Experiences and Learnings from Power Market Development in South Asia: Power Trading and Power Exchanges

Rajiv Ratna Panda
SARI/EI/IRADe

HAPUA-ASEAN-UNESCAP Workshop on ASEAN Electricity Exchange (AEE): An International Perspective
17-19 April, 2017Hotel JS Luwansa, Jakarta, Indonesia
Contents

- South Asia: A Snapshot
- Power Market Structure in South Asian Countries (SACs)
- Indian Power Sector
- Power Sector Evolution and Power Trading Development in India
- Indian Power Market
- Power Exchange Evolution in India - Key features
- Power Exchange Products in India
- Regulation of Power Exchange in India
- Contribution of power exchanges
- Key Lessons: Power Market and Exchange Development in India
- Development of South Asia Regional Regional Power exchange
- Way forward
South Asia Remains World’s Fastest Growing Region. Economic Growth (EG) expected to accelerate to 7.3 percent in 2017 from 7.1 percent in 2016.

Home to 1/5th of world’s population. India is the largest economy in the region and geographically centrally located.

Most of the countries are facing power shortages. Demand growth to remain robust due to high EG.

Total electricity demand in the region projected to grow at an average rate of *5.2% annually from 2013-2040 period

Current Installed capacity is around 363 GW; (India 315 GW) Required installed capacity by 2040 is *1067 GW

Cross Border Electricity Trade (CBET) : India, Bhutan is the net exporter and Bangladesh, Nepal net importer of electricity

Per capita energy consumption (517 KWh/Capita) is one of the lowest in the world ( World average 2803)

Huge untapped hydro potential


Huge Hydro Potential of SA region: 350 GW (54 GW) Complementarities in SA countries:

South Asia, only 15% of Hydro resources has been developed. Nepal and Bhutan have developed 1% and 5% of their potential. India 29% of their potential.

25 (0.25) Afghanistan
59 Pakistan
83 (0.73) Nepal
30 (1.6) Bhutan
0.33 (0.23) Bangladesh

8 SAARC Countries

Total CBET in SA 2363 MW

Bhutan-India-1410MW
Bangladesh-India-600MW
Nepal-India-350 MW
India-Myanmar-3 MW

Demand and resource complementarities

Confidential © 2017 South Asia Economic Focus Spring 2016 Fading Tailwinds World Bank
Power Market Structure in South Asian Countries
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>Ministry of Energy and Water (MEW)</td>
<td>Electricity Regulatory Authority</td>
<td>DABS</td>
<td>DABS</td>
<td>DABS</td>
<td>Single Buyer (SB), DABS</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Ministry of Power, Energy and Mineral Resources</td>
<td>Bangladesh Energy Regulatory Commission</td>
<td>BPDB, EGCB, APSCL, NWPGC, IPPs, SIPP, Rental Plants</td>
<td>PGCB</td>
<td>SB Model</td>
<td>Single Buyer, BPDB, Multiple Seller (MS)</td>
</tr>
<tr>
<td>Bhutan</td>
<td>Ministry of Economic Affairs (MEA)</td>
<td>Bhutan Electricity Authority (BEA)</td>
<td>Druk Green Power Corporation (DGPC)</td>
<td>BPC (NLDC)</td>
<td>Single Buyer</td>
<td>Export Licensee, SB Model</td>
</tr>
<tr>
<td>India</td>
<td>Central: Ministry of Power under Goi, State: Power/Energy Department under the State Government</td>
<td>Central: CERC, State: SERCs/JERCs</td>
<td>Central: NTPC, NHPC, NPCIL, UMPPs, IPPs, MPPs</td>
<td>Multiple Buyer and MS Model Central: Inter-state Licensees; State: Discoms / Trade Cos (Include State Holding Cos) / Intra-state Licensees, Power Exchange Platform</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>Ministry of Energy (MoE)</td>
<td>Electricity Tariff Fixation Commission (ETFC)</td>
<td>Nepal Electricity Authority (NEA), IPPs</td>
<td>NEA</td>
<td>NEA</td>
<td>SB Model –NEA, Multiple Seller (MS)</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Ministry of Water and Power (MOWP)</td>
<td>National Electric Power Regulatory Authority (NEPRA)</td>
<td>State-owned generating companies formed after restructuring of WAPDA (CPGCL, JPCl, LPGLC, NGPCL) &amp; other IPPs</td>
<td>NTDC</td>
<td>SB Model, CPPA, Multiple Seller (MS)</td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>Ministry of Power and Energy (MOPE)</td>
<td>Public Utilities Commission of Sri Lanka (PUCSL)</td>
<td>Ceylon Electricity Board (CEB), IPPs</td>
<td>CEB Transmission Licensees</td>
<td>SB Model, Multiple Seller (MS)</td>
<td></td>
</tr>
</tbody>
</table>

