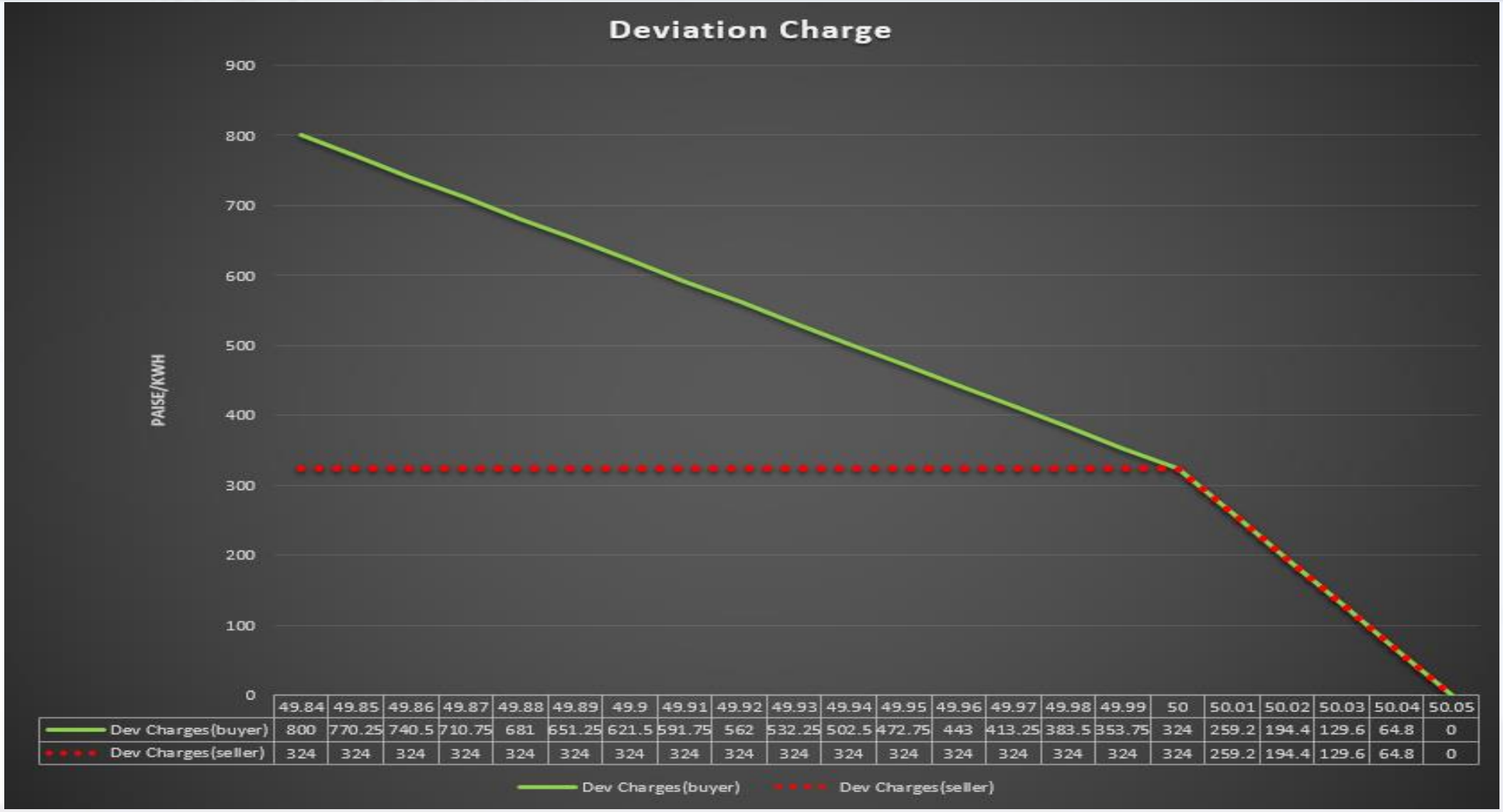
DSM Price linked to PX Clearing Price:

- **Daily (simple) Average Area Clearing Price (ACP) discovered in the Day Ahead Market segment of power exchange shall be considered the Price at 50.00 Hz.**
- **The maximum ceiling limit applicable for average Daily ACP shall be 800 Paisa/kWh.**
- **The Deviation Settlement Mechanism (DSM) vector will have dynamic slope by connecting points as below:**
  - ✓ **50.05 Hz (zero);**
  - ✓ **50 Hz. (daily simple average ACP);**
  - ✓ **49.85 Hz (Rs. 8 per unit);**

Additional DSM Charges:

- **Additional Charge 1 – Additional DSM charge shall be leviable for crossing block wise volume limits;**
- **Additional Charge 2 – Additional DSM charge shall be leviable for violation of sign change stipulation;**

Deviation Charges Vector



	49.84	49.85	49.86	49.87	49.88	49.89	49.9	49.91	49.92	49.93	49.94	49.95	49.96	49.97	49.98	49.99	50	50.01	50.02	50.03	50.04	50.05
Dev Charges(buyer)	800	770.25	740.5	710.75	681	651.25	621.5	591.75	562	532.25	502.5	472.75	443	413.25	383.5	353.75	324	259.2	194.4	129.6	64.8	0
Dev Charges(seller)	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	259.2	194.4	129.6	64.8	0

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Extracts from ERPC Website in respect of Deviation Charges

सत्यमेव जयते

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
पूर्वी क्षेत्रीय विद्युत समिति
Eastern Regional Power Committee
14, गोल्फ क्लब रोड, टालीगंज, कोलकाता-700033
14 Golf Club Road, Tollygunj, Kolkata-700033

आई एस ओ : 9001-2008
ISO : 9001-2008

Tel No. :033-24239651, 24239650 FAX No.:033-24239652, 24239653 Web: **www.erpc.gov.in**

NO: ERPC/COM-II/ABT-DC/ 2184 - 2218 Date: 30.05.2019

To
As per List

Sub: Statement of Deviation Charges including Additional Deviation Charges, RRAS, FRAS & SCED Settlement Account for the period from 06.05.2019 to 12.05.2019.

http://erpc.gov.in/ui-and-deviation-accts/

USAID FROM THE AMERICAN PEOPLE

SARI/EI

IRADe Integrated Research and Action for Development

Extracts from ERPC Website in respect of Deviation Charges

EASTERN REGIONAL POWER COMMITTEE

KOLKATA

ABT based Deviation Charge Account

For the period 06.05.19 TO 12.05.19

AS PER 4TH AMENDMENT OF DSM, 2018 W.E.F. 01/01/2019

(All figures in Rs. Lakhs)

UTILITIES AND DEVIATION CHARGES PAYABLE BY THEM	DEVIATION CHARGE (in Rs. Lakhs)		ADDITIONAL DEVIATION CHARGE DUE TO VIOLATION OF BLOCK WISE VOLUME LIMIT (in Rs. Lakhs.)	ADDITIONAL DEVIATION CHARGE DUE TO VIOLATION OF SIGN CHANGE (in Rs. Lakhs.)	FINAL DEVIATION CHARGE (in Rs. Lakhs)	
	RECEIVABLE	PAYABLE			RECEIVABLE	PAYABLE
A	B	C	D	E	F	G
INTER- NATIONAL						
NVVN-BD		41.26403	4.45213	123.79210		169.50827
NVVN-NEPAL		14.79009	4.36109	4.05025		23.20142
TPTCL		37.37994	1.91428			39.29422

USAID FROM THE AMERICAN PEOPLE

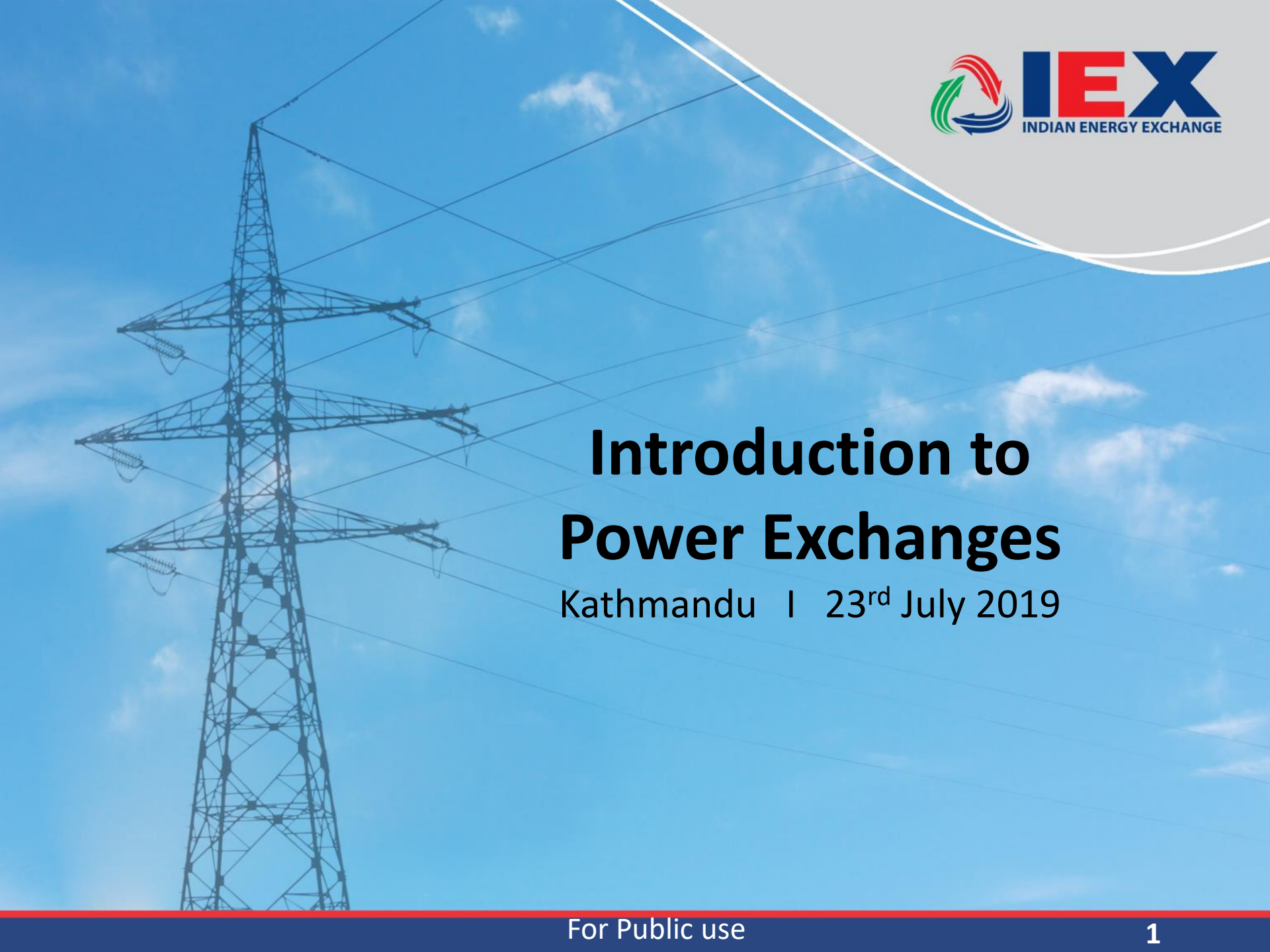
SARI/EI

IRADe Integrated Research and Action for Development

Key Takeaways and Way Forward

- ❑ Strong Cross Border Connections can bring in Regional Economy & Efficiency;
- ❑ For strong connectivity connections need to be made at multiple points;
- ❑ Within Nepal internal system there is a need for strong interconnections;
- ❑ There is a need to operate the whole system as one interconnected Grid;
- ❑ Transactions through market can bring in overall economy and efficiency;
- ❑ For enabling market based trade metering and other requisites are essential;
- ❑ A close eye need to be kept on deviations and accurate load forecasting;
- ❑ Enabled Regional Common Information System/MIS can help enhancing CBET;

THANK YOU



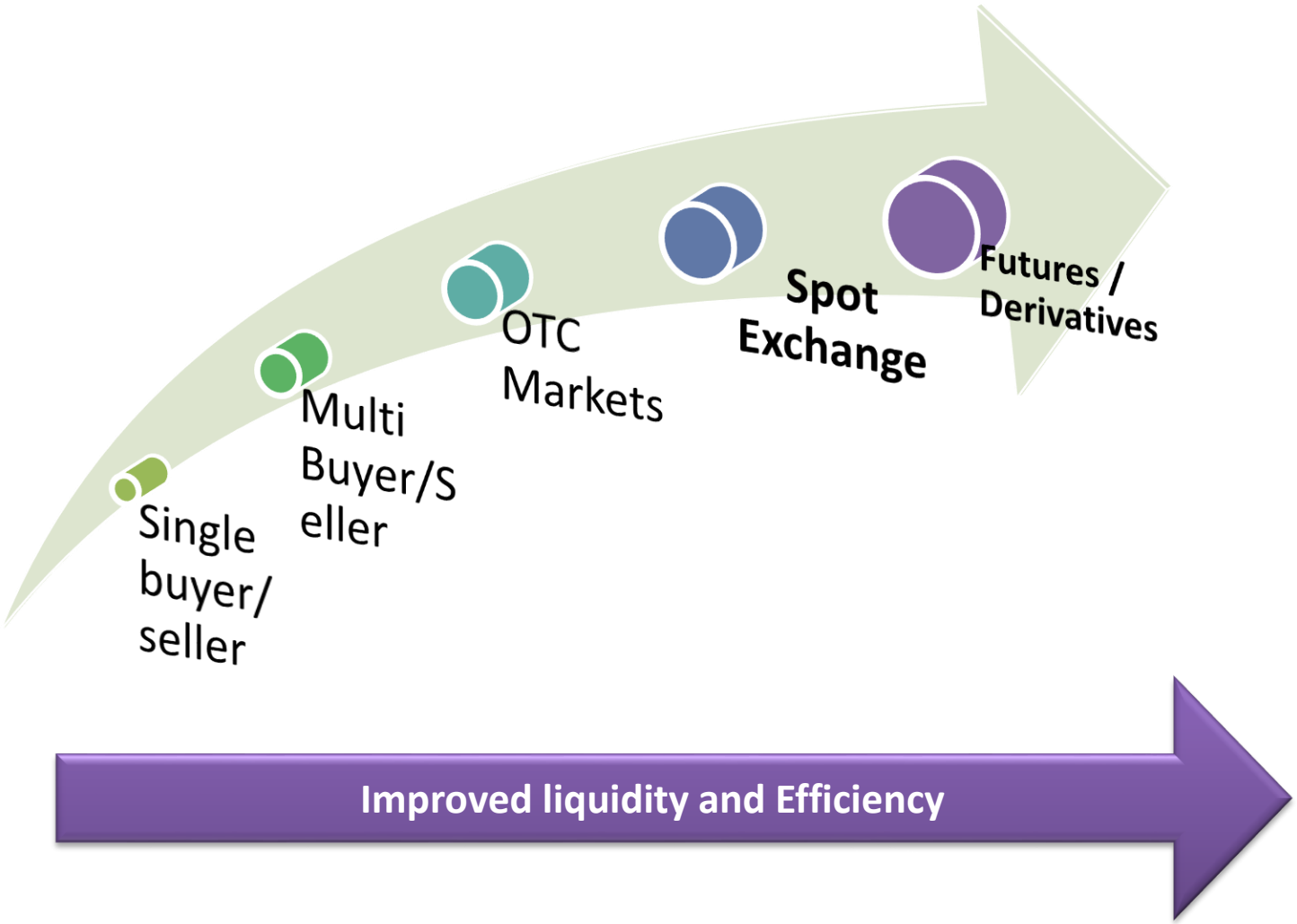
Introduction to Power Exchanges

Kathmandu I 23rd July 2019

In this presentation

- ❑ Power Market Overview
- ❑ Exchange Snapshot
- ❑ Way Forward

Power Market Evolution



Options For Power Trading

Long-term
>7 years

- >7-year PPA -
- Tariff on cost-plus or Competitive bid
- Two-part tariff: Fixed + Variable

Medium Term
1-5 years

- 1 - 5 Years
- Tariff covers : Fixed Cost + Variable Cost
- Competitive bid

Short Term (OTC)
<= 1 year

- Bilateral & PX
- Intraday- 3 Months to be procured through competitive bidding only
- Single part tariff
- Competitive bidding (DEEP Platform) or PX

Power Exchanges

Day-Ahead Market

Term-Ahead Market

Choice of 15-min to whole day
Highly liquid and transparent marketplace
Flexible load management

Growing share of Short-term market

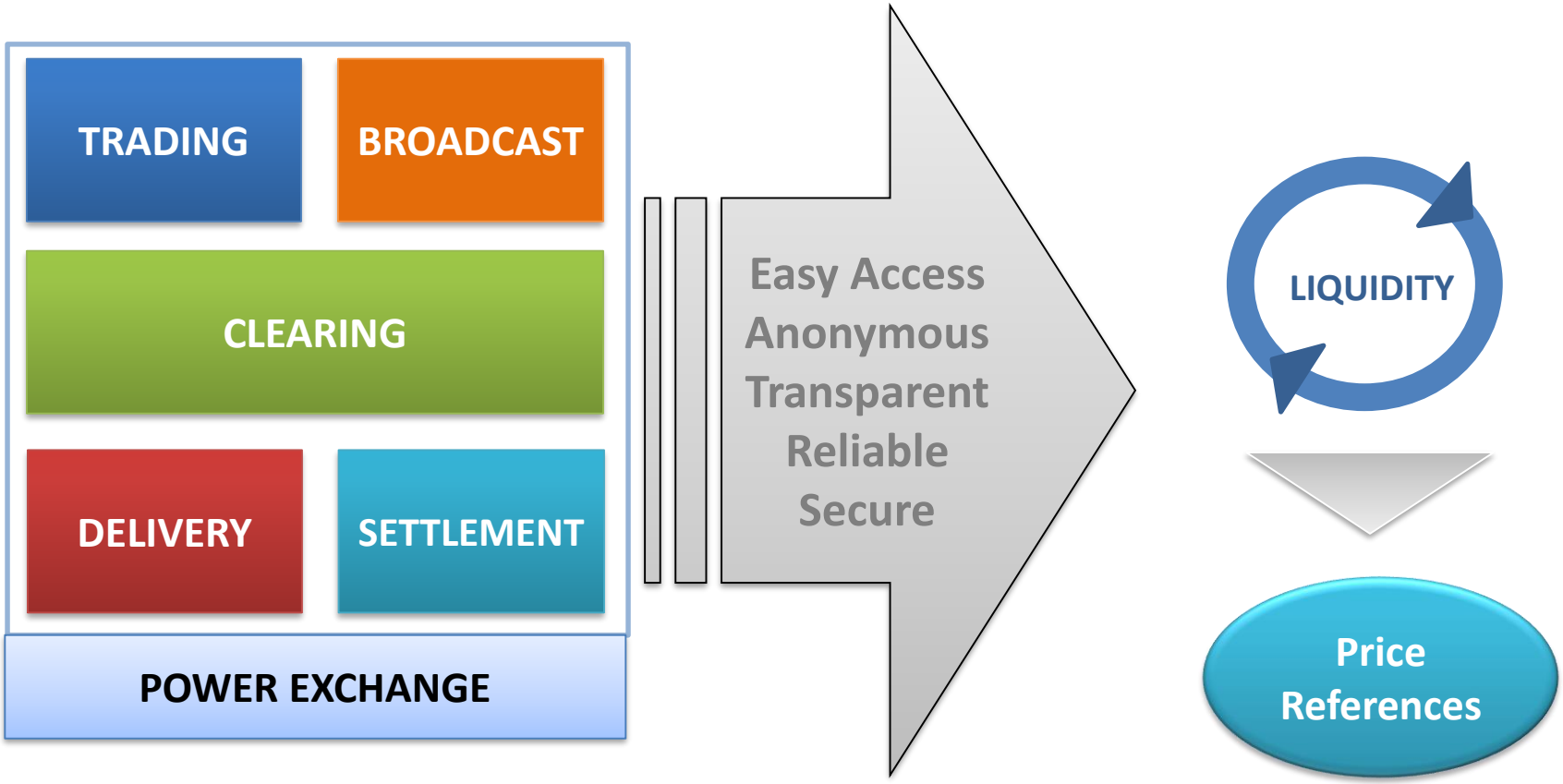
	FY 2009	FY 2019
Long Term		
PPA for over 25 years through long term	93.86%	88.3%
Short-Term	6.1%	11.7%
Exchanges	0.4%	4.0%
Through traders	3.2%	4.1%
Direct Bilateral	0.5%	1.5%
Unscheduled Interchange	2.1%	2.0%

Source: Percentage as per CERC *Report on Short Term Power Market* (Till March '19)

About IEX

- Inception in June 2008
- Established under regulatory oversight of Central Electricity Regulatory Commission (CERC)
- Transparent market platform that facilitates delivery based trading
- Worldwide, Power Exchanges are most commonly used platform to trade power and Day ahead Market (DAM) is more popular
- Financial products such as Derivatives and Forwards EXPECTED

Power Exchange Functions



History and Evolution

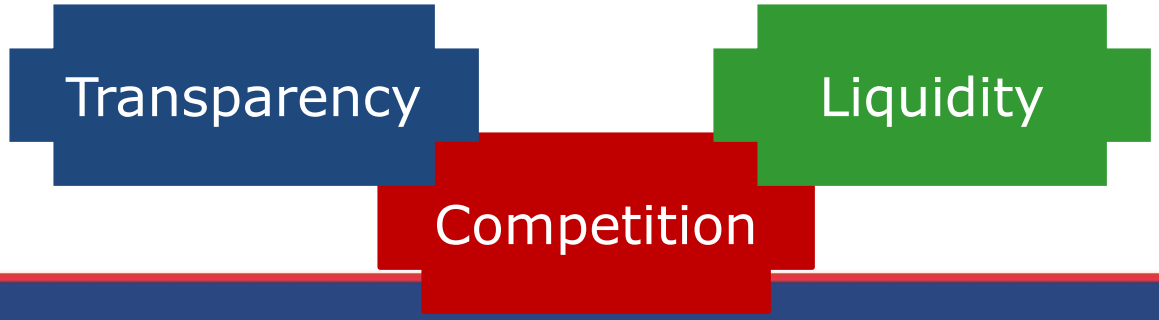
FY18	IEX was listed on the Indian stock exchanges in October 2017 (NSE: IEX, BSE:540750). Started trading ESCerts in September, 2017, traded around 1.3 million ESCerts
FY17	▪ Received certification under ISO 9001:2008, ISO 14001:2004 and ISO 27001:2013 ▪ Daily average cleared volume touches 109 MU/day ▪ Highest cleared volume in a day crossed over 147 MUs ▪ Approval from CERC received for trading of ESCerts
FY16	▪ Highest cleared volume in a day crossed over 136 MUs
FY15	▪ Highest cleared volume in a day crosses over 131 MUs.
FY14	▪ Over 2,900 open access consumers were procuring power through IEX
FY11	▪ Commencement of RECs trading.
FY10	▪ Registered first industrial consumer ▪ Commencement of trading for TAM ▪ Average monthly cleared volume crossed 500 MU.
FY09	▪ Commencement of trading for DAM
FY07	▪ Incorporation of the company as a public limited company

About IEX

- ✓ Market Share: **97%**
- ✓ Average daily trade: **6000 MW+ / 50 Billion kWh /year**
- ✓ High Participation: **4000+ (Electricity Market)**
- ✓ Record Daily Volume : 308 MUs (12,900MW)

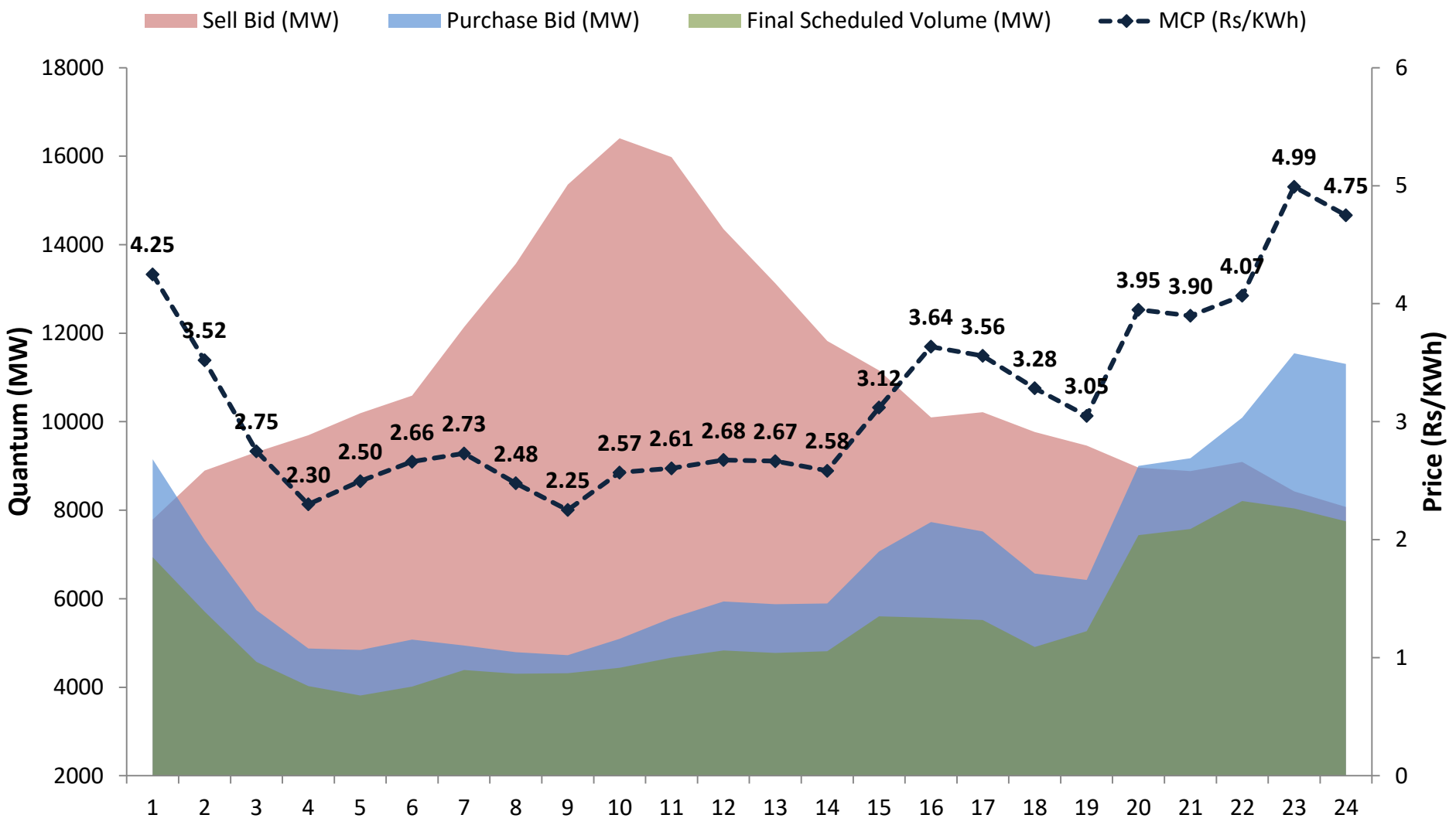
4000+ Industries I **55** Discoms (all) I **100+** ESCert Entities

400+ Generators I **1500+ RE** Generators & Obligated entities



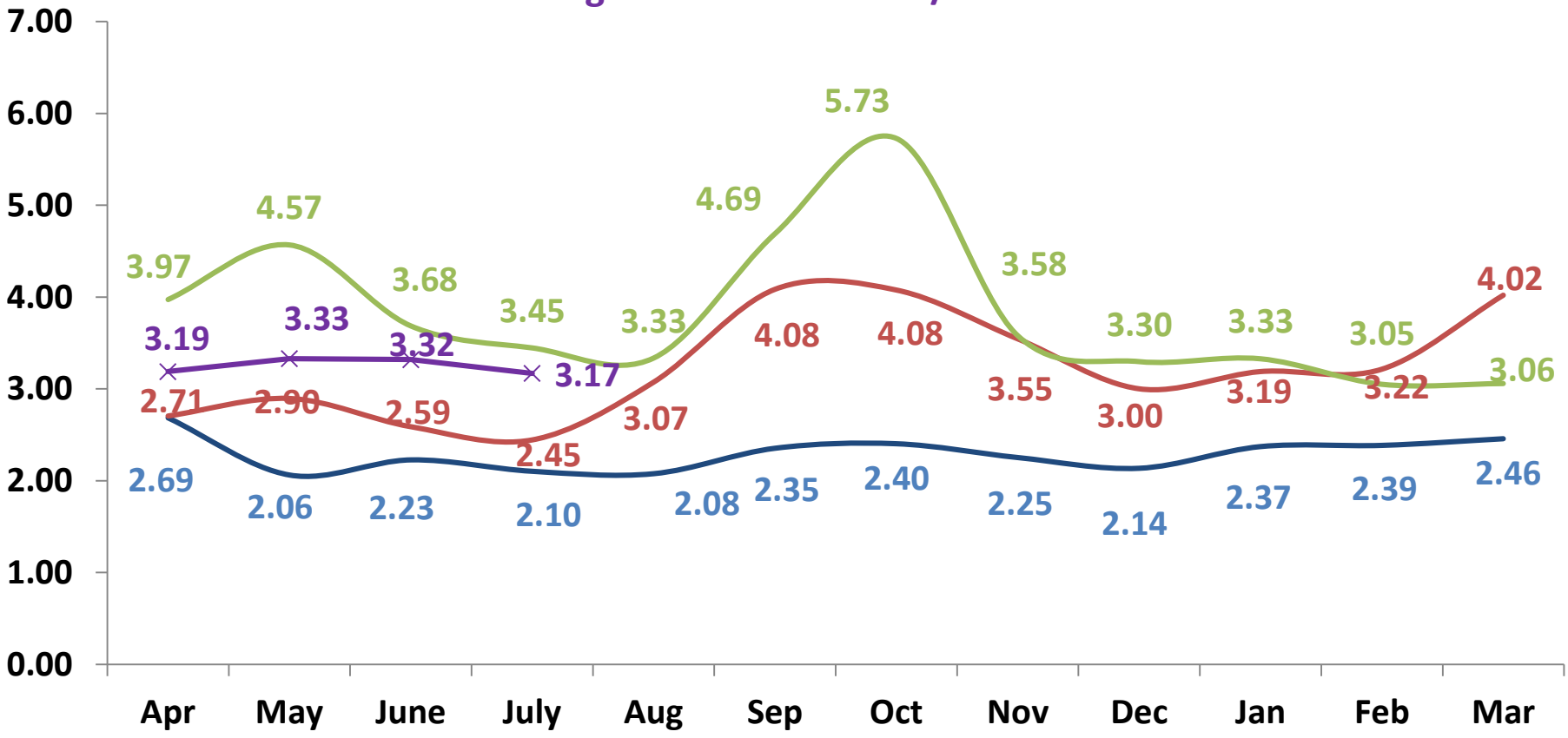
EXCHANGE SNAPSHOT

DAM Market Snapshot
06 June 2019



IEX Monthly Avg Price Trend

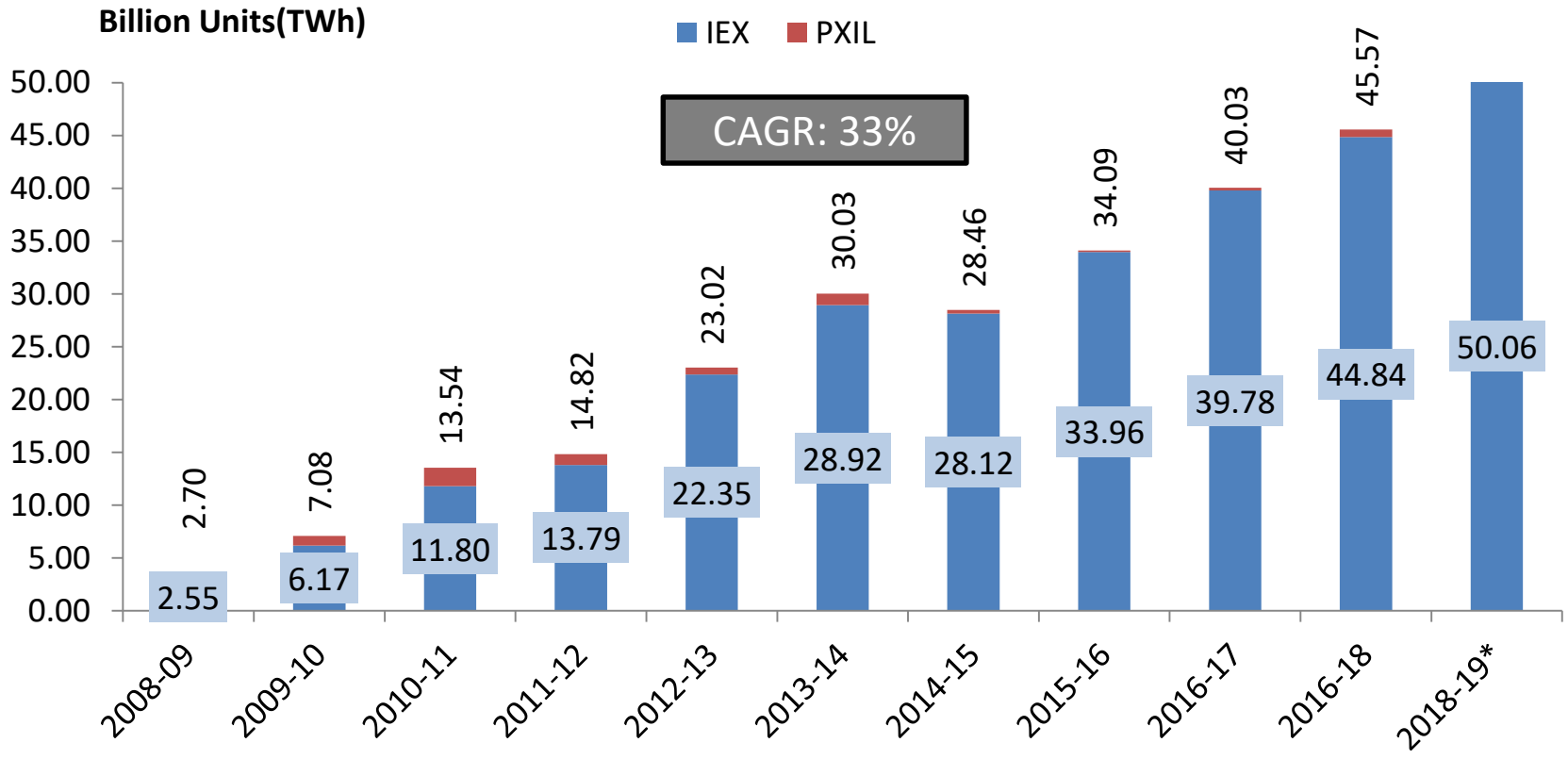
FY 16-17 Avg. RTC Price: Rs 2.29/kWh
FY 17-18 Avg. RTC Price: Rs 3.24/kWh
FY18-19 Avg. RTC Price: Rs 3.81/kWh
FY19-20 Avg. RTC Price: Rs 3.27/kWh



Data till 9th July

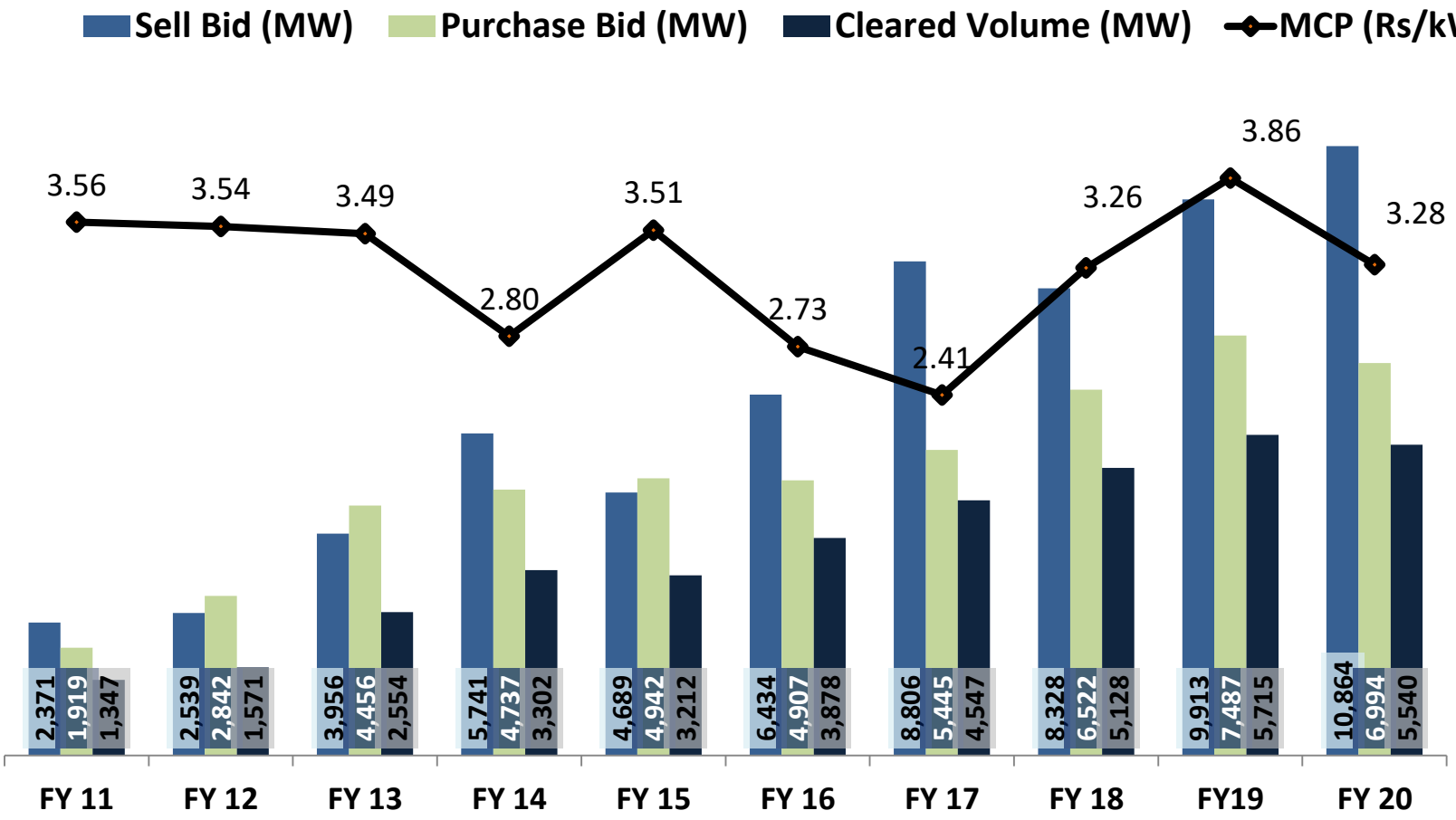
Evolution and growth of Exchanges

- **PXs approved & regulated by Central Electricity Regulatory Commission (CERC)**
- **Two exchanges in India: IEX and PXIL; commenced operations in 2008**



Source: CERC MMC Report (Day-Ahead Market)
**Till March 2019*

Day Ahead Market Volume Trend



Increase in generation capacity pushed the prices down except FY 19 when prices increased primarily due to coal shortage & coal price increase

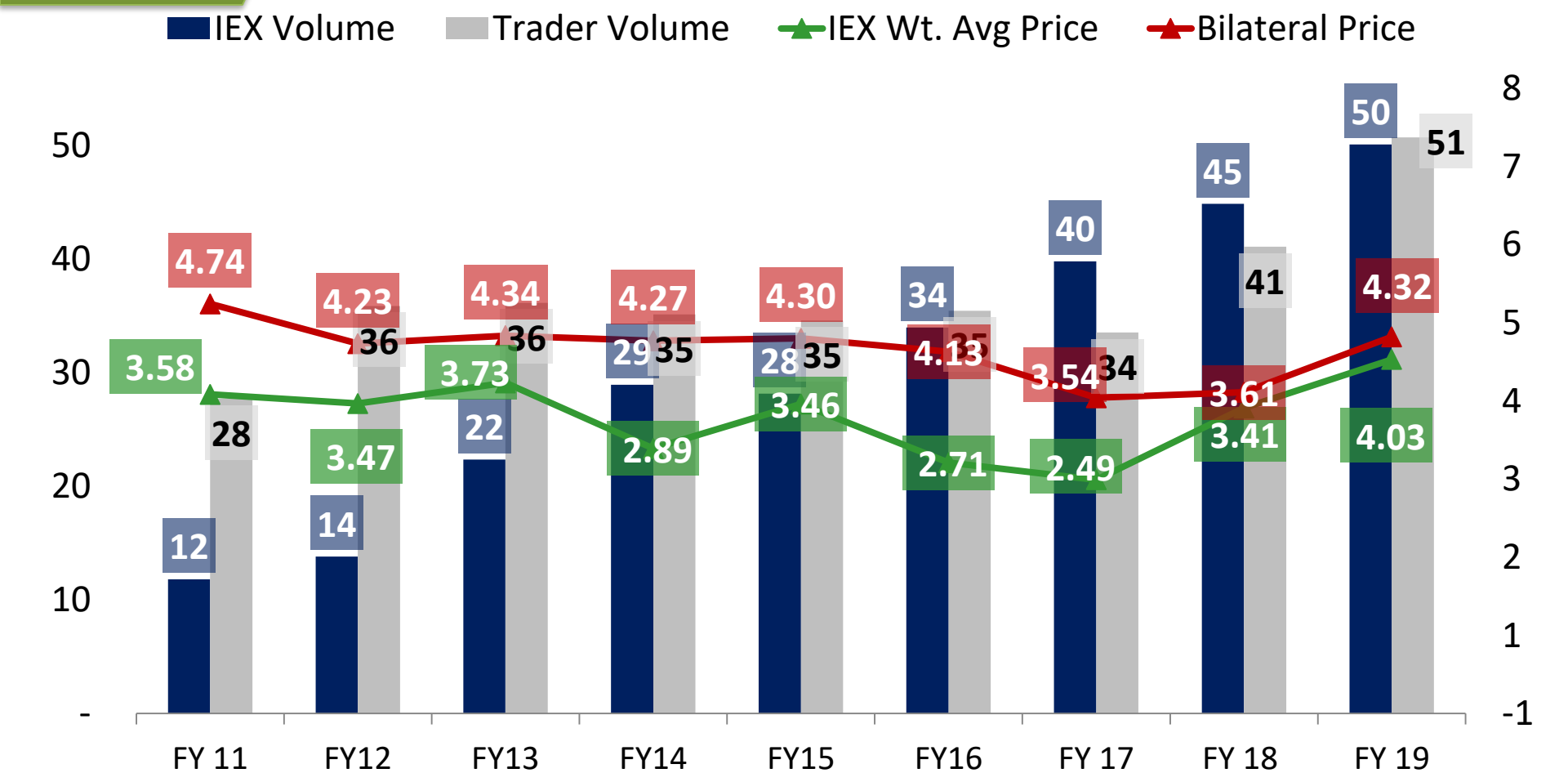
Data till 9th July

Comparison: Volume and Price (Bilateral vs IEX)

Efficient Price Discovery

Efficient Price Discovery has been the biggest growth driver for exchanges in the past

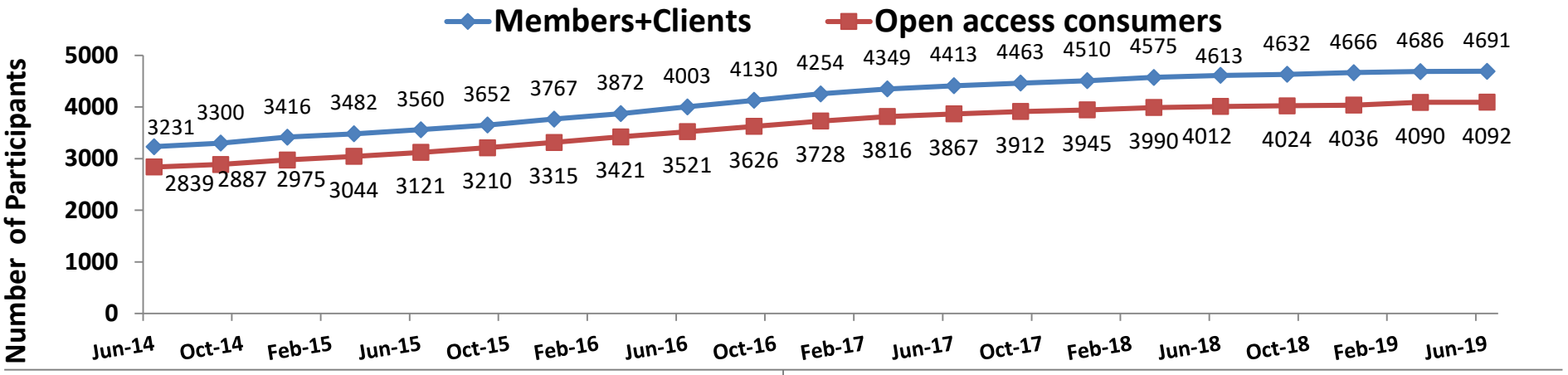
- Discoms can source cheaper power through Exchange to meet shortages
- Prices at Exchange always lower than Bilateral contracts



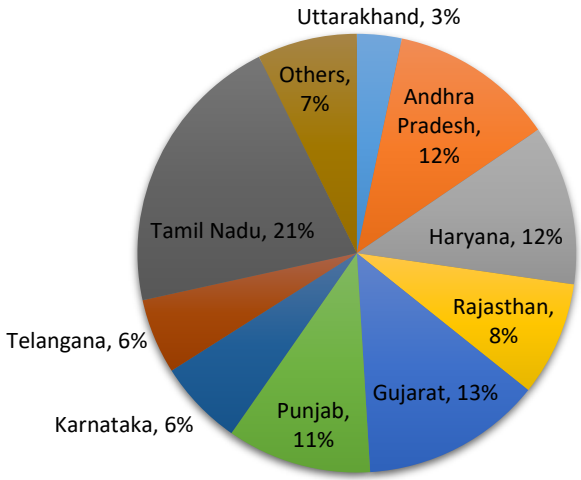
Source: *CERC MMC Reports*

Large participation

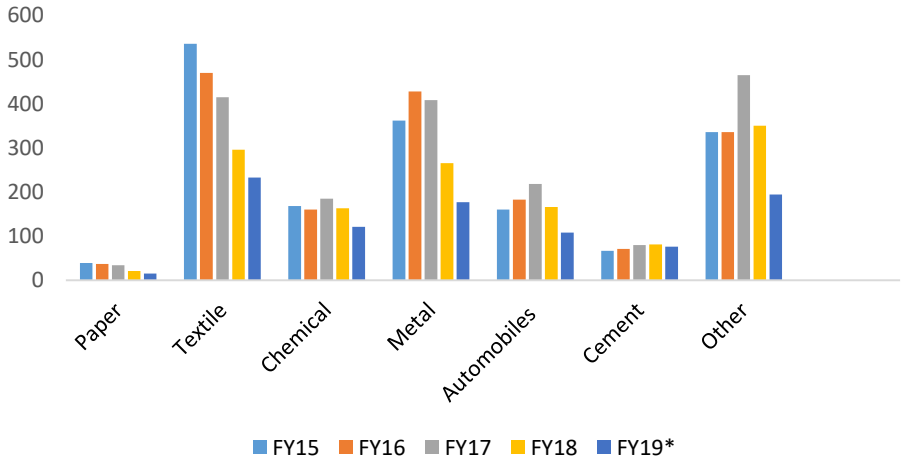
Registered participant base has been growing



Open Access Consumers _ States (As on 31st Dec18)