Except India most of SA countries have SB Model. Power Trading/Power exchange Platform Exist in India only.
Indian Power Sector
Installed capacity in India- 319 GW (March 2017), 3rd largest producer & 4th largest consumer of electricity in the world.

Installed Capacity profile (Feb-2017):
- Coal: 59.9%, Gas: 8.0%, Diesel: 0.3%
- Nuclear: 1.8%, Hydro: 14.1%, RE: 15.9%

The Per capita energy consumption-1,074 kWh (2015-16) still less than half of the world average

The share of Renewable Energy in India's generation capacity portfolio has progressively increased reaching 50 GW as on March, 2017

RE capacity has grown at CAGR of 21% over last five years

Wind energy accounts for about 57% of installed RE capacity, followed by solar with 18% share in the RE mix

The overall potential for renewable energy in the country is estimated to be about 1095 GW (as on March 2016)


Source: CEA Report
Note: 92% based on Total village in India is 640867

Confidential © 2017
The demand-supply deficit has progressively reduced over the last five years. For the First time India is expected to be power surplus in 2017.

**Demand-Supply Peak Deficit (MW)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Peak Deficit [MW]</th>
<th>Deficit [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY11</td>
<td>(12,031)</td>
<td>-9.8%</td>
</tr>
<tr>
<td>FY12</td>
<td>(13,815)</td>
<td>-10.6%</td>
</tr>
<tr>
<td>FY13</td>
<td>(12,159)</td>
<td>-9.0%</td>
</tr>
<tr>
<td>FY14</td>
<td>(7,006)</td>
<td>-4.5%</td>
</tr>
<tr>
<td>FY15</td>
<td>(4,903)</td>
<td>-4.7%</td>
</tr>
<tr>
<td>FY16</td>
<td>2.6%</td>
<td>4,250</td>
</tr>
</tbody>
</table>

**Energy Deficit (Million Units)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Deficit [MU]</th>
<th>Deficit [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY11</td>
<td>(73,236)</td>
<td>-8.50%</td>
</tr>
<tr>
<td>FY12</td>
<td>(79,313)</td>
<td>-8.46%</td>
</tr>
<tr>
<td>FY13</td>
<td>(86,905)</td>
<td>-8.71%</td>
</tr>
<tr>
<td>FY14</td>
<td>(42,428)</td>
<td>-4.23%</td>
</tr>
<tr>
<td>FY15</td>
<td>(38,143)</td>
<td>-3.57%</td>
</tr>
<tr>
<td>FY16</td>
<td>(23,557)</td>
<td>-2.10%</td>
</tr>
</tbody>
</table>

**FY17**

-13,252
1.10%

Source: CEA Report
Decades back, story was very different

**Installed Capacity and Per Capita Consumption**

- Installed Capacity (GW)
- Per Capita Consumption (kWh/Capita)

**Energy and Peak Deficits - India**

- Energy Deficit - %
- Peak Deficit - %

**Installed Capacity: State, Center and Private Sector**

- Installed Capacity-State
- Installed Capacity-Center
- Installed Capacity-Private

**Low Per Capita:** In 1990 per capita was only around 172 KWH/Capita, by 2016 - 1075 KWH/Capita. IC 64 GW in 1990 to 350 GW in 2016

**High Deficits:** In 1997 Energy and peak deficits were 11.51% and 17.97% respectively, by 2016 reduced to 2.1% & 3.2% only

**Limited Private Sector (PS):** Share of PS - 10% in 2001 to 41% in 2016

Data Source: CEA-Report on Growth of Electricity, other database of CEA
How all this was achieved?
Power Sector Evolution in India