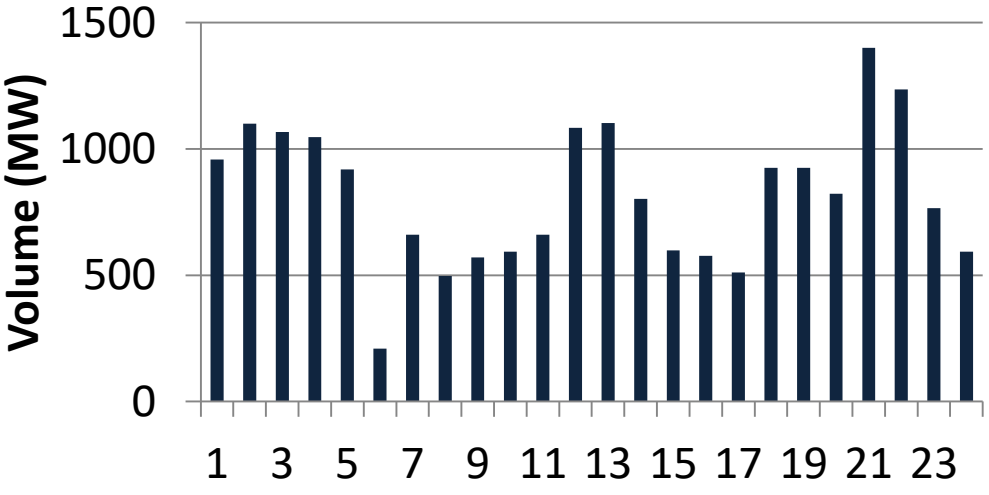
And Spread Across Industries (FY19 - As on 31st Dec,18)



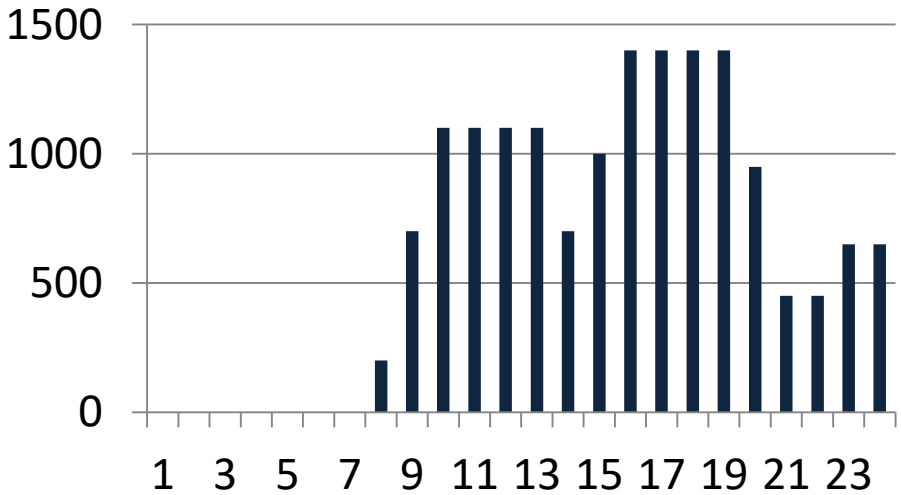
Participation has shown tremendous growth over the years

Average daily participation/day- 600

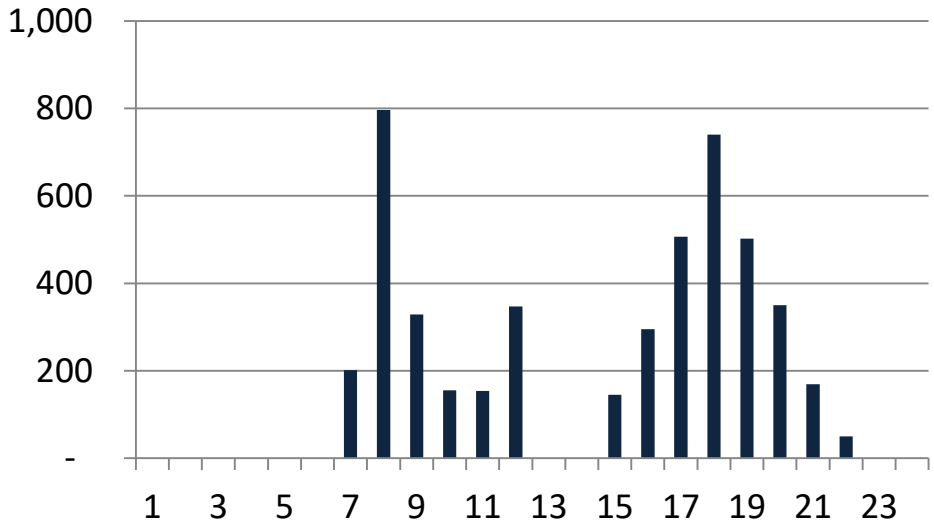
3. Flexibility to utilities to manage portfolio



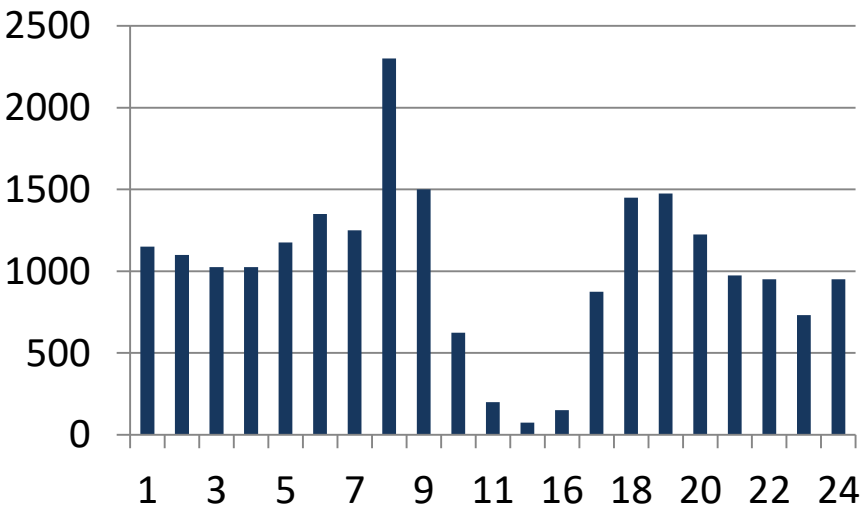
Buy Profile West Bengal-29th Jan '19



Buy Profile – Gujarat-15th Jan '19



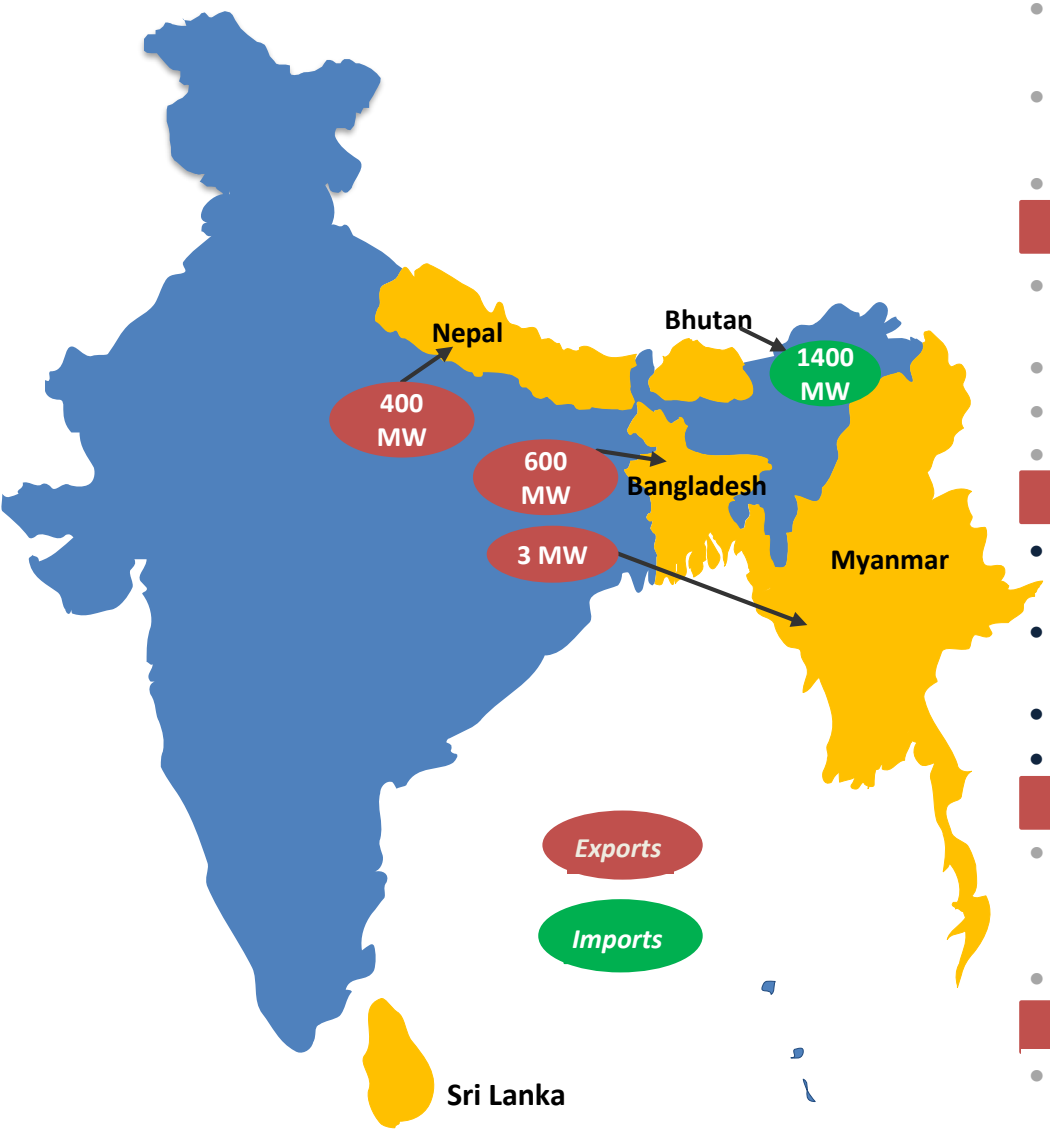
Haryana Sell Profile - 22nd Jan '19



Buy Profile – Telangana - 15th Jan '19

WAY FORWARD

Today: India trades ~2500 MW / ~13BUs with its neighboring countries in S Asia (Nepal, Bangladesh, Bhutan)



Bhutan

- Power surplus: Primarily hydro power; India purchases all surplus as per the **2006 Inter-Governmental Treaty**
- **Total imports of ~1500 MW or 5.6 BUs**; existing **1500 MW transmission capacity**
- **Seasonal generation**, concentrated in **May-Sept.** period

Bangladesh

- Power deficit: Peak demand of ~13 GW and capacity of ~12 GW however, effective capacity of ~9GW (lack of gas)
- **India exports 600 MW or 5.3 BUs**, to meet B'desh's deficit
- **600 MW** transmission capacity**; expected to double** in 5 years
- **Power deficit situation to continue for next 10 years**

Nepal

- Power Deficit: Instances of blackouts during dry seasons; expected to be surplus during monsoon in 5 years
- India financed hydro projects currently stuck owing to land-acquisition challenges
- **India exports 400MW** or 1.8 BUs
- Transmission capacity to be **expanded to 1000 MW** (400 MW now)

Myanmar

- Power surplus: Internal demand is low due to **poor grid connectivity within Myanmar** – only 35% households connected to their main grid
- **India exports 3 MW** or 0.03 BUs; no inter-regional transmission

Sri Lanka

- Power sufficient, though costs are high due to expensive oil imports
- **No power trade currently** given **lack of transmission capacity**;
- 500 MW transmission capacity to come up by ~2030

Enabling Steps for Cross Border Trade through Exchange

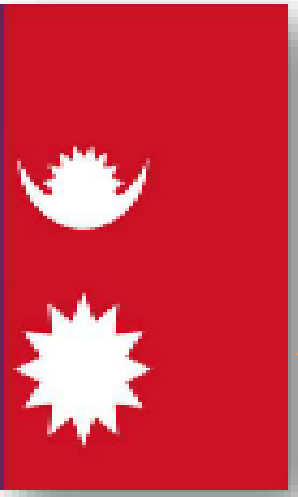
Guidelines issued by Ministry of Power ✓

CERC to notify Regulations for Cross Border Trade ✓

CEA notified draft CBR (Conduct of Business Rules) ✓

IEX to file for changes in contract specs in line with CERC regulations and CEA rules — In process

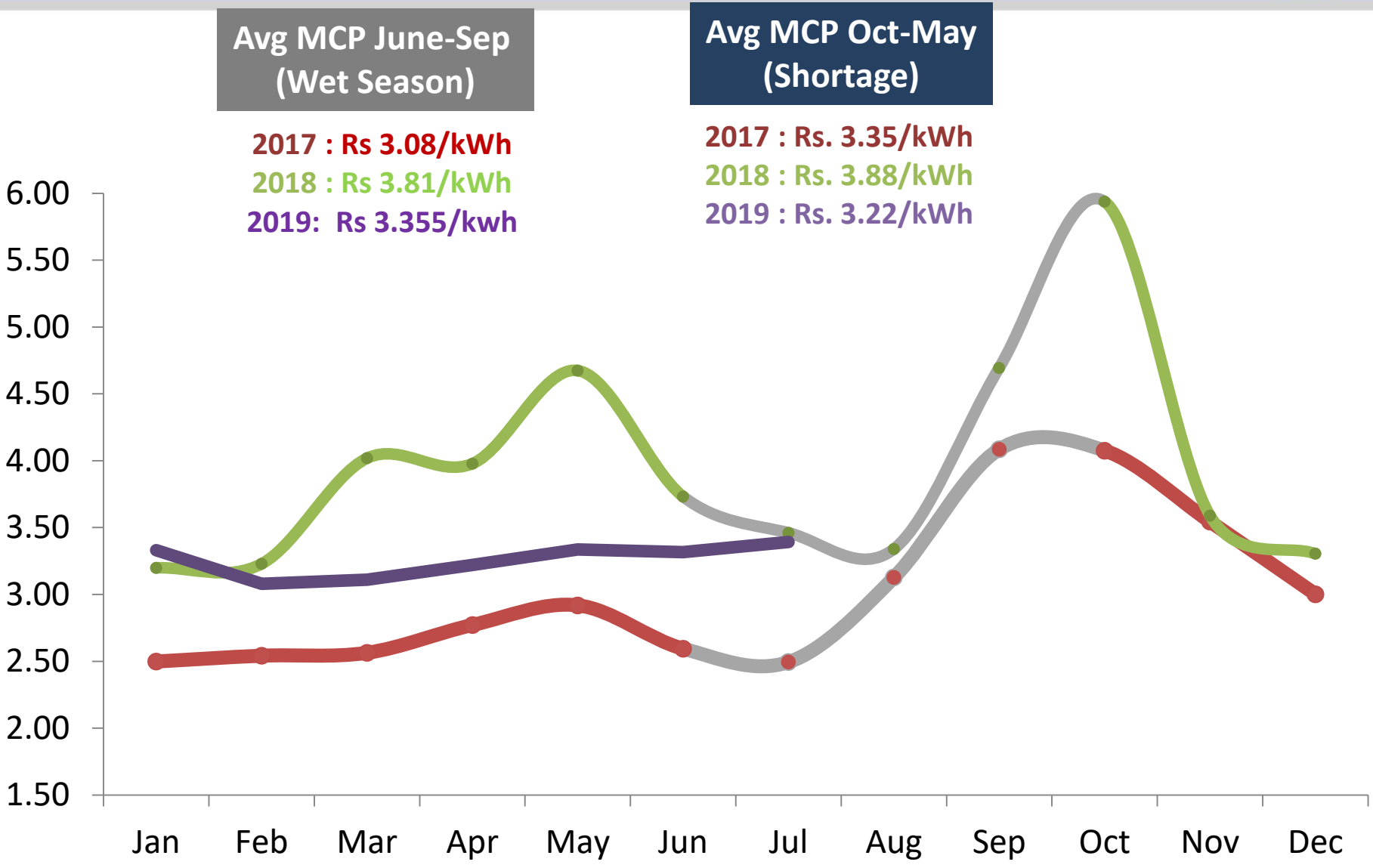
India-Nepal Transactions Potential



- Exports during wet season
- Significant hydro power export possible

- Thermal power support for load following
- Dry season support

IEX Monthly Average Market Clearing Price (Rs./kWh)



Nepal Portfolio Management through Exchange

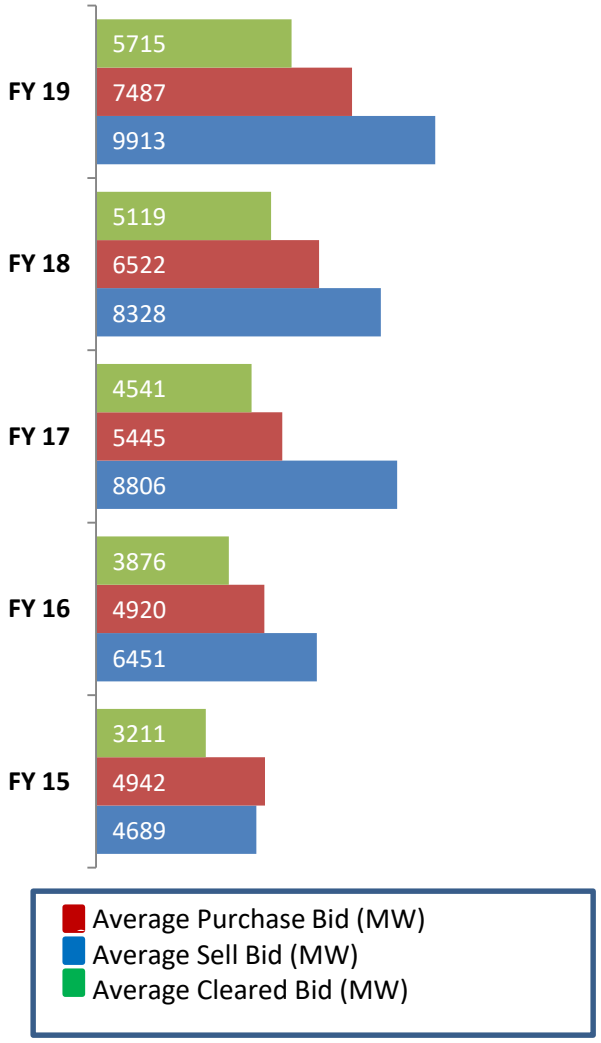
Meeting Shortages

- **Buy Residual Requirement** : when transmission margins are available and demand exits
- **Economise when possible:** Can buy when it's cheaper on IEX and replace costlier power through Bilateral trade to the extent of Contract conditions (~20% in case of 80% take-or-pay contracts)
- **Leverage Value of Stored Water:** Can leverage Storage , similar to Hydro rich state like HP etc., save water for generation in peak hours/ seasons etc.
- **Cheaper Power :** Exchange Prices are lowest during Nepal's peak season (Oct-Feb)

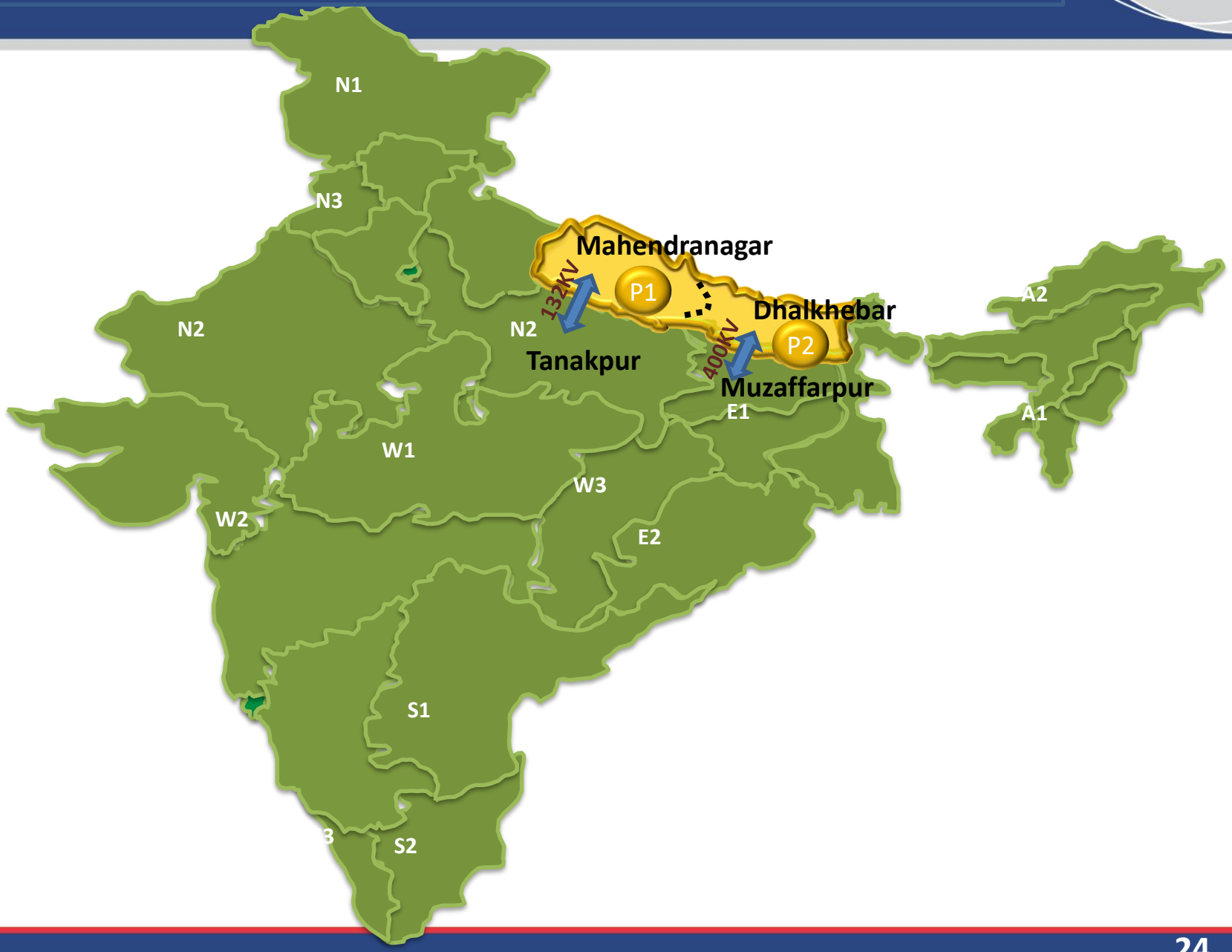
Selling Surplus

- Nepal Going forward will be surplus is wet season
- IEX will offer a very liquid platform to sell the surplus at competitive prices
- Nepal should implement concept of "Value of water" and try to commercially mange manage reservoirs