1910
• Private Urban Licenses

1948-75
• Vertically Integrated State Electricity Boards, Planning-CEA, Electricity Supply Act

1975-89

1991-96

1998
• Electricity Regulatory Commission Act; Setting up Independent Regulatory Commission-CERC and SERC

1998-2002

2003
• Land Mark EA-2003 Passed; De-licensing Generation, Competition in the Sector, Open Access, Power Trading as Distinctive Activity and Power Market, Independent System Operator,

Post 2003

Post 2008

With the Legal Framework mandated under EA Act-2003, Power Trading , Power Exchange Developed – Legal, Regulatory Framework is Important , though Initially friendly Guidelines/Regulation and calibrated approach were adopted to promote Market Development

Experiences and lessons learnt from Power Market Development in South Asia/ Rajiv Panda/SARI/ EU/IRADE
Confidential©2017
Current Power Market Structure

Power markets are broadly categorized into four models, with India currently at Model III

1948 - 1970s
Model I - Monopoly
Vertically integrated utility with G, T and D functions
Customers

1970s-2003
Model II - Single Buyer
IPP/CGs
Own Generation
IPP/CGs
Single Buyer
DISCOM
Customers

Model III - Wholesale competition
IPP/CGs/GENCOs
Large Customers
DISCOM
Customers
Wholesale Marketplace
(Bilateral, collective i.e. Power Exchange etc.)
IPP/CGs/GENCOs
IPP/CGs/GENCOs
IPP/CGs/GENCOs
DISCOM

Model IV - Retail competition
IPP/CGs/GENCOs
Retailer
Retailer
Retailer
Wholesale Marketplace
IPP/CGs/GENCOs
IPP/CGs/GENCOs
IPP/CGs/GENCOs
DISCOM / Retailer

Source: Making competition work in electricity – Sally Hunt
Confidential © 2017
India’s Power Sector Experience: It’s Relevance towards Integration of Power system for inter-regional energy transfer/exchange and Market Development in Regional Context

- Electricity in the Concurrent List
- Both Centre and state have power to legislate and govern, state & Centre’s policy, regulation coexist. (29 states)
- India had different regional grid i.e. different power systems. Complex Structure
- Considerable amount of Coordinated harmonization at legal, technical and regulatory level happened over the years for increased inter-regional energy transfer/exchange.

Integration of Regional Grid played the crucial role for Development of power trading and power exchange.

Inter Regional Energy Transfer (TRET) in BUs

- Pre independence - small isolated system, Prior to 60s - State Grids, During 60s - limited interconnection between neighboring states, late 80s – integrated grid operation through 400kv.
- Pre 1991 - Asynchronous inter regional links; long distance HVDC links /b2b stations

Systematic regional planning, grid integration, coordinated harmonization- 9 BUs in 2002 to 105 BUs of IRET by 2016
## Indian Power Sector: Very Complex Institutional Structure

### Inter-state

<table>
<thead>
<tr>
<th>Legislation &amp; Regulation</th>
<th>Ministry of Power, Govt. of India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy and legislation</td>
<td>Ministry of Power / Energy / Electricity, State Govt.</td>
</tr>
<tr>
<td>Plan</td>
<td>CEA</td>
</tr>
<tr>
<td>Regulation and tariff determination</td>
<td>Central Electricity Regulatory Commission</td>
</tr>
<tr>
<td>Licensing</td>
<td>Central Electricity Regulatory Commission</td>
</tr>
</tbody>
</table>

### Intra-state

<table>
<thead>
<tr>
<th>Policy and legislation</th>
<th>State Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan</td>
<td>State Electricity Regulatory Commission</td>
</tr>
<tr>
<td>Regulation and tariff determination</td>
<td>State Electricity Regulatory Commission</td>
</tr>
<tr>
<td>Licensing</td>
<td>State Electricity Regulatory Commission</td>
</tr>
</tbody>
</table>

### Generation

| Inter State Generating Stations-CGS, Mega Power Plants, UMPPs |
| Intra State Generating Stations, Gencos, IPPs |

### Transmission

| Inter State Transmission Licensees |
| Intra State Transmission Licensees |

### Transmission Planning

| Central Transmission Utility |
| State Transmission Utility |

### System Operation

| National and Regional Load Despatch Centers (N,E,S,W, NER) |
| State Load Despatch Centers |