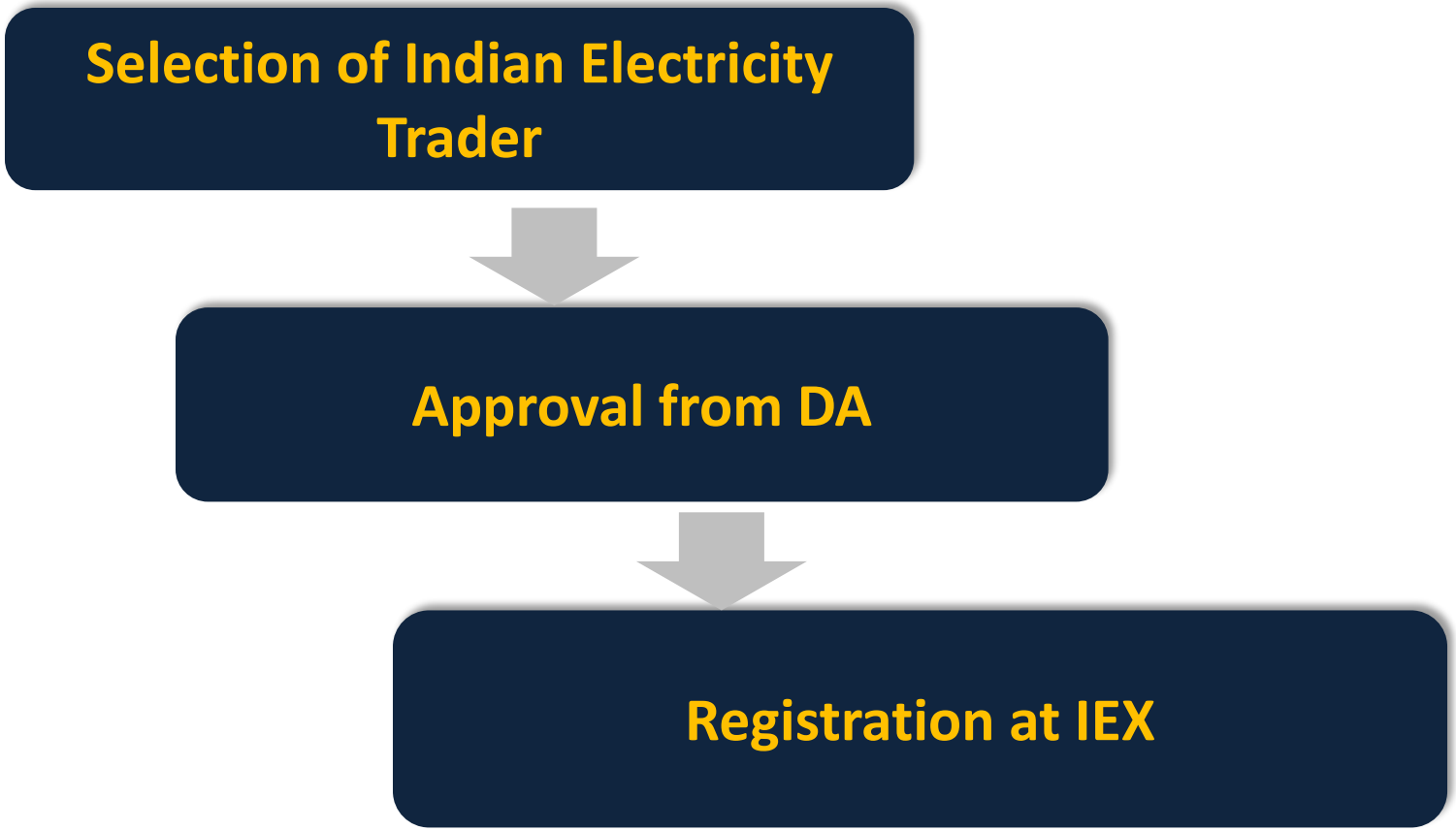
High Liquidity



New Bid Areas & Existing interconnection



Registration Procedure



Thank You

www.iexindia.com

Follow us *@IEXLtd*

Use IEX Mobile Application to track prices

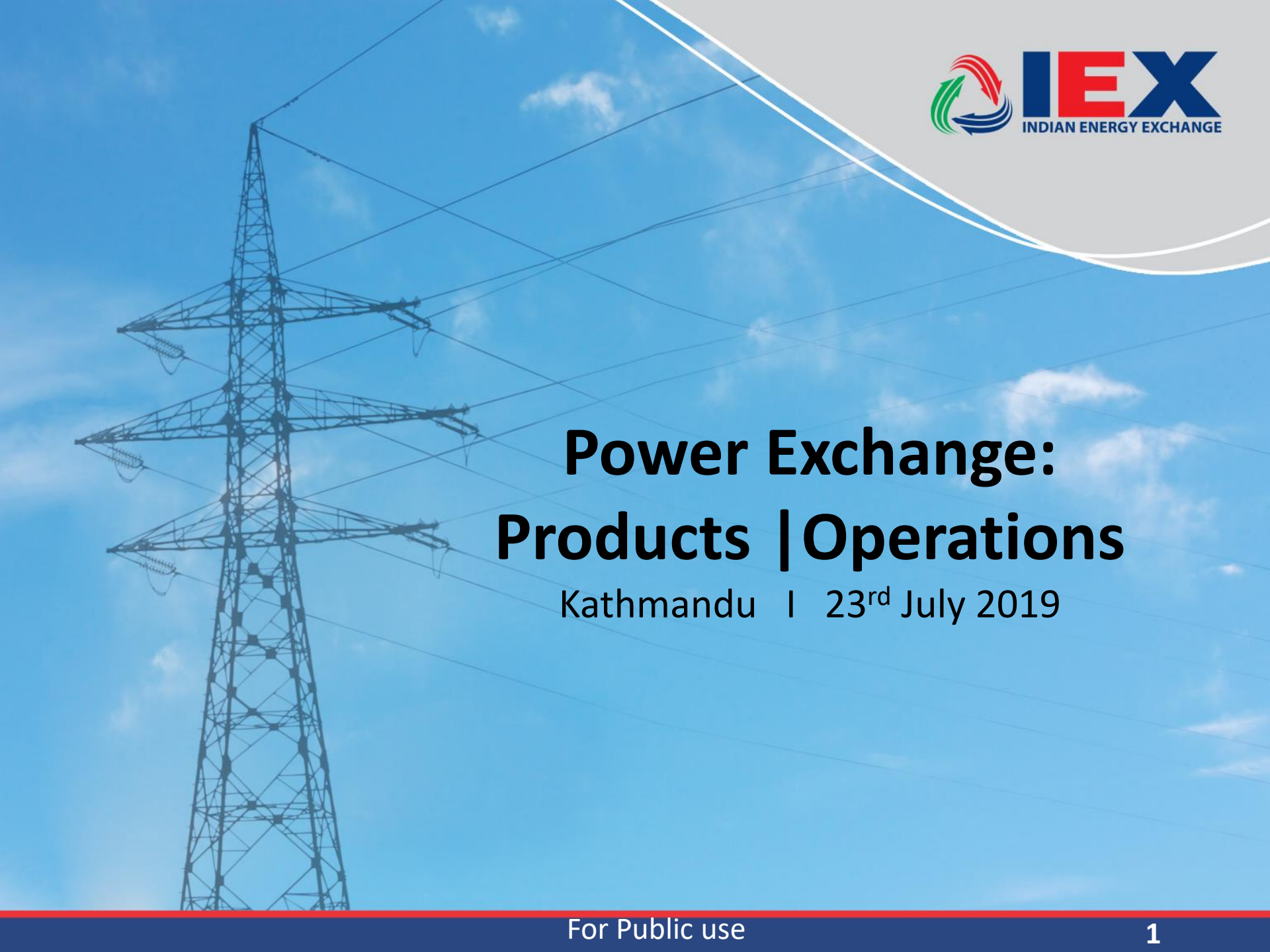
Register for Daily SMS alerts

Register for IEX Monthly Bulletin

Load Forecast: Nepal

Fiscal Years	Energy (MU)	Peak Load (MW)
2017-18	7,489	1,644
2018-19	8,391	1,842
2019-20	10,138	2,225
2020-21	12,017	2,638
2021-22	13,952	3,062
2022-23	15,332	3,365
2023-24	16,869	3,703
2024-25	18,579	4,078
2025-26	20,585	4,519
2026-27	22,826	5,011
2027-28	25,332	5,561
2028-29	28,111	6,171
2029-30	31,196	6,848

Source :NEA Annual Report 2017-18



Power Exchange: Products |Operations

Kathmandu I 23rd July 2019

In this presentation

- Exchange Products & Operations
- Exchange Snapshot
- Cross Border Electricity Trade –

  International Scenario & SAARC Status
- Way Forward

EXCHANGE PRODUCTS & OPERATIONS

Key Functions

Trading

- ✓ Bid accumulation
- ✓ Calculation of Provisional result
- ✓ Publishing provisional results
- ✓ Calculation of Final result (with technical constraints)
- ✓ Publishing final results
- ✓ Publishing Daily Obligation reports

Surveillance

- ✓ Round the clock
- ✓ Checking of Collateral
- ✓ Checking of Permissible Quantity as per NoC & Margins
- ✓ Deviation from Bidding Pattern
- ✓ Daily MIS reporting
- ✓ Real time support to members

Clearing

- ✓ Pre-Trade Margin Check
- ✓ Post Trade Margin Call
- ✓ Daily Obligation settlement
  - ✓ Pay In
  - ✓ Pay Outs
- ✓ Risk Management
- ✓ Bank Reconciliation of Settlements Accounts
- ✓ Daily NLDC/SLDC charges Payment

Delivery

- ✓ Update NoC
- ✓ Calculation of transmission capacity requirement between various points based on market clearing volume
- ✓ Interaction with NLDC for transmission capacity availability
- ✓ Market splitting in case of transmission congestion
- ✓ Delivery schedule for every portfolio
- ✓ Scheduling with SLDCs
- ✓ Member communication for schedule and trade related reports
- ✓ Monthly and weekly reporting to various organizations such as CERC & S/O
- ✓ Monthly REA data verification
- ✓ Real Time Congestion Management

- ✓ Over 3 Lakh contracts traded
- ✓ All activities performed for 1200-1500 portfolio daily
- ✓ Precision and adherence to timelines

IEX Market Segments

Day-Ahead Market since June,08	• *Delivery for next day* • *Price discovery: Closed , Double-sided Auction*
Intraday Market & Day-Ahead Contingency Round the clock since Jul'15	• *Intraday: For Delivery within the same day* • *Day Ahead Contingency: Another window for next day* • *Gate closure : 2.5 hours*
Term-Ahead Contracts since Sep'09	• *For delivery up to 11 days* • *Daily Contracts, Weekly Contracts*
Renewable Energy Certificates since Feb'11	• ***Green Attributes as Certificates*** • ***Sellers :*** *RE generators not under feed in tariffs* • ***Buyers:*** *Obligated entities; 1MWh equivalent to 1 REC*
Energy Saving Certificates since 27th Sept'17	• ***1 ESCert = 1 mtoe*** *(metric Tonne of Oil Equivalent)*

Auction **Continuous**

DAY AHEAD MARKET

Features of Day Ahead Market

A closed double-sided anonymous auction for **each 15-min time block** for the following day

The intersection between the aggregated sale and purchase curves defines the market clearing price (MCP)

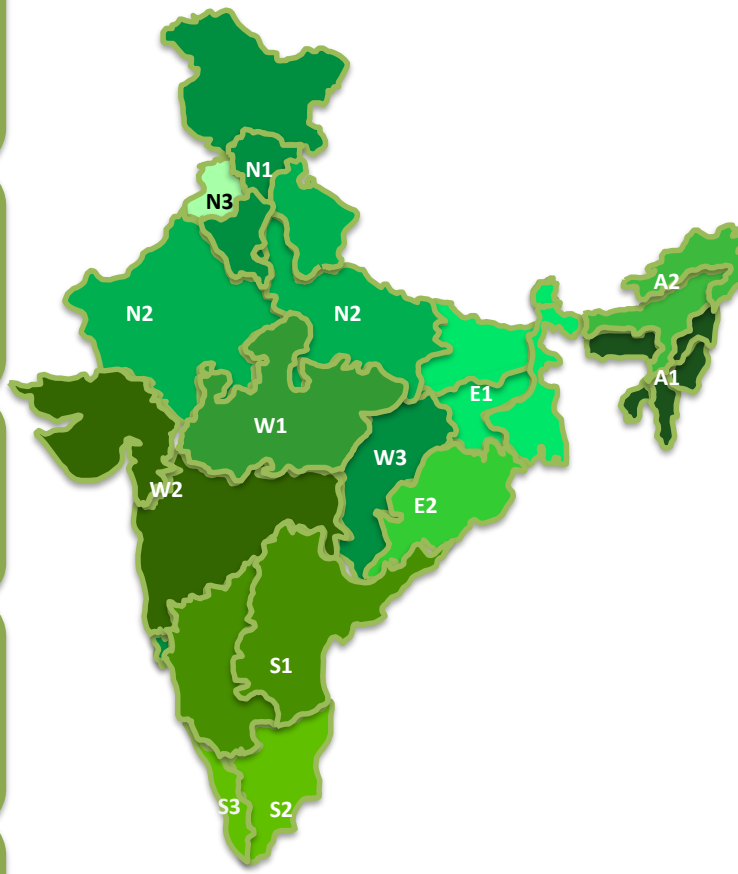
13 Bid Area defined

Congestion Management through market splitting and determining Area Clearing Price (ACP) specific to an area

Bid types: Portfolio Orders or Block Orders

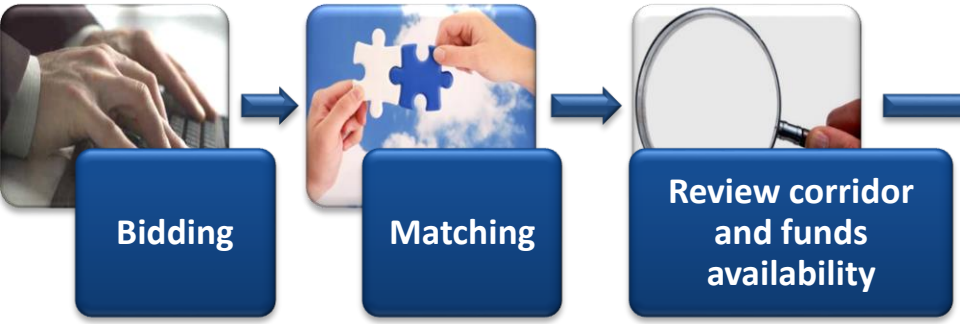
Minimum Bid=Re.1 for 0.1MWh

Minimum Price & Volume Step = 0.1 * 0.1 MWh



13 Bid Areas

DAM Trading Process



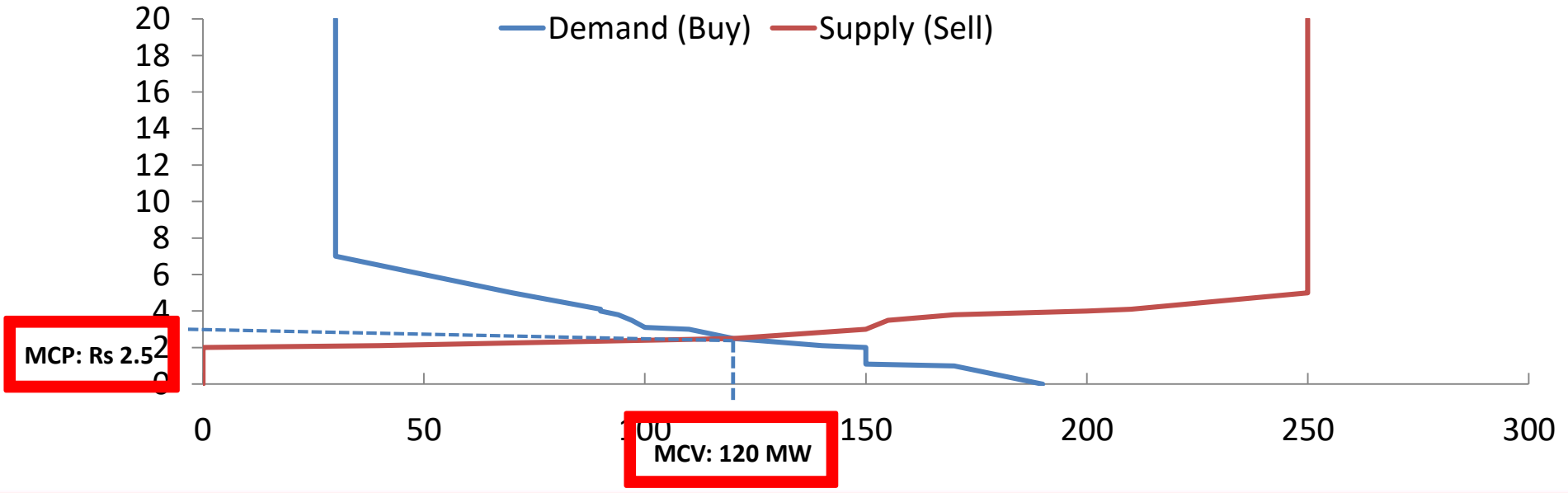
Bidding	Matching	Review corridor and funds availability	Result	Confirmation	Scheduling
10:00 am to 12:00 pm	12:00 pm to 1:00 pm	1:00 pm to 2:00 pm	3:00 pm	5:30 pm	6:00 pm
Bids for 15- min each or block bids can be placed	MCP &MCV calculated	Corridor availability from NLDC and funds verified from bank	Final ACV and ACP calculated. Market splitting if congestion	Collective transaction confirmation by NLDC and Pay In	Final Schedule sent to RLDC for incorporation

*Timeline is based on IST

Matching: Model Price Calculation Algorithm

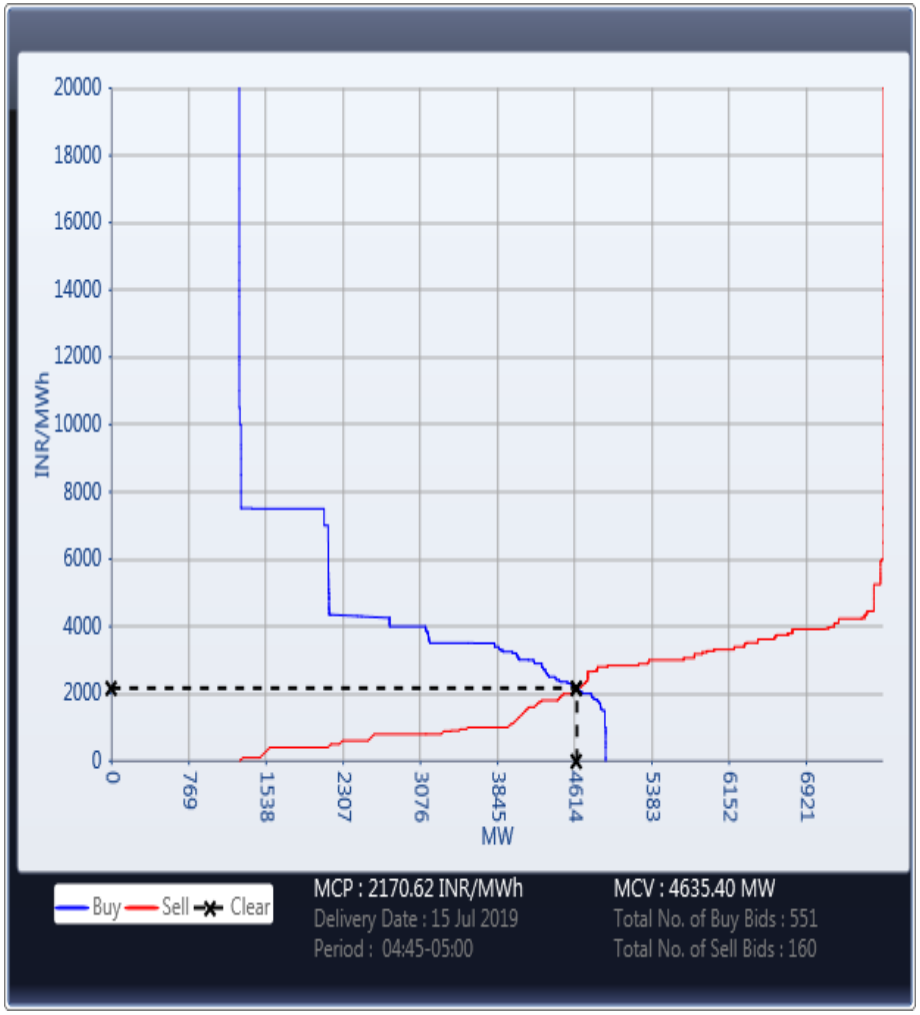
(Example for a sample 15-min- single bids)

Price Tick	0	1	1.1	2	2.1	2.5	3	3.1	3.5	3.8	4	4.1	5	7	9	12	14	17	19	20
Portfolio A	20	20	20	20	20	20	20	10	7	4	0	0	0	0	0	0	0	0	0	0
Portfolio B	60	60	60	60	50	40	40	40	40	40	40	40	20	20	20	20	20	20	20	20
Portfolio C	70	70	70	70	70	60	50	50	50	50	50	50	50	10	10	10	10	10	10	10
Portfolio D	40	20	0	0	-40	-60	-80	-81	-85	-100	-120	-120	-120	-120	-120	-120	-120	-120	-120	-120
Portfolio E	0	0	0	0	0	-40	-50	-50	-50	-50	-60	-60	-90	-90	-90	-90	-90	-90	-90	-90
Portfolio F	0	0	0	0	0	-20	-20	-20	-20	-20	-20	-30	-40	-40	-40	-40	-40	-40	-40	-40
Total Buy, MW	190	170	150	150	140	120	110	100	97	94	90	90	70	30	30	30	30	30	30	30
Total Sell, MW	0	0	0	0	-40	-120	150	-151	-155	-170	-200	-210	-250	-250	-250	-250	-250	-250	-250	-250
Net Transaction, MW	190	170	150	150	100	0	-40	-51	-58	-76	-110	-120	-180	-220	-220	-220	-220	-220	-220	-220

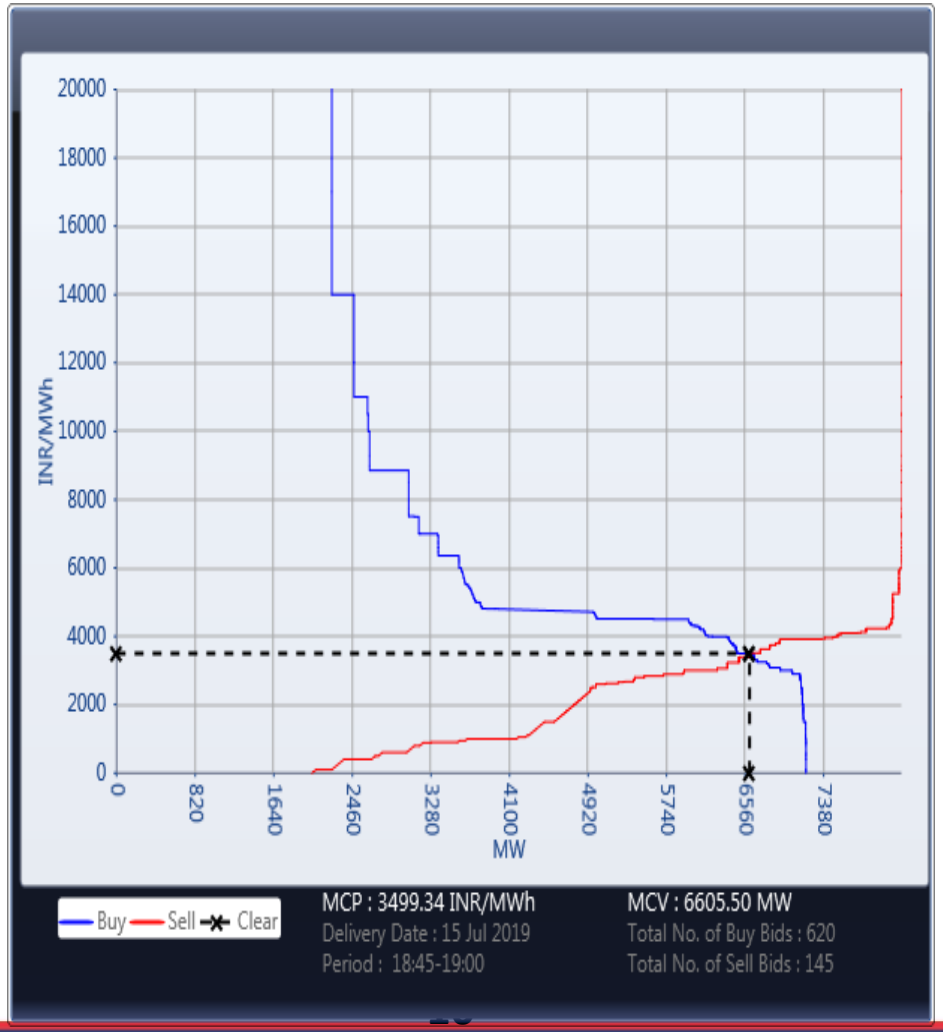


Aggregate D-S curve: 15th July 2019

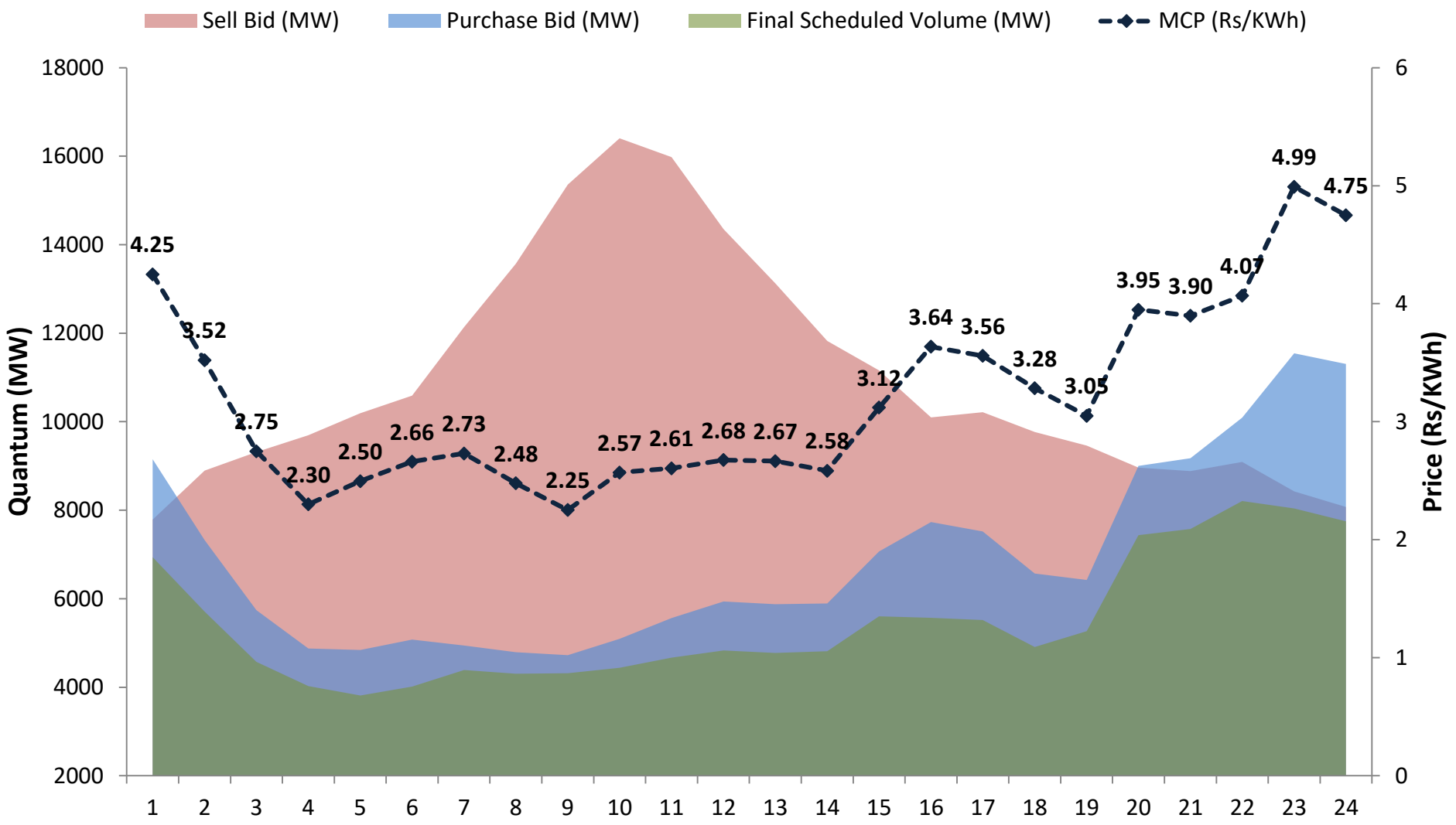
Off-Peak- 4:45Hrs-5:00Hrs



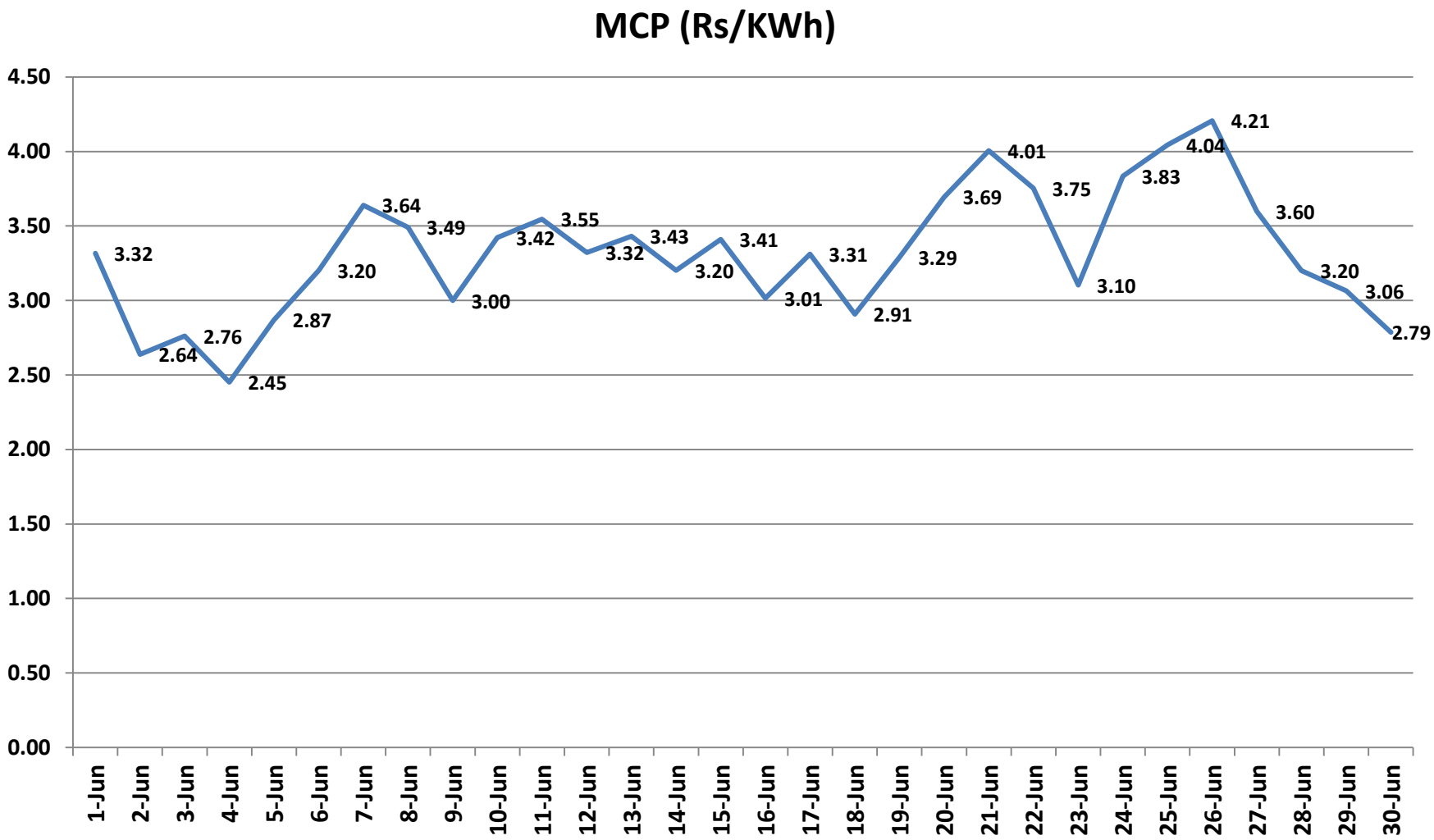
Peak- 18:45Hrs-19:00Hrs



DAM Market Snapshot
06 June 2019

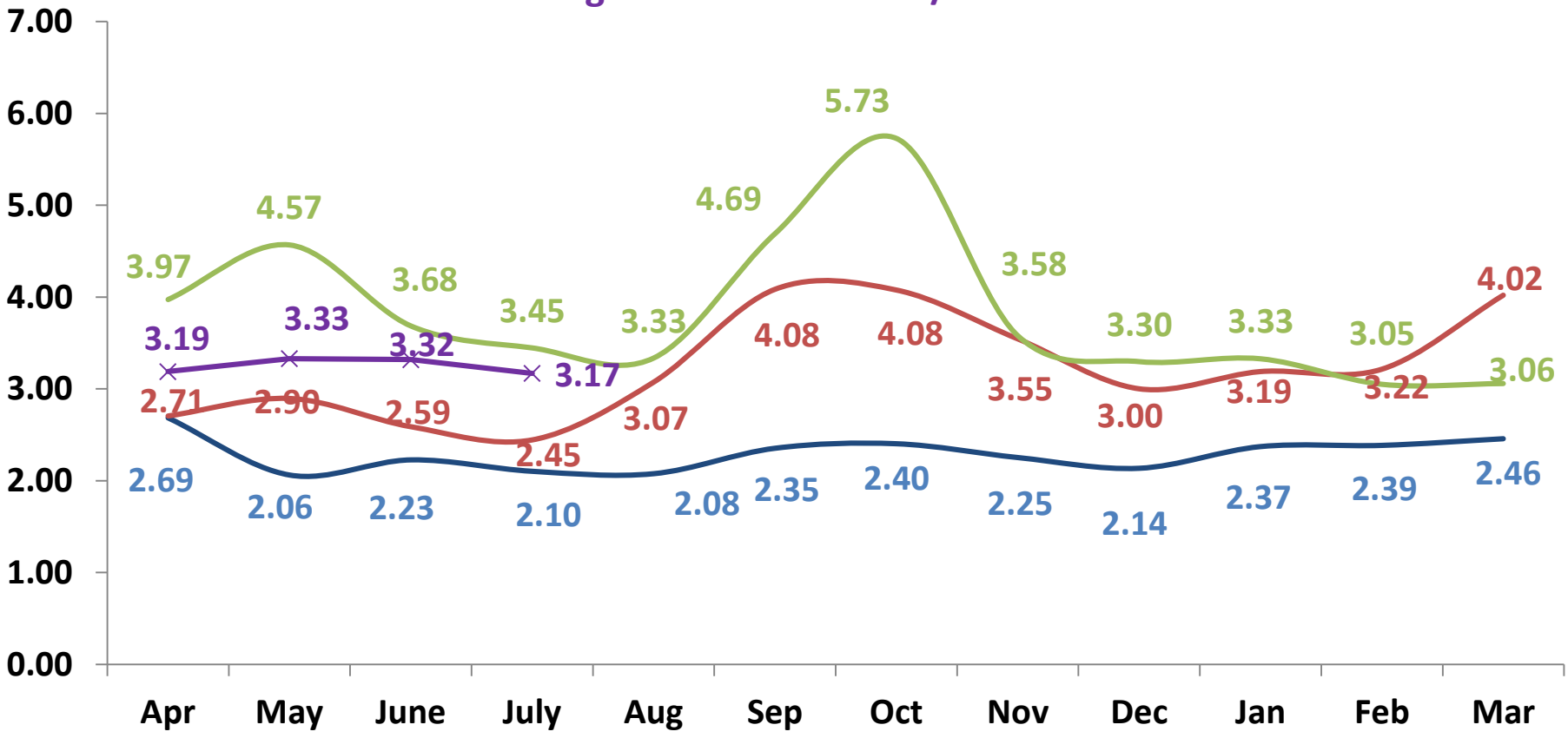


IEX Daily Price Trend for June



IEX Monthly Avg Price Trend

FY 16-17 Avg. RTC Price: Rs 2.29/kWh
FY 17-18 Avg. RTC Price: Rs 3.24/kWh
FY18-19 Avg. RTC Price: Rs 3.81/kWh
FY19-20 Avg. RTC Price: Rs 3.27/kWh



Offering trading option with high flexibility

Duration Flexibility

- Bidding for 15 min time block basis
- Bidding options:
  - Single time block I Round The clock I Custom Time block : Uniform & Non Uniform

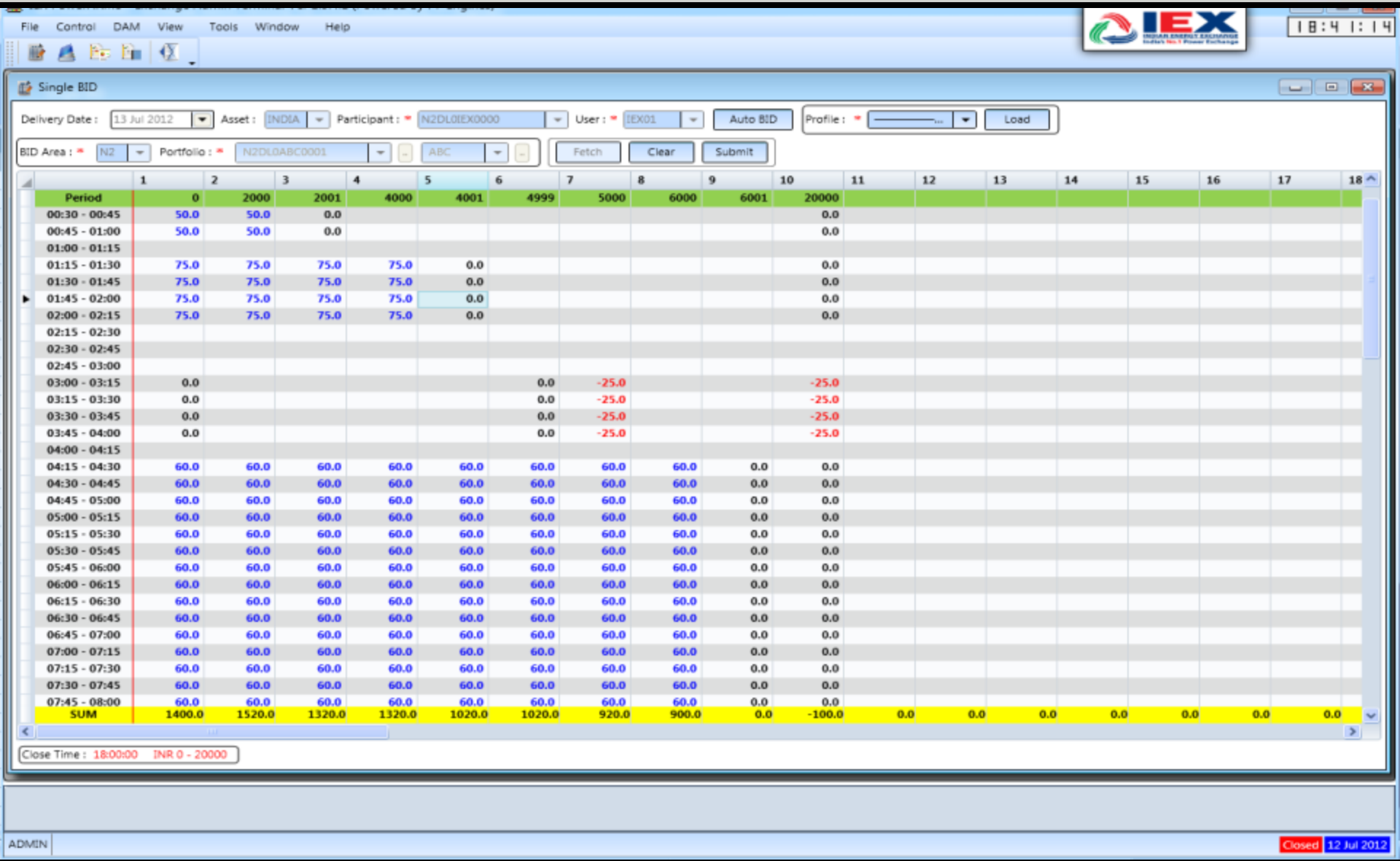
Volume Flexibility

- Bidding possible for any volume > 0.1 MW
- Bidding Options:
  - **Single Bid**
    - Participant can enter multiple Price-Quantity pair for any/all time blocks.
    - Partial selection possible
  - **Block Bid**
    - To avoid partial and non uniform clearing , participants can enter Block Bid
    - Any set of time blocks with uniform volume to be selected on “All or None” principle
    - Different Block bid can be linked as “Mother-Child”. (Child bid is selected only if Mother bid selected)
- Pump storage power plant can be operate on this model by creating separate block bid for Pumping & Generation.
- Few other hybrid bid options are under development like flexible Block Bid

Single Bid Concept

Time Block	Bid Volume (MW)	Buy Bid Price	Clearing Price	Result
1	100	Rs 4	Rs 1	
2	100	Rs 4	Rs 5	
3	100	Rs 4	Rs 3	
4	100	Rs 4	Rs 5	
Average		Rs 4	Rs 3.5	

DAM-Single Bid

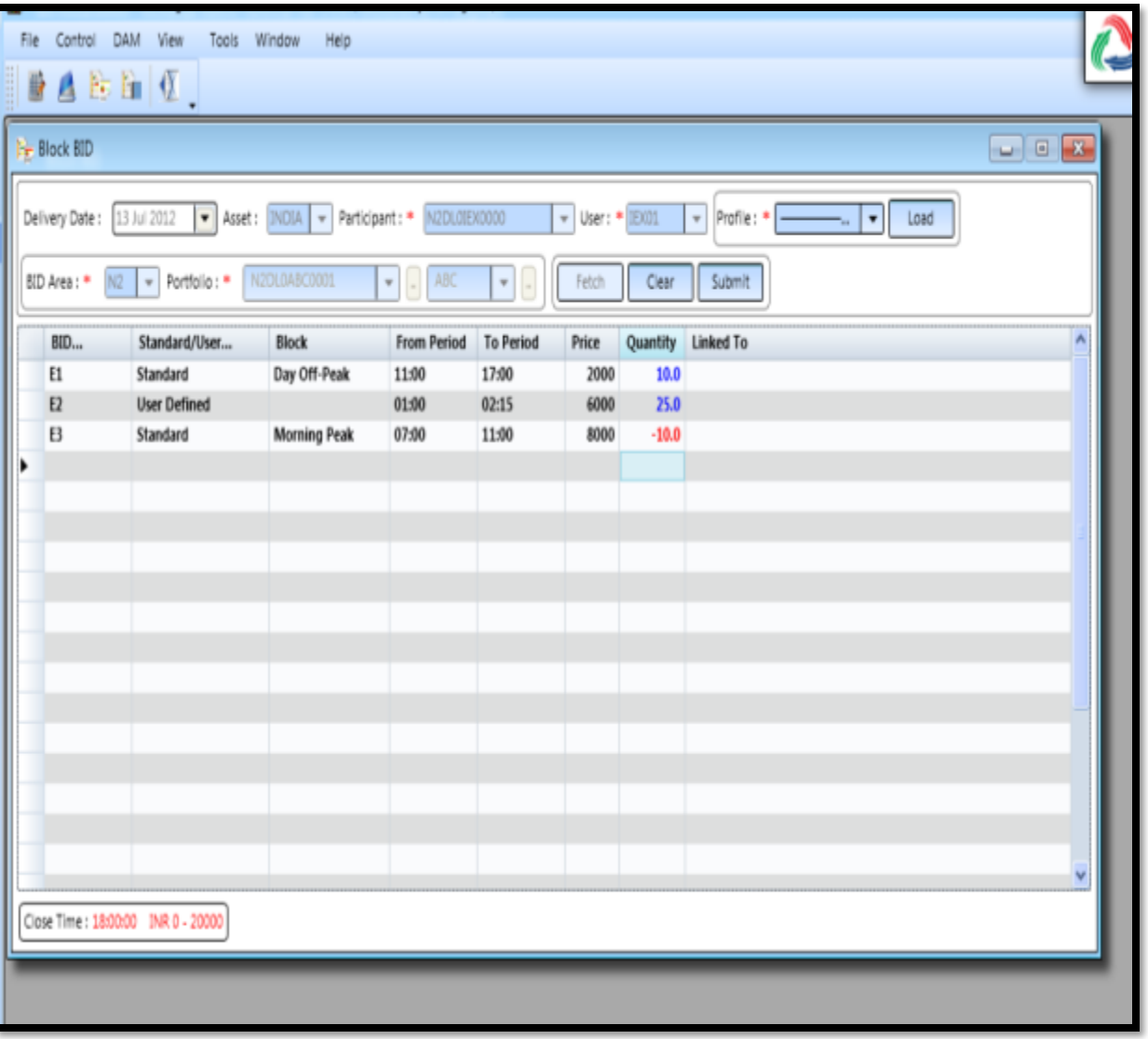


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Period	0	2000	2001	4000	4001	4999	5000	6000	6001	20000								
00:30 - 00:45	50.0	50.0	0.0							0.0								
00:45 - 01:00	50.0	50.0	0.0							0.0								
01:00 - 01:15																		
01:15 - 01:30	75.0	75.0	75.0	75.0	0.0					0.0								
01:30 - 01:45	75.0	75.0	75.0	75.0	0.0					0.0								
01:45 - 02:00	75.0	75.0	75.0	75.0	0.0					0.0								
02:00 - 02:15	75.0	75.0	75.0	75.0	0.0					0.0								
02:15 - 02:30																		
02:30 - 02:45																		
02:45 - 03:00																		
03:00 - 03:15	0.0					0.0	-25.0			-25.0								
03:15 - 03:30	0.0					0.0	-25.0			-25.0								
03:30 - 03:45	0.0					0.0	-25.0			-25.0								
03:45 - 04:00	0.0					0.0	-25.0			-25.0								
04:00 - 04:15																		
04:15 - 04:30	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
04:30 - 04:45	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
04:45 - 05:00	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
05:00 - 05:15	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
05:15 - 05:30	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
05:30 - 05:45	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
05:45 - 06:00	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
06:00 - 06:15	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
06:15 - 06:30	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
06:30 - 06:45	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
06:45 - 07:00	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
07:00 - 07:15	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
07:15 - 07:30	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
07:30 - 07:45	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
07:45 - 08:00	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0								
SUM	1400.0	1520.0	1320.0	1320.0	1020.0	1020.0	920.0	900.0	0.0	-100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Block Bid Concept

Time Block	Bid Volume (MW)	Buy Bid Price	Clearing Price	Result
1	100	Rs 4	Rs 1	
2			Rs 5	
3			Rs 3	
4			Rs 5	
Average		Rs 4	Rs 3.5	

DAM-Block Bid



Rules for bid linking :

•A bid (bid B) can only be linked to one other bid (bid A)

•Both bid A and bid B must be of same type, i.e. sale-sale or purchase-purchase.

•Bid A and bid B can span any set of hours independently of each other

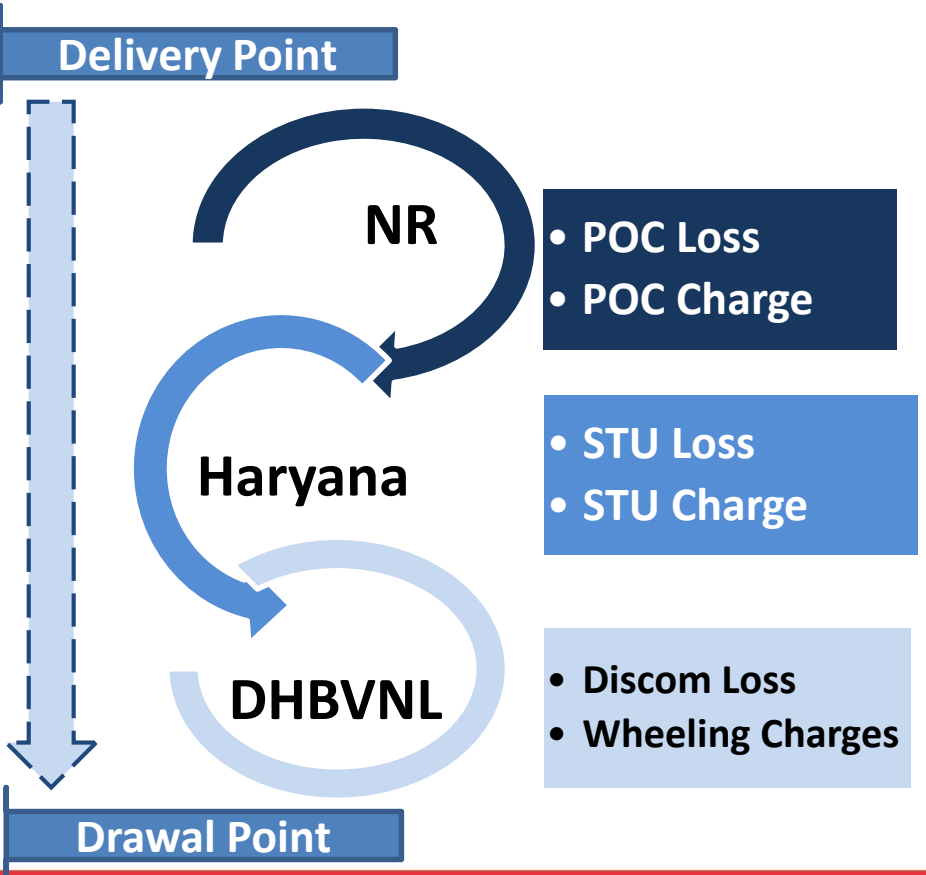
•Bid A and bid B can have any bid price independently of each other.

How to Use it ??