### Billing Settlements

| 5- Regional Power Committee, Preparation of Regional Energy and Transmission Accounts. |
| SEBs, DISCOM, Distribution Licensees |

### Distribution

| Inter State Trading Licensee |
| Intra State Trading Licensee |

### Trading

| Trading Platforms, Power exchanges, - PXs, Bilateral, OTC etc |

### Appellate Tribunal

| Ministry of External Affairs, Ministry of Power, Designated authority, CERC, POSOCO- Coordination for trans-national exchange/Trade of power |
| SERC, DISCOMs, State Governments |

---

**Coordinated Integrated System and Market Operation**

**Decentralized Dispatch**

**Indian Market Design is Based on Decentralized dispatch Concept**

**Regional Load Despatch Centres (RLDCs)** (Regional system operator): Apex bodies in regional grid operation; Supervise and control operation of inter-regional and inter-state transmission systems. RLDCs can give directions to intra-state utilities for security of the grid.

Power Market in India

Competitive Power Market

- **Long Term**
  - Up to 25 Years
  - Power Purchase Agreements (90%)

- **Medium Term**
  - 3 Months-5 Years
  - Bilateral Transactions Over the Counter (OTC) Licensed Traders (43) (5%)

- **Short Term**
  - OTC Intraday 3 Months
  - Contingency Transaction
  - Day Ahead Transaction
  - Collective Transaction
  - Bilateral Transaction
  - Intraday-3 months (3%)

- **Balancing Market**
  - Deviation Settlement Mechanism (DSM)
  - Real Time (2%)

- **Transmission Licensees**
  - 600+

- **Generating Stations**
  - 30+

- **Trading Licensees**
  - 43

- **System Operators**
  - 1 NLDC, 5 RLDCs, 29 State SLDCs

- **Power Exchanges**
  - 2

- **Distribution Utilities**
  - 70+

- **Size of Short Term Power Market**
  - ₹ 240 Billion (4.2 Billion US $)

- **Size of PX Market**
  - ₹ 95 Billion (1.59 Billion US $)

- **Size of bilateral Trader Market**
  - ₹ 145 Billion (2.43 Billion US $)

**ST power market size in FY 2016 was 115.23 BU or 10.4% of total power procured**

Short Term Overall volume has grown at **CAGR of 27% between FY 2008 and FY 2016**

**Balancing Market**

- Real Time

**Power Market Development in South Asia**

Experiences and lessons learnt from Power Market Development in South Asia/Rajiv Panda/SARI/EI/IRADE

Confidential©2017
Short Term Power Market

- **Positive Growth in all segments of the power market (short term).**
- **Growth in Volume in Power Exchange is Significant** from 2.77 BUs in 2008 to 35 BUs in 2016.
- **What is for the Consumer?**
  - Price have gone down due to competition, Choice and market
  - Price through Exchange: ₹ 7.49/Kwh (11.5 Cents) in 2009 to ₹2.72/Kwh (4.2 cents) in 2016
  - Price of Electricity (Trader): ₹ 7.29/Kwh (11.2 Cents) in 2009 to 4.11/Kwh (6.3 Cents) in 2016

Note: 1 US$= 65 ₹

Experiences and lessons learnt from Power Market Development in South Asia/Rajiv Panda/SARI/EI/IRADE

Confidential © 2017
How the power market evolved
Evolution of Power Trading/Power Market in India

1999
- National Electricity Policy: 15% of new capacity can be sold outside PPAs to promote market development; Development of power market by Commissions Tariff Based Competitive Bidding guidelines - Ministry of Power, Trading License Regulations

2002
- Scheduling: Metering, Accounting & Settlement; Availability Based Multi-Part Tariff; Imbalance Pricing

2003
- Grid Code (1999)
- Incorporation of Power Trading Corporation of India Ltd

2004
- EA 2003 - recognition of electricity trading as distinct activity; promotion of competition & introduction of open access;

2005
- Open Access in transmission introduced; Trading license granted to PTC India Ltd

2006
- Need to Create a Common Trading Platform Power Exchange Guidelines (2007); Power exchanges IEX & PXIL launched

2008
- CERC Trading License Regulations; CERC Congestion Regulation – calculation of available transfer capability & congestion charges, Grant of Connectivity, LTA and MTOA