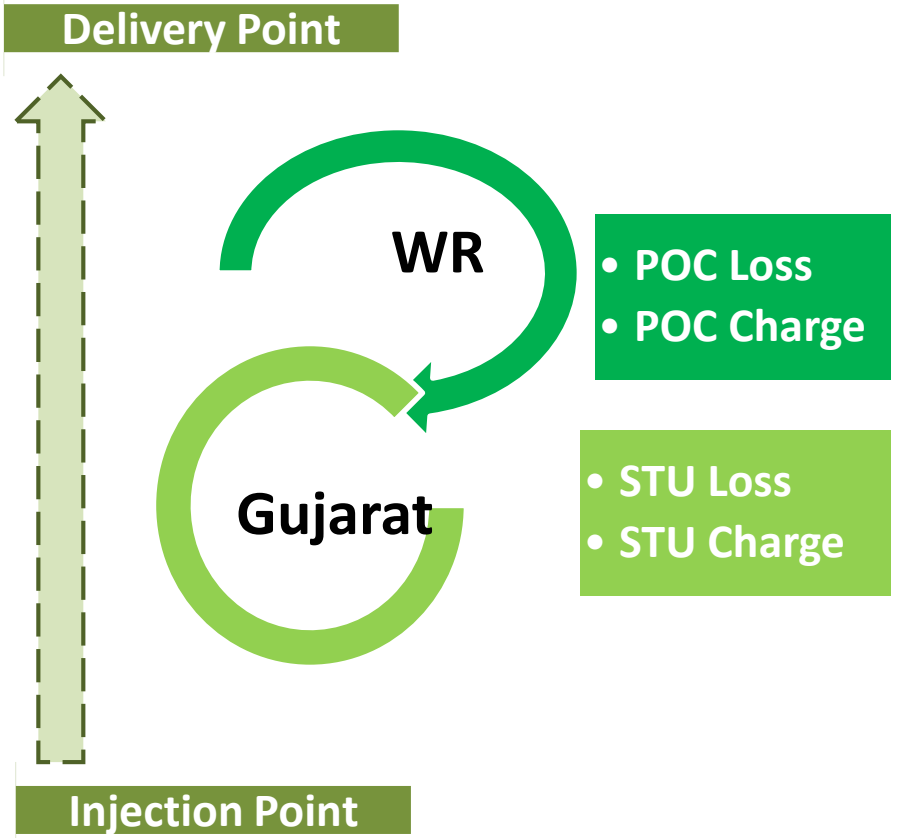
Charges payable

- Delivery point for Buyers & Sellers is their respective **Regional Periphery**
- **Buyer**: All losses and charges from delivery point till Drawal Point
- **Seller**: All losses and charges from Injection point till Delivery Point

Buyer Connected to Haryana Discom network



Seller Connected to Gujarat State network

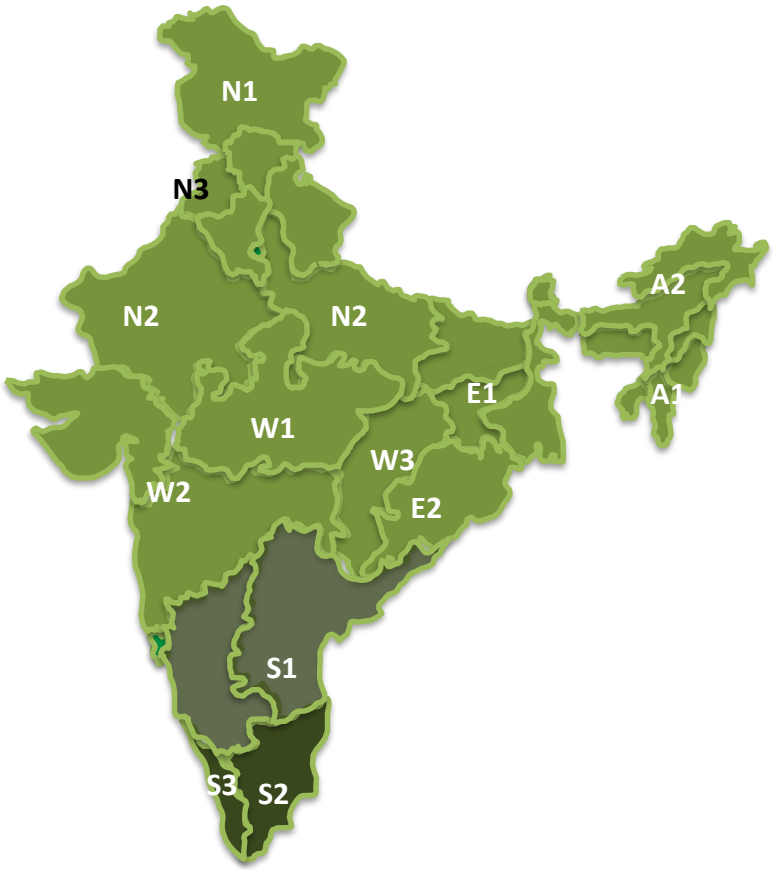


Concept of Market Splitting

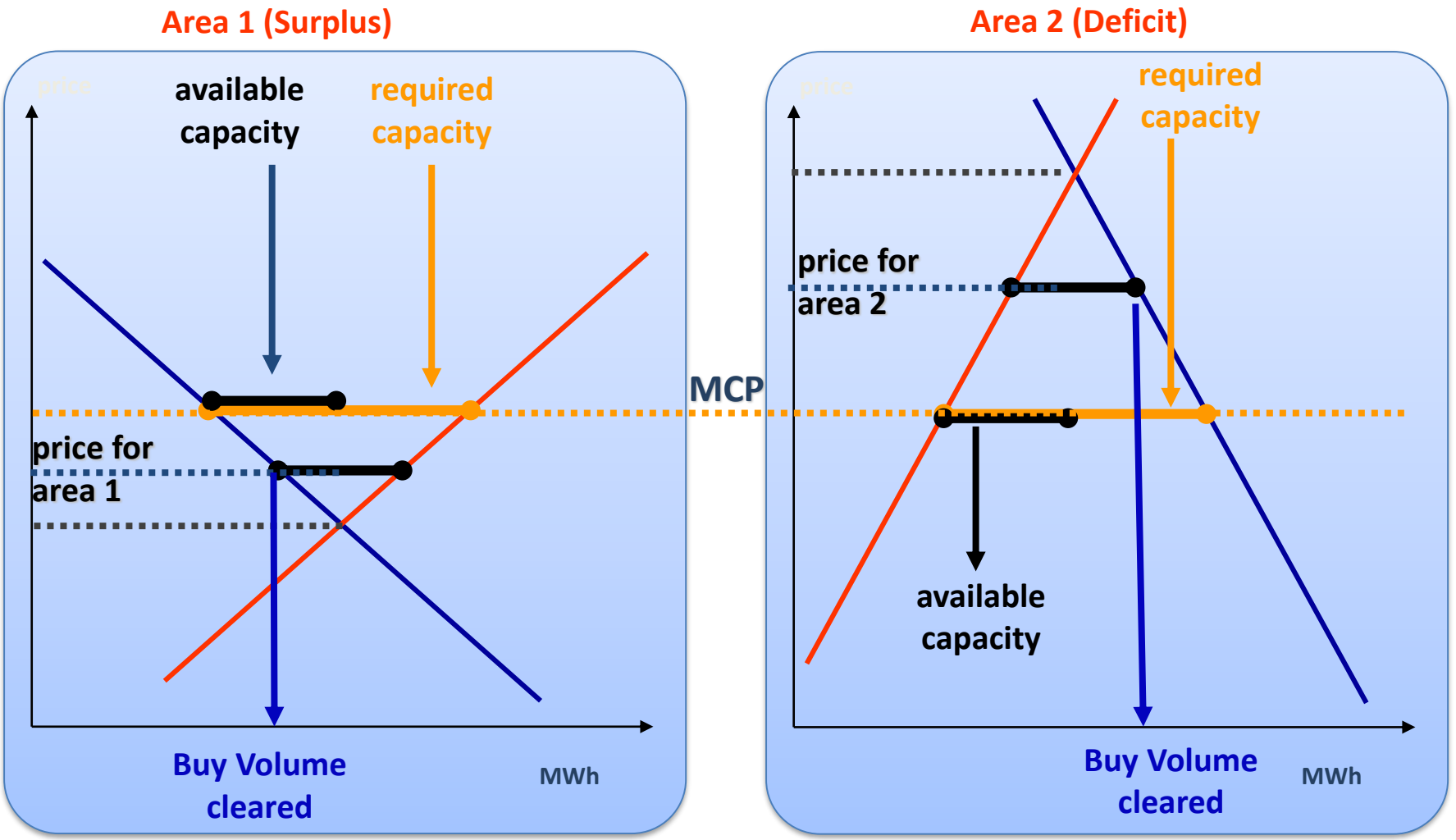
- Country is divided into 13 bid areas for the purpose of trading through Exchange

- In case of congestion **when the required flow exceeds transfer capability,** Exchange determines Area Clearing Price (ACP) specific to the bid area

- **The price is reduced in the surplus bid area (sale > purchase) and increased in the deficit area (purchase > sale)**

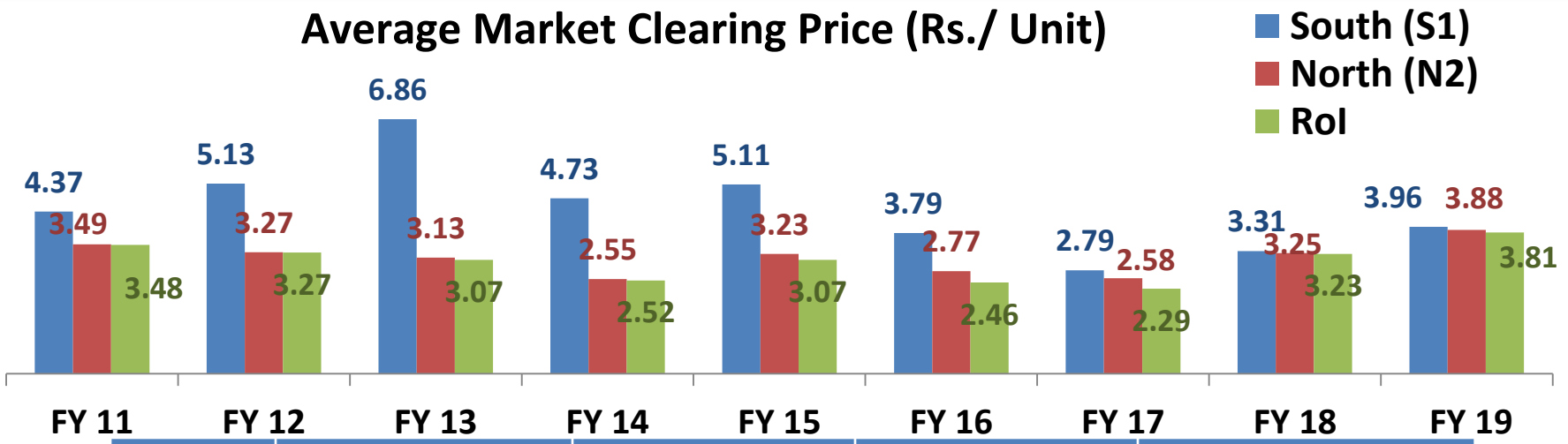


Congestion Management : Market Splitting



Courtesy Nordpool Consultancy

Lowered Congestion and Price convergence in Regions

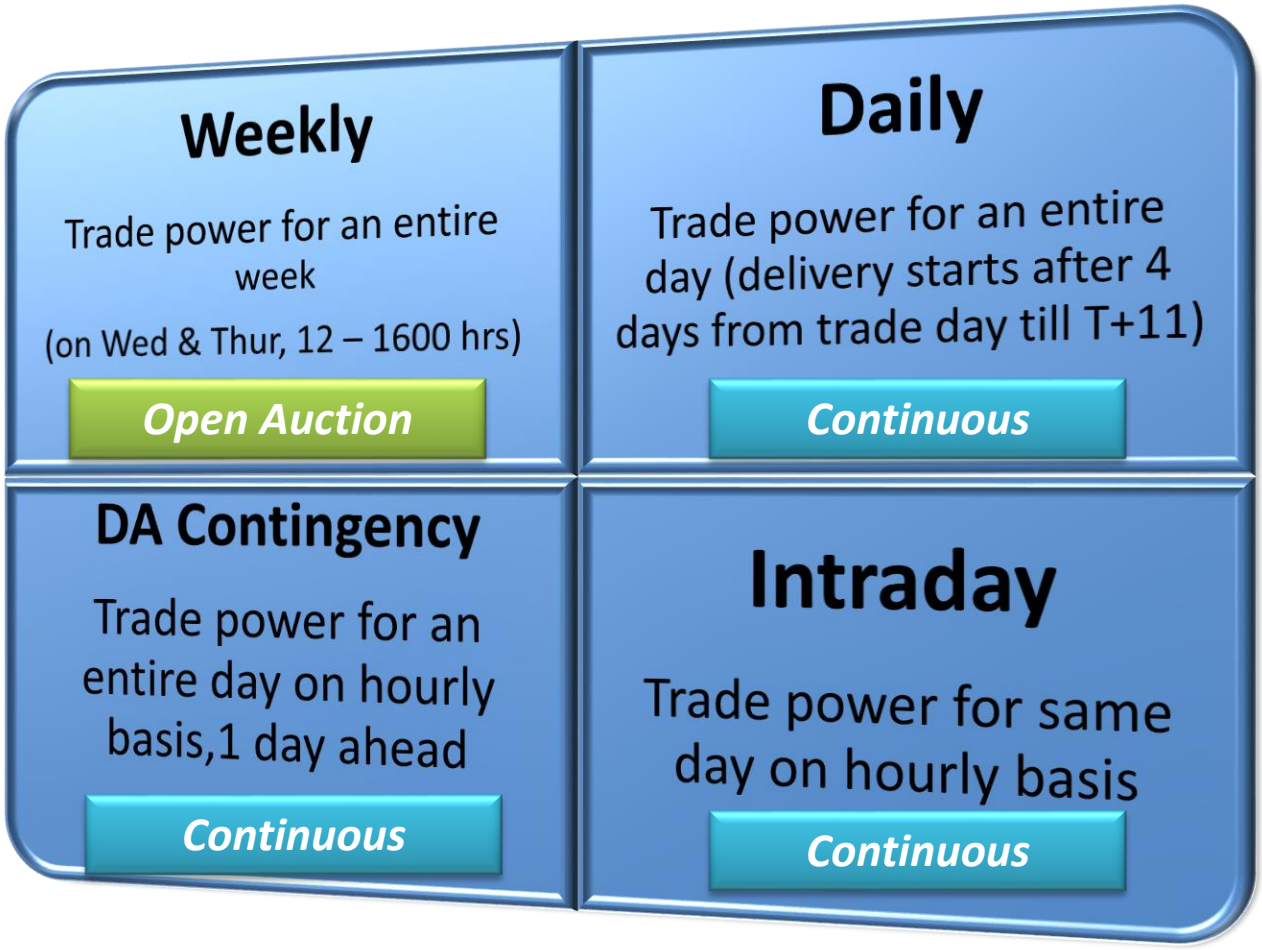


FY	Market Clearing Volume (MU)	Cleared volume (MU)	Curtailed Volume (MU)	Curtailment (%)
FY 14	34,230	28,925	5,305	15.5
FY15	31,227	28,141	3,086	9.9
FY16	36,210	34,067	2,143	5.9
FY17	41,310	39,830	1,480	3.6
FY18	45,121	44,925	196	0.4
FY19	50,600	50,136	464	0.9

- With transmission augmentation, congestion has reduced.
- Reduced congestion has increased reliability in sourcing power from exchanges

TERM AHEAD MARKET

TAM Market Segments



BID MATCHING

Open/Closed Auction

- Orders accumulated during call phase (no matching)
- Orders matched after call period
- Orders are used for calculation common price i.e. Equilibrium Price.
- All successful orders matched at Equilibrium Price.

Continuous Trading

- Price-time priority based continuous matching
- The highest Buy order & lowest Sell order gets the priority
- If the prices are same then priority is given to the time of the order received.

Contract Characteristics

	TERM AHEAD MARKET				
Contract Characteristic	**Day Ahead Market**	**Intraday Contracts**	**Day Ahead Contingency**	**Daily Contracts**	**Weekly Contracts**
Delivery	Next day	0400-2400 Hrs same day	For next day	From T+2 day to next T+9 days	For next week
Auction Type	**Closed Auction**	Continuous trading	Continuous trading	Continuous trading	Open Auction
Contracts	**15 min**	Hourly	Hourly	Block of Hours (Fixed)	Block of Hours (Fixed)
Trade Availability	All Days	All days	All Days; 1500-2300	All Days; 1200-1500	Wed & Thurs; 1200-1600
Financial Settlement	Pay-In- D-1; Pay Out – D+1	Pay in: T+1 Pay out: T+1	Pay in: T+1 Pay out: T+2	Pay-In- D-1; Pay Out – D+1	Pay-In- D-1; Pay Out – D+1

T = Trade

D = Delivery

Trading of Intra-day Contracts

Trading Hour

Trading Hours:20
(00:30-20:30)

0:30-1:30	1:30-2:30	2:30-3:30	3:30-4:30	4:30-5:30	5:30-6:30	6:30-7:30	7:30-8:30	8:30-9:30	9:30-10:30	10:30-11:30	11:30-12:30	12:30-13:30	13:30-14:30	14:30-15:30	15:30-16:30

16-:30-17:30	17:30-18:30	18:30-19:30	19:30-20:30

Delivery Hours:20
(04-24)

4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20

20-21	21-22	22-23	23-24

Contracts available for delivery on the same day

Intra-day & DAC contracts with current trading system

Trading Date	Trading Time	Intra-Day contracts	Trading Time	DAC contracts
17-04-2019	00:30- 01:30	H5 to 24 (of 17-04)		
17-04-2019	01:30 – 02:30	H6 to 24 (of 17-04)		
17-04-2019	02:30 – 03:30	H7 to 24 (of 17-04)		
17-04-2019	03:30 – 04:30	H8 to 24 (of 17-04)		
17-04-2019	04:30 – 05:30	H9 to 24 (of 17-04)		
17-04-2019	05:30 – 06:30	H10 to 24 (of 17-04)		
17-04-2019	06:30 – 07:30	H11 to 24 (of 17-04)		
17-04-2019	07:30 – 08:30	H12 to 24 (of 17-04)		
17-04-2019	08:30 – 09:30	H13 to 24 (of 17-04)		
17-04-2019	09:30 – 10:30	H14 to 24 (of 17-04)		
17-04-2019	10 :30- 11:30	H15 to 24 (of 17-04)		
17-04-2019	11:30 – 12:30	H16 to 24 (of 17-04)		
17-04-2019	12 :30- 13:30	H17 to 24 (of 17-04)		
17-04-2019	13 :30- 14:30	H18 to 24 (of 17-04)		
17-04-2019	14 :30- 15:30	H19 to 24 (of 17-04)	15:00 to 21:30 (of 17-04)	H1 (of 18-04)
17-04-2019	15 :30- 16:30	H20 to 24 (of 17-04)	15:00 to 22:30 (of 17-04)	H2 (of 18-04)
17-04-2019	16 :30- 17:30	H21 to 24 (of 17-04)	15:00 to 23:00 (of 17-04)	H3 to 24 (of 18-04)
17-04-2019	17 :30- 18:30	H22 to 24 (of 17-04)		
17-04-2019	18 :30- 19:30	H23 to 24 (of 17-04)		
17-04-2019	19 :30- 20:30	H24 to 24 (of 17-04)		

Trading of Weekly & Daily Contracts

Daily

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

TWS Screen

Pending Buy Order

Buy 10 MW @ Rs 4500/MWh

Pending Sell Order

Sell 15 MW @ RS 5500/MWh

Trading Engine

Buy 10 MW @ RS 4500/MWh

Sell 15 MW @ RS 5500/MWh

Buy 10 MW @ Rs 4500/MWh

Sell 15 MW @ Rs 5500/MWh

TWS Screen

Pending Buy Order

Buy 10 MW @ RS 5000/MWh

Buy 10 MW @ RS 4500/MWh

Pending Sell Order

Sell 15 MW @ Rs 5500/MWh

Trading Engine

Buy 10 MW @ RS 5000/MWh

Buy 10 MW @ 5000/MWh

TWS Screen

Pending Buy Order

Buy 10 MW @ RS 4500/MWH

Buy 10 MW @ 4500

Pending Sell Order

Sell 5 MW @ Rs 5000/MWh

Trading Engine

Sell 15 MW @ Rs 5000/MWh

Trade 10 MW @ RS 5000/MWh

Bid Modified

Sell 15 MW @ RS 5000/MWh

CLEARING AND SETTLEMENT

Clearing and Settlement (C&S) process:-

- C&S department acts as an internal clearing house to help with the receivables and payables of each trade on the Exchange.

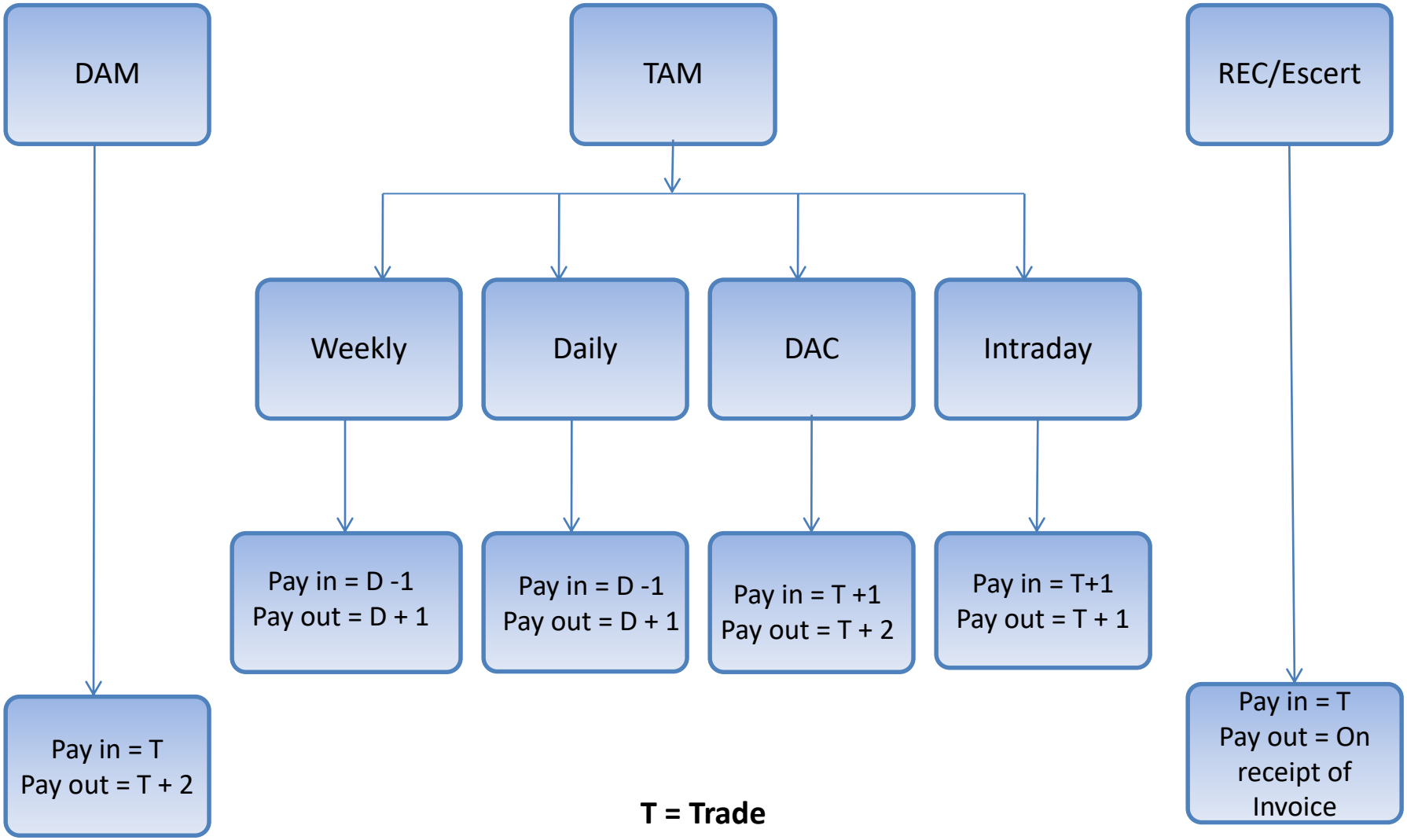
- C&S department provides member exposure, collaterals management on a day to day basis to enable smooth trading on the Exchange.

- IEX adopted best practices while formulating prudent Margining systems. Members risk is monitored constantly. Some key risk management measures are:

  - ✓ Margins and Pay in are collected as per the settlement cycle to maintain the efficacy of risk management.
  - ✓ Margins are maintained by the Members on a gross basis (purchase) across clients of the exchange.
  - ✓ There is no offsetting of positions of different Clients of a Member in the same market.

Payment and Settlement

Time Lines - Pay in / Pay out



T = Trade

D = Delivery

Risk Management:

Trader Member
• On T day (T stands for trade) at 09:30 hrs: Pre-trade Margin Check. - Equal to the initial margins or average of last 7 days' trading value, whichever is more. • T day at 13:30 hrs: Preliminary Obligation Margin Check - Preliminary Obligation =< Funds Available (incl initial margin), Block funds • T day at 15:30 hrs. : Pay-in • At T+2 11:00 hrs. Pay-out

- Each Member need to open a Settlement Account in a Clearing to settle its daily obligation , Margin and exchange related annual fees.

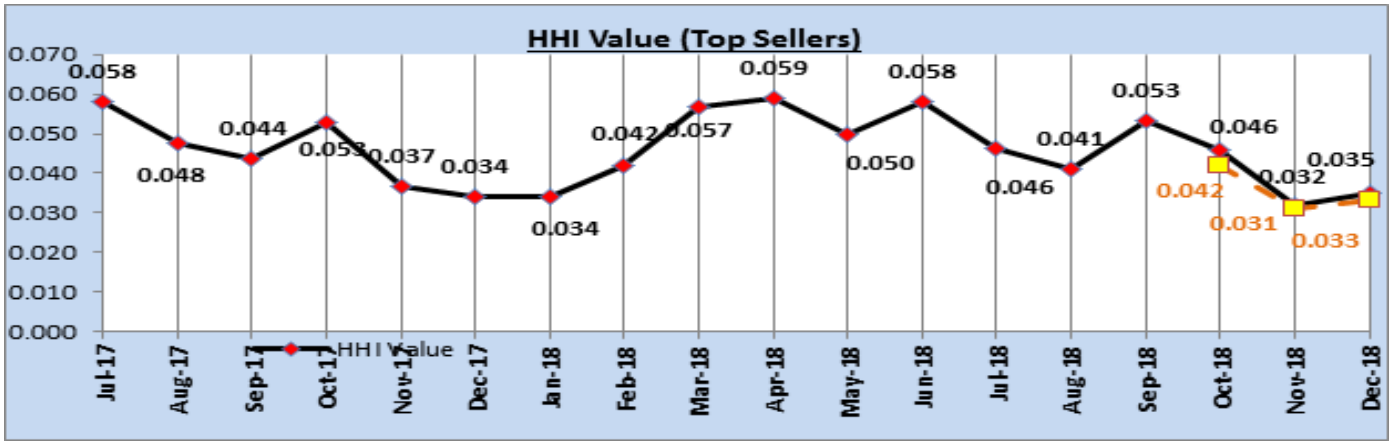
Financial Risk:-Exposure to Member-Risk Mitigation through Margin Process

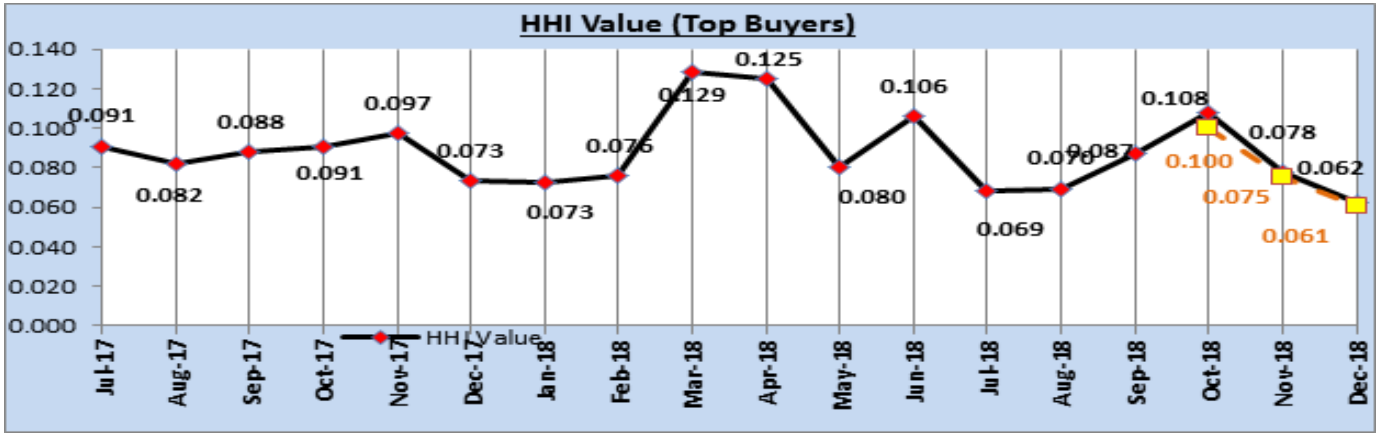
	Proprietary/Trading Licensee Members		Professional Members (client settlement a/c)	
	Initial Margin	**Basis/Additional Margin**	**Initial Margin**	**Basis/Additional Margin**
Day-Ahead Market	Margin equal to Last 7 Days Average of Buy turnover		As per Bank Balance less Hair Cut Factor	
TAM-Intraday	105% of Trade Value	-	105% of Trade Value	-
TAM-DAC	105% of Trade Value	-	105% of Trade Value	-
TAM-Daily	5% of Trade Value	50% of Trade Value	5% of Trade Value	50% of Trade Value
TAM-Weekly	5% of Trade Value	4 days Trade Value	5% of Trade Value	4 days Trade Value
REC	100% of Trade Value	-	100% of Trade Value	-

Funds Management

- Pay in / Pay out & Margins Processing transactions done through electronic interface between exchange & banks.
- All third party payments to NLDC/RLDCs and SLDCs are done electronically after taking confirmation from respective LDC with regard to their bank account details.
- Daily reconciliation of Member's/NTL clients funds obligation.
- Weekly reconciliation of charges with SLDC.
- Monthly reconciliation of charges with NLDC.
- Maker and Checker Process for any transaction.

5. Increased competition- HHI for IEX transactions





- HHI below 0.01 (or 100) indicates a highly competitive index.
- **HHI below 0.15 (or 1,500) indicates an un-concentrated index.**
- HHI index between 0.15 to 0.25 (or 1,500 to 2,500) indicates moderate concentration.
- HHI index above 0.25 (above 2,500) indicates high concentration.

CROSS BORDER ELECTRICTY TRADE

INTERNATIONAL SCENARIO & SAARC STATUS

Cross Border trade through Exchange

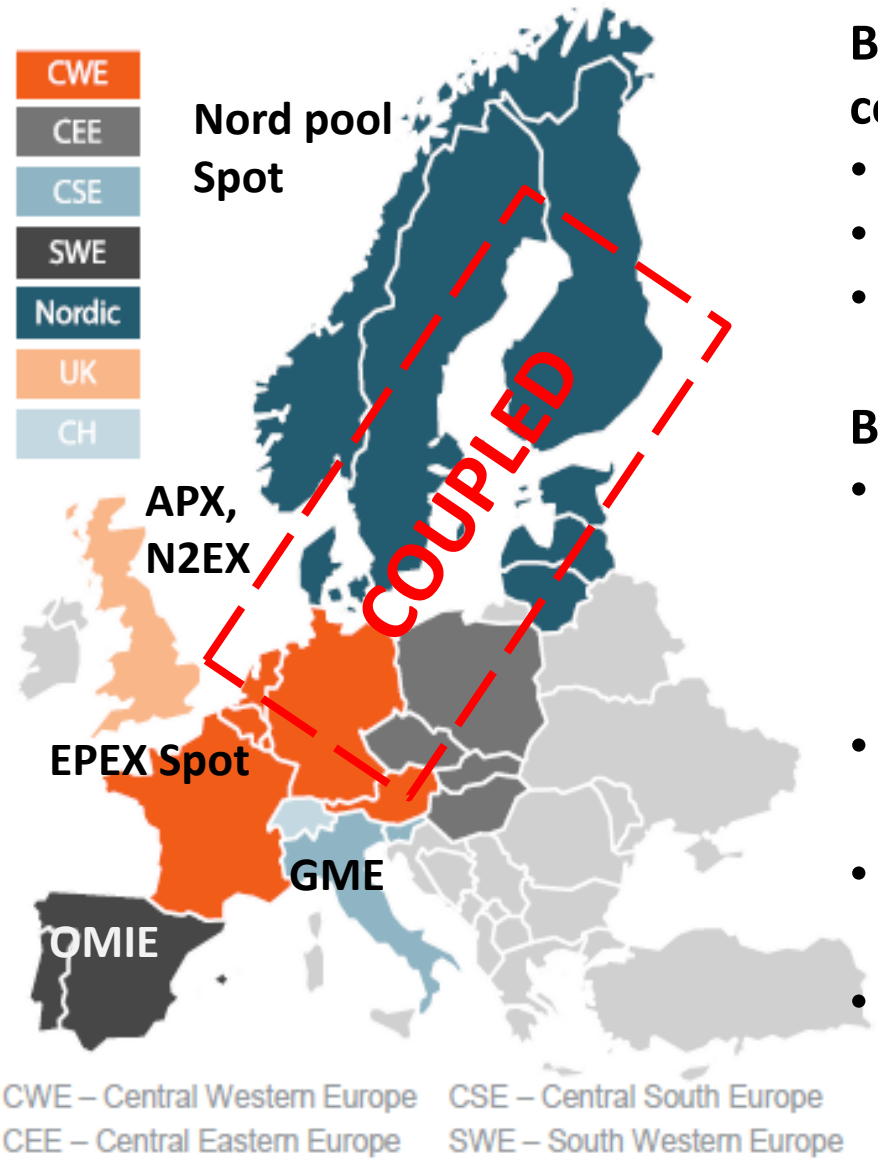
- Globally, countries have harnessed the resources by integration of power markets to harness greater system reliability, optimization of investments and optimum utilization of resources across border.

- Most **countries achieved efficient utilization of cross border transmission capacity and linking of the electricity markets of the neighboring companies through the Day Ahead Markets.**

- **European Union (EU) established a single electricity market through Day Ahead Market across 28 countries. Similarly, South African Power pool (SAPP) integrated 12 countries to form a common market offering Day-ahead contracts.**

- Cross Border transactions is expected to be much less compared to the surplus power in DAM. Therefore allowing cross border transaction cannot have any adverse impact on Indian markets.

Cross Border Integration of European Market



By 2015: North-West & South-West Europe coupled

- 19 Countries
- 75 % of Europe's energy
- 3000 BUs Consumption PA

Benefits:

- Price differences between each spot market are minimised, with convergence at times when there is sufficient capacity
- Capacity usage is optimized
- Perfect Market arbitrage
- Integrated market, higher security of supply through market integration

Evolution of Market Coupling in EU

- Market Coupling is linking separate day-ahead markets using cross-border transmission capacities. **It is conceptually similar to market-splitting being used internally for Day-ahead markets in India.**

2006

Trilateral market Coupling

(**France, Belgium Netherlands**)

2010

CWE **Pentalateral** Market Coupling

(**Germany, Austria** Joined)

2011

BritNed coupling

(**UK Joined**)

2014

North West Europe (NWE) coupled

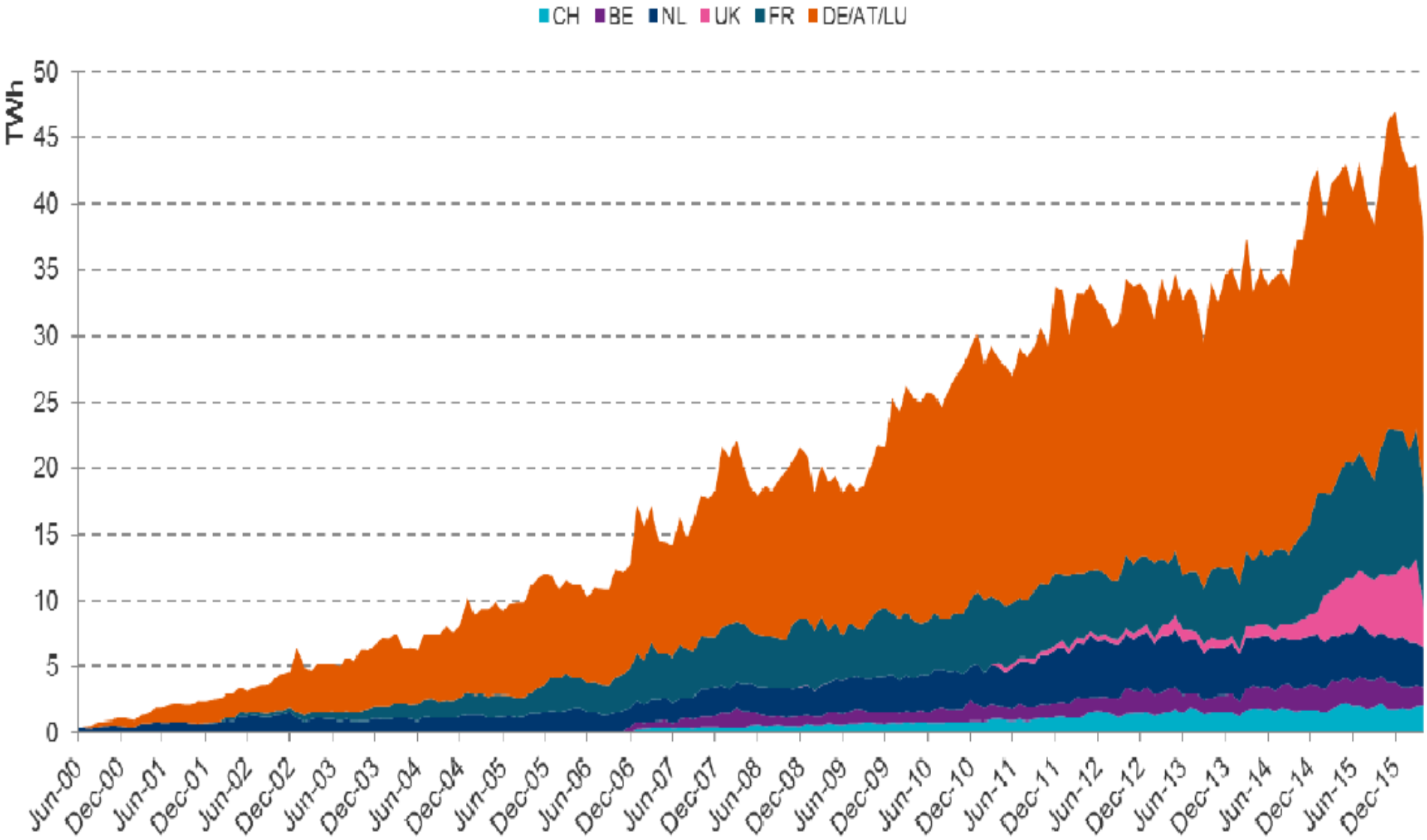
- Italy, Slovenia, Iberia joins NWE

2015

NWE, SWE, CEE Coupled

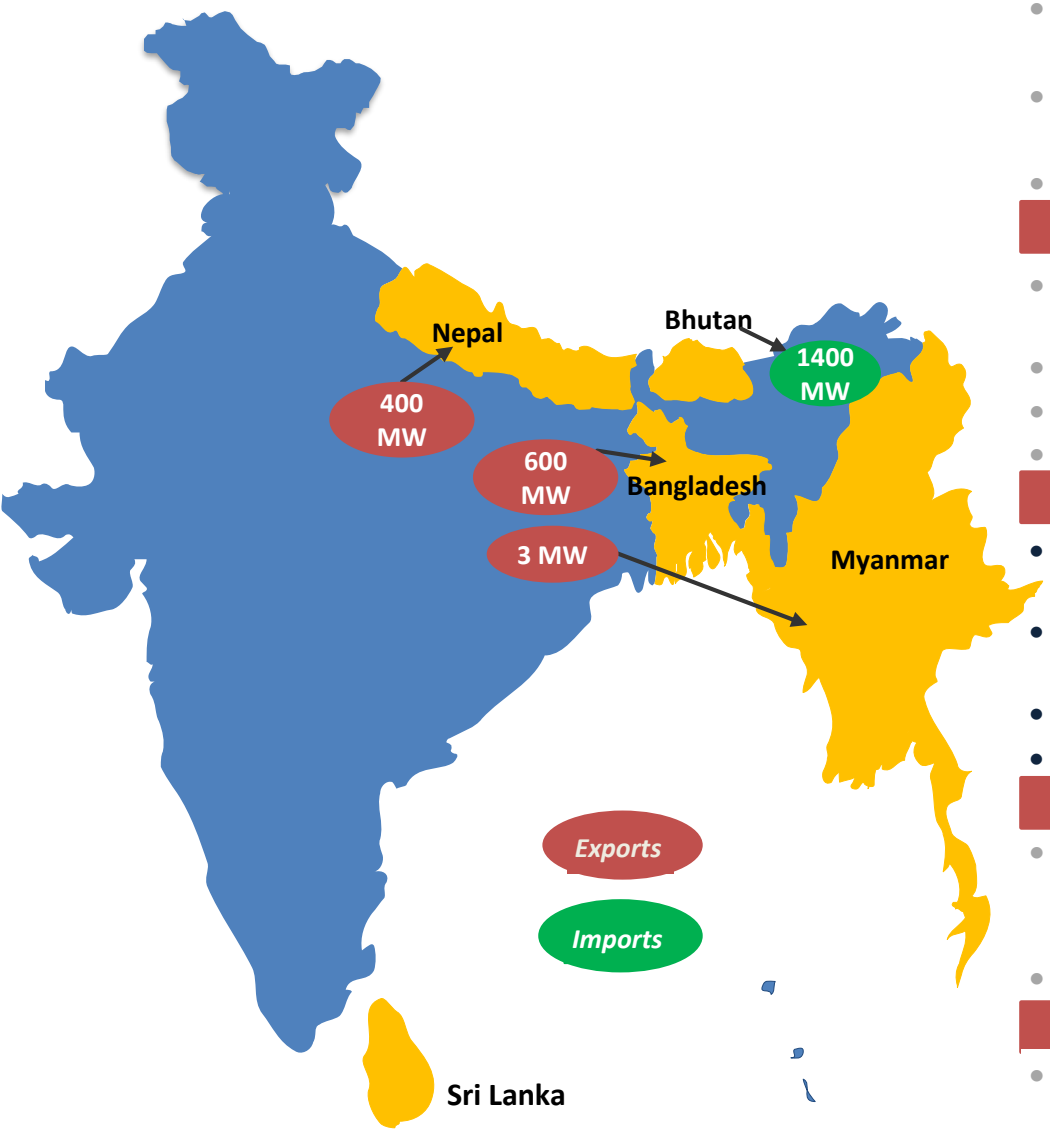
- Spain, Portugal
- Czech, Slovakia, Hungary Join

Growth in Day Ahead Trade Volumes in EU



CH: Switzerland , BE: Belgium, NL: Netherlands, DE: Germany, AT: Austria, LU: Luxembourg

Today: India trades ~2500 MW / ~13BUs with its neighboring countries in S Asia (Nepal, Bangladesh, Bhutan)



Bhutan

- Power surplus: Primarily hydro power; India purchases all surplus as per the **2006 Inter-Governmental Treaty**
- **Total imports of ~1500 MW or 5.6 BUs**; existing **1500 MW transmission capacity**
- **Seasonal generation**, concentrated in **May-Sept.** period

Bangladesh

- Power deficit: Peak demand of ~13 GW and capacity of ~12 GW however, effective capacity of ~9GW (lack of gas)
- **India exports 600 MW or 5.3 BUs**, to meet B'desh's deficit
- **600 MW** transmission capacity**; expected to double** in 5 years
- **Power deficit situation to continue for next 10 years**

Nepal

- Power Deficit: Instances of blackouts during dry seasons; expected to be surplus during monsoon in 5 years
- India financed hydro projects currently stuck owing to land-acquisition challenges
- **India exports 400MW** or 1.8 BUs
- Transmission capacity to be **expanded to 1000 MW** (400 MW now)

Myanmar

- Power surplus: Internal demand is low due to **poor grid connectivity within Myanmar** – only 35% households connected to their main grid
- **India exports 3 MW** or 0.03 BUs; no inter-regional transmission

Sri Lanka

- Power sufficient, though costs are high due to expensive oil imports
- **No power trade currently** given **lack of transmission capacity**;
- 500 MW transmission capacity to come up by ~2030

Enabling Steps for Cross Border Trade through Exchange

Guidelines issued by Ministry of Power ✓

CERC to notify Regulations for Cross Border Trade ✓

CEA notified draft CBR (Conduct of Business Rules) ✓

IEX to file for changes in contract specs in line with CERC regulations and CEA rules — In process

Guidelines on Cross Border Trade through Exchanges in India

- **Guidelines issued by Ministry of Power:** allows cross border trade through power exchange

- **CERC notified Cross Border Trade of Electricity Regulations, 2019 on 8th March 2019.**

- **Trade Through Indian Power Exchanges:**
  - Participating Entity of neighbouring Country can trade on Power Exchange only through Indian trading licensee.
  - For such trading, the trading licensee is required to take approval from Designated authority for specific quantum.
  - There is no restriction on the market i.e. DAM/TAM in which such transactions can be executed.
  - There is no restriction on IMPORTS into India through Power Exchange.
  - There is certain restriction on Indian exporters –
    - Only Imported Coal, Hydro, Gas, RE plants allowed to export

CERC Regulation

Salient Features

- **Designated authority** in India will grant **approval for export or import of electricity to/from India**.
- CBT shall be allowed through **mutual agreements** under the overall framework of agreements signed between India and the neighbouring country(ies).
- Tripartite agreements will also be allowed under the framework of bilateral agreements

➢ ***Tariff Determination***

- For import/export: Either determined through competitive bidding or mutual agreement or government to government agreements.
- For import from Hydro Plant: CERC may determine tariff based on request of the entity of neighbouring country through its government.

➢ ***Trade Through Indian Power Exchanges:***

- Participating Entity of neighbouring Country can trade on Power Exchange only through Indian trading licensee.
- For such trading, the trading licensee is required to take approval from Designated authority for specific quantum.
- There is no restriction on the market i.e. DAM/TAM in which such transactions can be executed.
- There is no restrictions on import or export of power through Power Exchange

➢ ***Transmission charges:***

- PoC injection charges or withdrawal charges for delivery of electricity at the pooling station within India shall be governed as per provisions of Sharing Regulations.

CERC Regulation

- ***Cross Border Transmission Link (CBTL) :***
  - The CBTL to planned jointly by Transmission Planning Agencies of the two countries
  - Not form a part of the basic ISTS network for the determination of PoC charges under the Sharing Regulations.
  - A generating station in neighbouring country may develop and operate the dedicated transmission system from the generating station to the pooling station within India at its own cost.
- ***Connectivity, Long Term Access, Medium Term Open Access and Short Term Open Access:***
  - long-term access or medium-term open access shall be made to CTU
  - short-term open access through NLDC under Regulations with approval of DA.
- ***Scheduling:***
  - Scheduling shall be carried out for each 15-minute time block.
  - Transmission System losses declared on weekly basis borne in kind by the buying/selling, as the case may be, as per the quantum
  - The respective party will inform their requisitions to the Settlement Nodal Agency.
  - SNA will co-ordinate with System Operators of respective neighbouring countries for scheduling of cross border transactions and revisions during the day of operation
- ***Transmission Losses:***
  - Withdrawal PoC losses as applicable shall be applied at the interface.
  - Injection PoC losses of respective injection grid shall be applied at the interface.
  - Net schedule after applying injection PoC loss of the concerned injection zone and withdrawal PoC loss

Draft conduct of Business Rules for Cross Border Trade of Electricity (1/2)

- Designated Authority (DA), **CEA** has proposed draft procedures for facilitating Cross Border trade of electricity on **26.04.2019**.
- Salient features of the proposed Rules are as under:
- **Objective**:
  - 1. *To grant approval to eligible entities to participate in Import/Export (Cross Border) of Electricity*
  - *2. Approval of transmission links with the neighbouring country*

– **Approval of DA to participate in Import/Export (Cross Border) of Electricity**:

➢ Approval of DA not required where the import/export is taking place under the Inter Government Agreement signed by India and neighbouring country for specific project.