2009
- Fixation of Trading Margin Regulations; Power Market Regulations: Role of PXs defined and norms for setting up and operating PX, Sharing of Inter-state transmission charges & losses regulations

2010

2011
- IEGC 2010 REC
- Transm ission Pricing (POC)

2014
- POC Regulations: Transmission Pricing rationalized DSM Regulations

2015
- CERC Ancillary Services Regulation RE Framework Ancillary Services

Four Pillars of Market Design

- Scheduling & Dispatch
- Congestion Management
- Ancillary Services

Gradual and step by step approach Through Progressive Policy and Regulatory Interventions....., Basic Ingredients were put in place

"Making Competition Work in Electricity" Sally Hunt
Power Exchange in India - Key Features

- Multiple Power Exchanges
- Voluntary participation
- Nationwide, Online and Electronic platform
- Auction: Double sided closed bidding
- Price Discovery: Uniform pricing – price of the marginal supply
- Day-ahead exchange
- 15 Minute Bids
- Congestion management by market splitting
- Power exchanges in India is based on the Nord pool market concept*
- Implementation and regulatory regime for PX customized to Indian Context.
- Risk Mitigation: PX acts as the counterparty in the trade and absolves the participants of any risk of payment defaults.

*Restructuring Developments and Issues in Indian Power System, [Link](http://searchdl.org/public/journals/2011/IJRTE/5/2/597.pdf)
[Link](http://www.cercind.gov.in/2013/orders/180_2010.pdf)

Why Power Exchange

- Efficient portfolio management, Management of daily demand variations
- Payment security, price discovery (no need for negotiations)
- Uniform Market Clearing price
- Low transaction cost, Low Overheads, Physical Delivery Based
- Electronic, on-line bidding, Standardized Contracts,
- Transparent market platform - facilitates delivery based trading
- Market development - competition increases, promotes efficiency and Optimum Utilization of Scarcity energy resources
- Efficient portfolio management, Management of daily demand variations

Social Welfare Maximization

- Sold at MCP
- Generators Surplus
- Consumers Discount
- Social Welfare Maximization

Accepted Purchase Bids (>= MCP) (Consumers’ Discount)
Accepted Sale Bids (<= MCP) (Generators’ Surplus)

No Financial products such as Derivatives and Forward contracts **DAM Market

*Restructuring Developments and Issues in Indian Power System, [Link](http://searchdl.org/public/journals/2011/IJRTE/5/2/597.pdf)
[Link](http://www.cercind.gov.in/2013/orders/180_2010.pdf)

1: Physical delivery-based market – not susceptible to any kind of manipulation
Development of Power Exchanges in India

The earlier Development helped in effective for launch and adoption of power exchange platform in India:

- Basic Principle of Design need to be considering and customised.
- Streamlined Scheduling and Settlement Mechanism to penalize deviations.
- A robust and efficient national Load dispatch center and institutionalized coordination among region load dispatch centers.
- Open Access to network, Policy and Regulatory framework
- Bilateral trading was happening, trading of electricity were allowed.
- Regulatory Oversight and Governance
- Provision to allow for selling power apart from long term PPAs and third party purchase.
- Light handed Regulation in initial years.

Power Market Regulation came after power exchange started functioning

Four Pillars of Market Design

- Electricity Market
  - Scheduling & Dispatch
  - Congestion Management
  - Ancillary Services
  - Imbalances

"Making Competition Work in Electricity" Sally Hunt

Enactment of EA 2003
Bilateral trading was happening

Guidelines on setting up PX

Guidelines on
• Guidelines for Collective Transactions
• Guidelines for Scheduling of transactions on PX

January: Revised regulations for Open Access

June -IEX & Nov-PEX Launched, Spot Market

Open access Regulation

CERC staff paper on PX

Extended Market Session

April, 2012: Sub-Hourly Market (15 Min Bidding in PX)
Products on Power Exchange

Day Ahead Market
Since June 2008

Term-Ahead Market
Since Sep 2009
Extended Markets
Since July 2015
(TAM provides a range of products allowing participants to buy/sell electricity on a term basis for a duration of up to 11 days ahead.)