➢ **Trading in Indian Power Exchange (PX):**

- Indian Trader trading in Day Ahead Market (DAM) in PX on behalf of Entity of neighbouring country **require approval of DA for specific quantum and period**.
- To sell in other products (i.e. other than DAM) of Indian PX, requires to obtain approval from the DA as per Procedure for '**Export of electricity by Indian Entities'**.
- For other than DAM, PX to ensure that the buyer from neighbouring country is able to buy only from approved exporters of India.
- Approval will be given for quantum of electricity (in MW) and time period.
- Applicant to furnish PPA/LoI with the entity of neighbouring country for trade in Indian PX
- The application should also have consent of respective government of the neighbouring country for allowing trade of power.

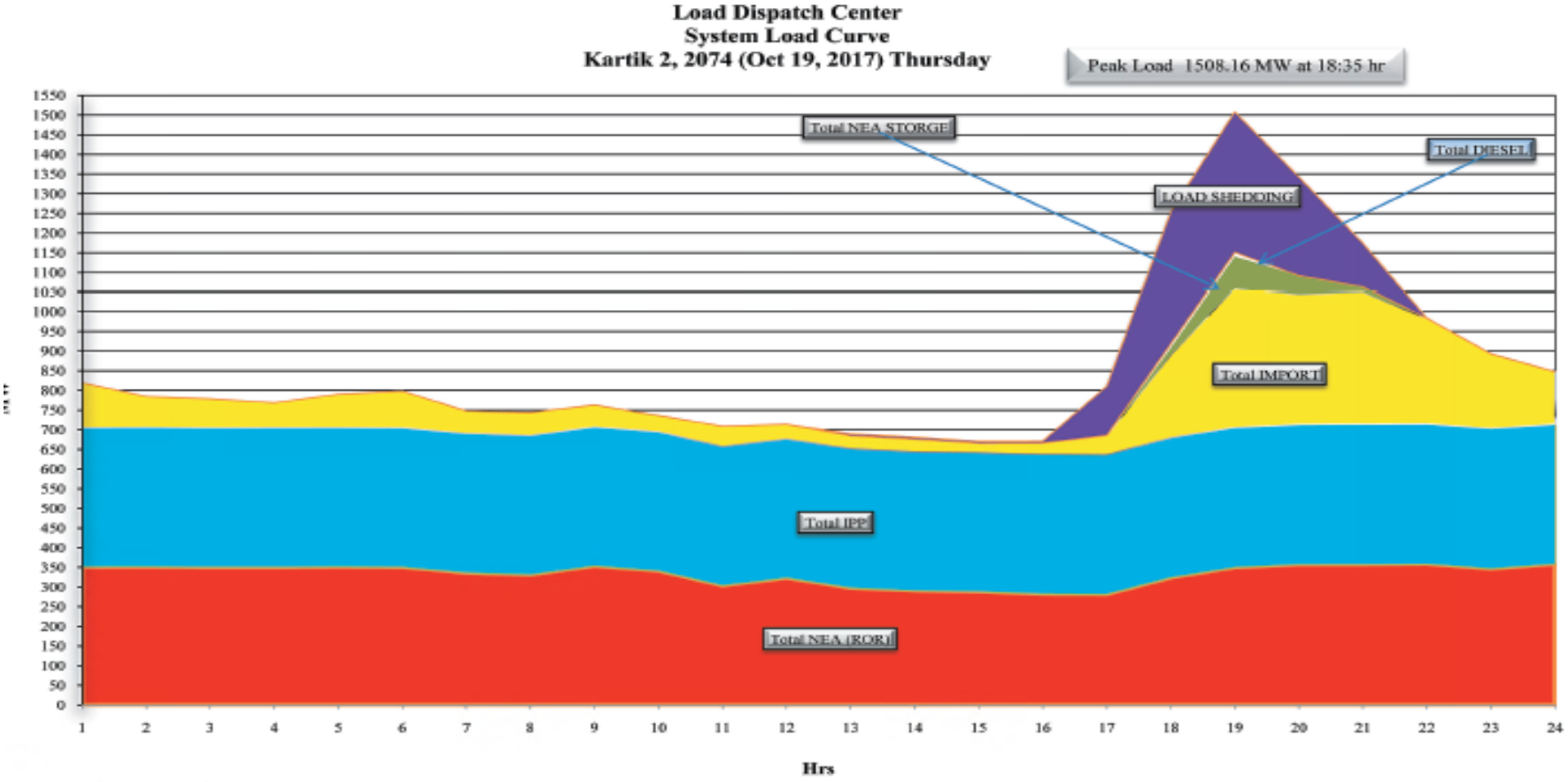
Draft conduct of Business Rules for Cross Border Trade of Electricity (2/2)

- **Import of electricity by Indian Entities:**
  - Allowed from projects with permission to export power to India from the respective Government of the neighbouring country.
  - Allowed from the generation projects located in neighbouring countries directly or through Government or Company, licensed for trading
  - The Applicant shall submit a copy of PPA/LOI from generator of neighbouring country, for import of such power.
- **Export of electricity by Indian Entities:**
  - Generating Companies/ Distribution Companies of India may export directly or through trading licensee(s) of India.
  - Export of electricity generated from coal utilizing imported coal or spot e-auction coal or coal obtained from commercial mining is allowed.
  - The Applicant to submit a copy of PPA)/LOI from entity of neighbouring country, for export of such power, except for those who intend to sell in other products of Indian PX (i.e. other than Day Ahead Market), where establishment of one-to-one transaction is possible.
- The trading licensees of India can apply for STOA to NLDC and MTOA/LTA to CTU for facilitating transfer of power from one neighbouring country to other neighbouring country through Indian Grid, provided it has approval from the DA (or Government of India) for such quantum of power during the period.
- The last date of comments is 15.5.2019

WAY FORWARD FOR NEPAL

Daily Load Curve – Peak and Base Load variation

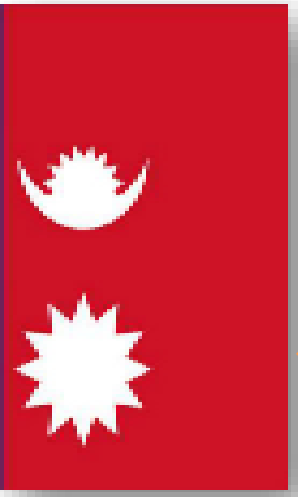
System Load Curve of Peak Load Day



FINANCE DIRECTORATE | FISCAL YEAR 2017/18

Source :NEA Annual Report 2017-18

India-Nepal Transactions Potential



- Exports during wet season
- Significant hydro power export possible

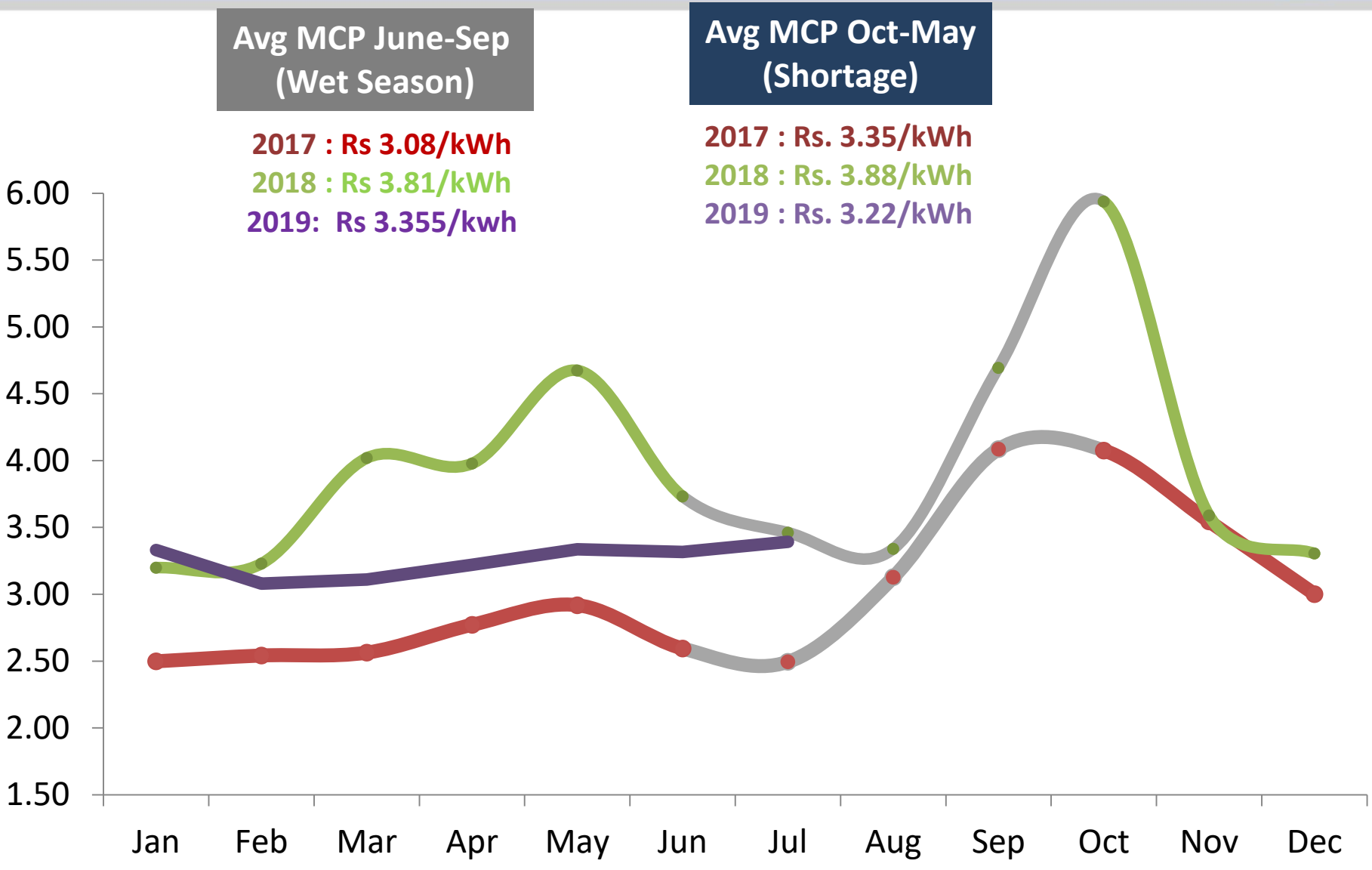
- Thermal power support for load following
- Dry season support

Nepal Import Details

	Quantum	IR Link
Bihar	250-300 MW	Bihar-Nepal (Bihar connections)
DB Power	50 MW	East-Nepal (Dhalkebar-M'pur line)
GMR	25 MW	
Sembcorp Gayatri Power Ltd	120 MW	
Baglihar Hydroelectric Power Project	25 MW	North-Nepal (Tanakpur)
Tanakpur HEP	70 MUs	

- Presently, Bihar is supplying power to Nepal under consultation Power Exchange Committee

IEX Monthly Average Market Clearing Price (Rs./kWh)



INDIA NEPAL CONNECTIVITY

Existing

- 13 cross border interconnections at 11kV, 33kV and 132 kV level through which Nepal draws power upto 240MW.
- ✓ 132 kV Tanakpur line
- ✓ Muzaffarpur(India) – Dhalkebar(Nepal) 400kV D/c line (being operated at 132 kV. total up to 160 MW. Expected at rated voltage of 400 kV by December 2019 (power upto 600 MW can be exported)
- ✓ 132 kV Katiya – Kusaha 2nd circuit and 132 kV Raxaul – Parwanipur S/C Lines. (additional 100 MW can be exported)

Upcoming

- Joint Technical Team (JTT) of India and Nepal has prepared an integrated Master Plan for power evacuation from about 280 hydro projects in Nepal to India totaling to about 45GW installed capacity. Total eleven high capacity cross-border links have been identified to be implemented in phased manner till 2035.
- New Butwal (Nepal) – New Gorakhpur (India) 400kV D/c (Quad) line is proposed to be implemented. (Feasibility report under preparation)

15,800 MW by 2036-40

✓ *Exchange Transaction feasible*

Nepal Portfolio Management through Exchange

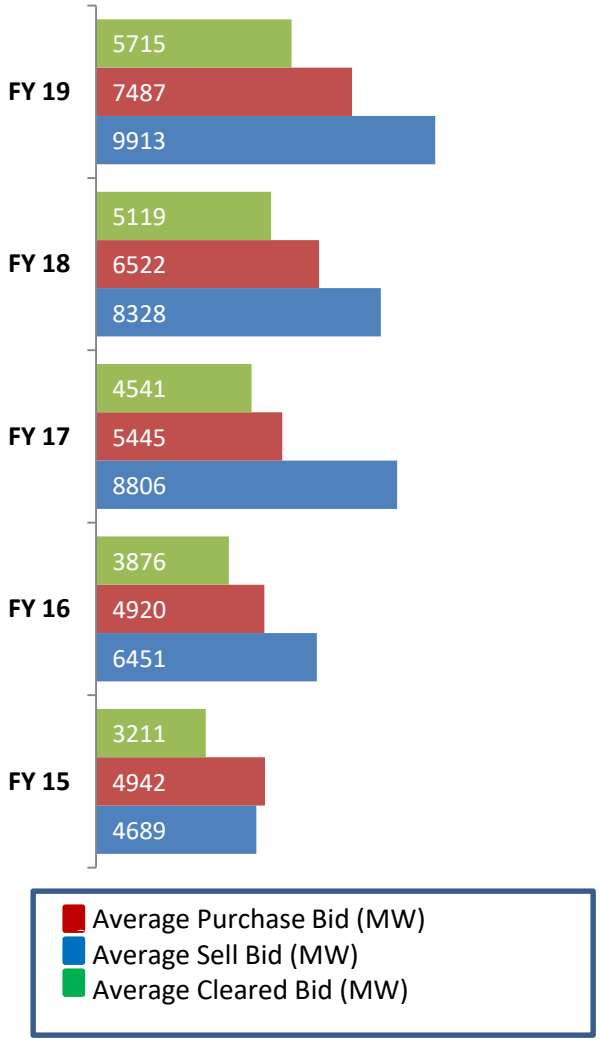
Meeting Shortages

- **Buy Residual Requirement** : when transmission margins are available and demand exits
- **Economise when possible:** Can buy when it's cheaper on IEX and replace costlier power through Bilateral trade to the extent of Contract conditions (~20% in case of 80% take-or-pay contracts)
- **Leverage Value of Stored Water:** Can leverage Storage , similar to Hydro rich state like HP etc., save water for generation in peak hours/ seasons etc.
- **Cheaper Power :** Exchange Prices are lowest during Nepal's peak season (Oct-Feb)

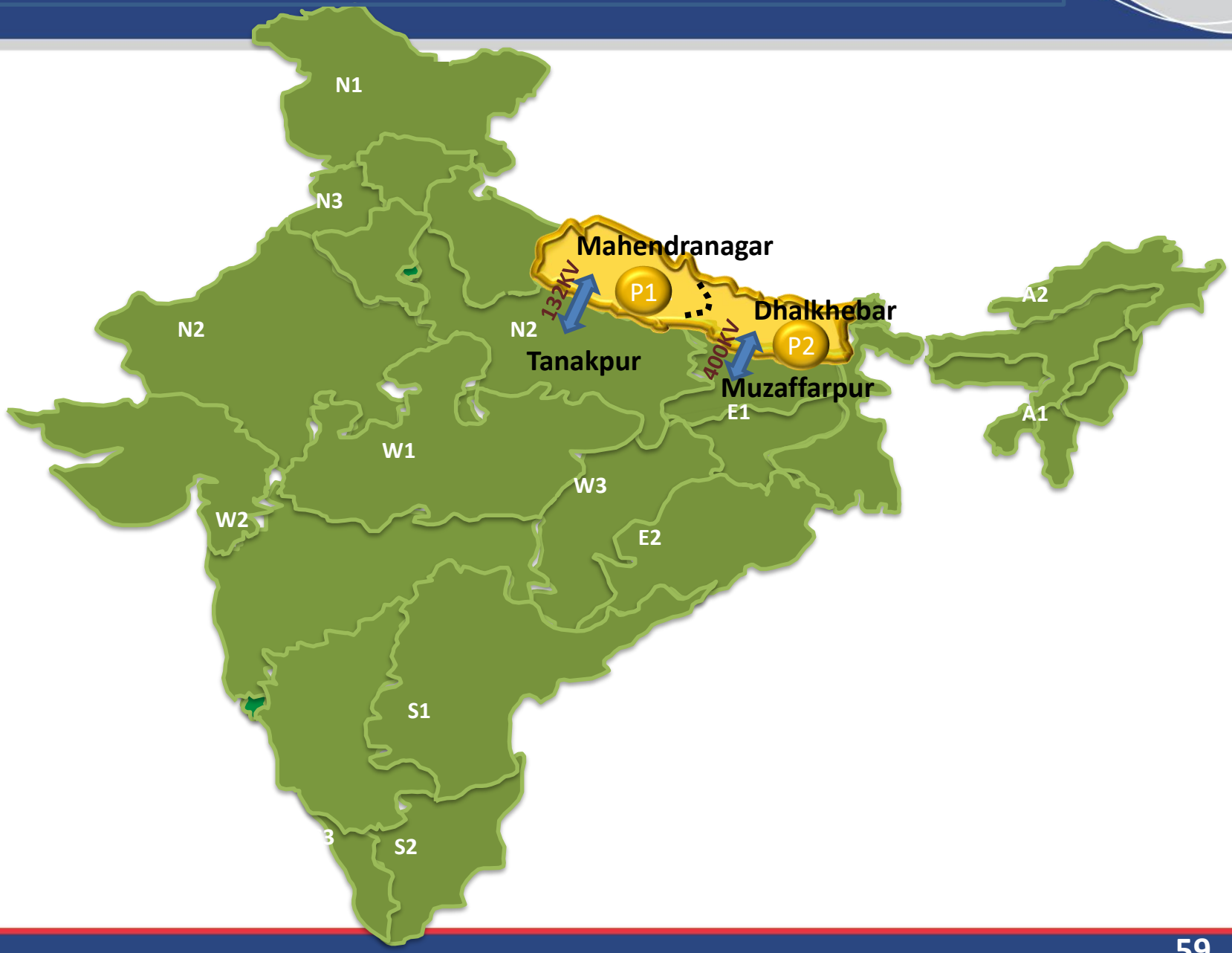
Selling Surplus

- Nepal Going forward will be surplus is wet season
- IEX will offer a very liquid platform to sell the surplus at competitive prices
- Nepal should implement concept of "Value of water" and try to commercially mange manage reservoirs

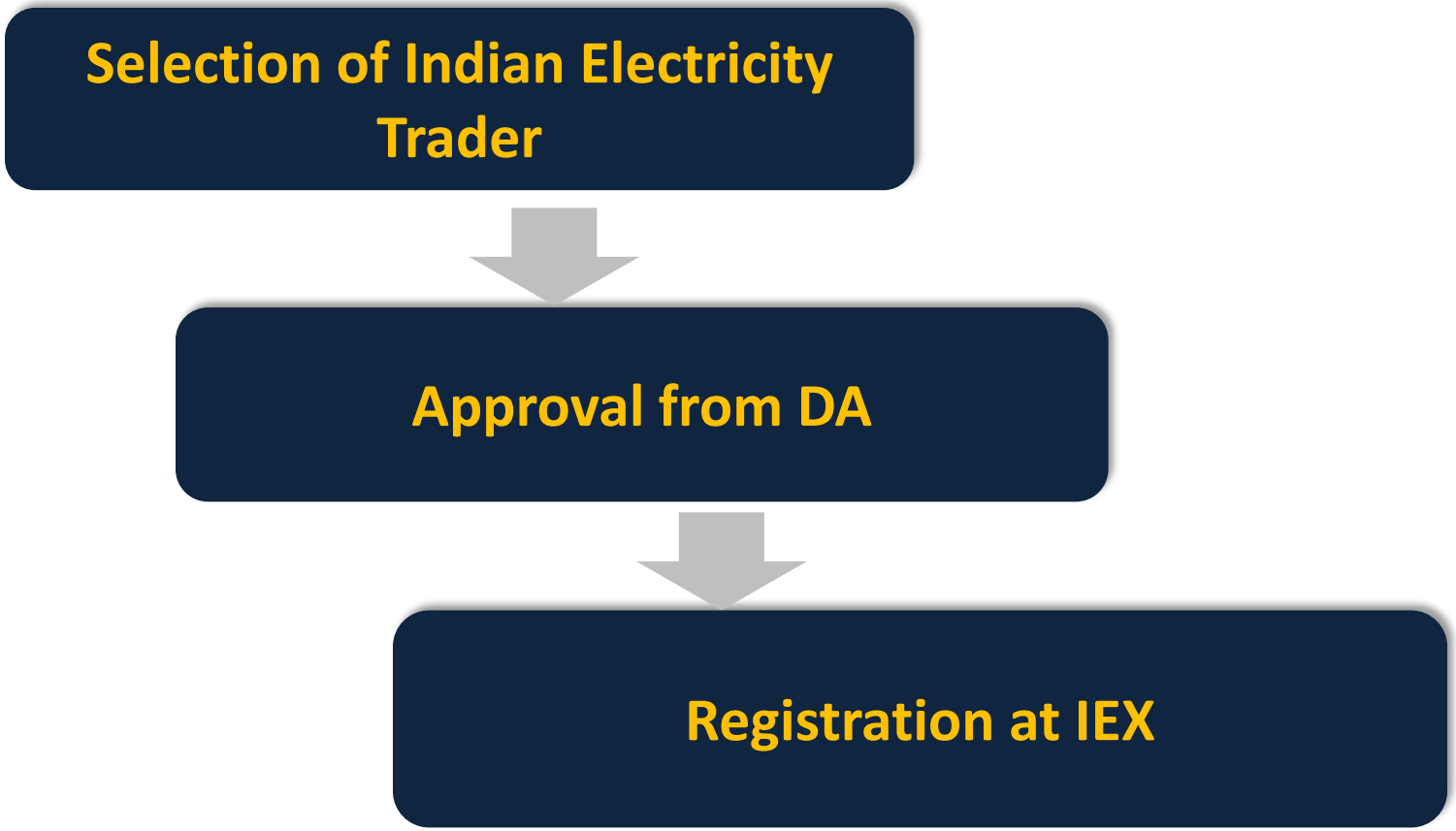
High Liquidity



New Bid Areas & Existing interconnection



Registration Procedure



Thank You

www.iexindia.com

Follow us *@IEXLtd*

Use IEX Mobile Application to track prices

Register for Daily SMS alerts

Register for IEX Monthly Bulletin

INDIA-NEPAL: MAJOR INTERCONNECTIONS

S. No	Connection Point	Present Import (MW)
1	Kusaha-Kataiya (132kV)	Around 200
2	Gandak - Ramnagar (132kV)	25
3	Tanakpur - Mahendranagar (132kV)	30
4	Kataiya (Bihar) - Rajbiraj (Nepal)(33kV)	7
5	Sitamari (Bihar)- Jaleshwor (Nepal) (33kV)	10
6	Raxaul (Bihar)- Birganj (Nepal) (33kV)	10
7	Jaynagar (Bihar) – Siraha (Nepal) (33kV)	7
8	Nanpara – Nepalgunj (33kV)	10

Load Forecast: Nepal

Fiscal Years	Energy (MU)	Peak Load (MW)
2017-18	7,489	1,644
2018-19	8,391	1,842
2019-20	10,138	2,225
2020-21	12,017	2,638
2021-22	13,952	3,062
2022-23	15,332	3,365
2023-24	16,869	3,703
2024-25	18,579	4,078
2025-26	20,585	4,519
2026-27	22,826	5,011
2027-28	25,332	5,561
2028-29	28,111	6,171
2029-30	31,196	6,848

Source :NEA Annual Report 2017-18