Renewable Energy
Certifications
Since Feb 2011

Day Ahead Contingency*: Trading window of 1500-2300 hours, Hourly Intra-Day*: Extended Market: Trading window increased to 0030 – 2000 hours for same day delivery starting at 0400 HRs-Hourly Block, Continuous trading Daily*: for rolling seven days (delivery after 4 days)-Block of Hours Weekly**: for next 1 week-Block of Hours

Green Attributes as Certificates*
Sellers: RE generators selling at APPC
Buyers: Obligated entities (1MWh equivalent to 1 REC)

Auction: Closed, Double-sided**
1000-1200 hours bidding
Each 15-min block, 0.1 MW min,

Trade Through Exchange
DAM is 97%

Trade on IEX and PXIL

Percentage consumption traded on Exchanges

Power Exchanges witnessed growth at a CAGR of 62% (FY-09 to FY 15).

Power Exchanges provides an electronic platform to facilitate the trading of electricity at a national level in following products.
Some key Issues/factors discussed/debated Prior to setting of PX

- National power exchange Vs Many power exchanges
- Mandatory Vs Voluntary participation
- Regulation of power exchange
- Interface between power exchange and system operator
- Double side bidding Vs supply side bidding
- Ownership and management of power exchange
- Unscheduled interchange (UI) vis-à-vis power exchange
- Timing for launching power exchange
- Day-ahead exchange Vs same day exchange
- Congestion management
- Implicit versus explicit Auction
- Time block for bidding
- Uniform pricing Vs Discriminatory pricing
- Concerns of Licensed Traders
- Source: http://cercind.gov.in/03022007/Commonplatformforelectricitytrading.pdf
- Source: statement of reasons- Development of a common platform for electricity trading
### Key PX Issues raised & Appropriately resolved Prior to setting of PX

<table>
<thead>
<tr>
<th>National power exchange Vs Many power exchanges:</th>
<th>Multiple power exchange was allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory Vs Voluntary participation</td>
<td>Voluntary Participation</td>
</tr>
<tr>
<td>Double side bidding Vs supply side bidding</td>
<td>Double Side Bidding (DSB) adopted</td>
</tr>
<tr>
<td>Concerns of Licensed Traders</td>
<td>Traders allowed for membership of PX</td>
</tr>
<tr>
<td>Ownership and Management of Power Exchange</td>
<td>No Ownership Condition, FDI is allowed</td>
</tr>
</tbody>
</table>

Initially it was argued to have one PX because of complex city of Coordination with System Operators, Volume of Business etc. but later; One PX would be a monopoly and will be complacent in the long run,

The main objective of PX in India was to provide more option to utilities/entities. It was argued, advantage of Voluntary PX is that impact of price fluctuations, which are not so uncommon in trading through PX will, at least to some extent, be cushioned by negotiated bilateral trading.*

DBS is more suited for markets where decentralized dispatch is in vogue. (In India, scheduling and dispatch is being done on decentralized basis). In DBS, buyer's demand is sensitive to prices, which is good for DISCOMs**

The Licensed Traders concerned about the adverse impact that the establishment of a PX on their business operations.

The general approach of the CERC is to allow operational freedom to the PX within an overall framework and PX regulation that would be minimal and restricted to requirements essential for preventing derailment/accidents and collusion. PX in India Private Sector Initiatives

---

*Meeting demand irrespective of the prices may not suit distribution licensees in India, due to poor financial condition of most of the distribution licensees. In any case, load shedding due to shortage of power is not uncommon. Therefore, submitting demand with reference to price appears to be the right choice for PX in India.

**On the other hand, when supplies to PX are expected to be limited, which is the case in our country, mandatory participation may help in improving liquidity and reduce price fluctuations. It is suggested that participation in the PX could be voluntary, at least to begin with.

Regulations impacting PXs in India

**Act**
- Electricity Act, 2003

**Regulations**
- CERC (Open Access in Inter State Transmission) Regulations, 2008
- CERC (Indian Electricity Grid Code) Regulations, 2010
- CERC (Power market) Regulations, 2010
- CERC (Terms & Conditions for recognition/issuance of REC for RE Generation) Regulations, 2010
- CERC (Deviation Settlement Mechanism & related matters) Regulations, 2014

**Guidelines**
- Procedure for Scheduling of Collective Transaction
- Procedure for Scheduling of Bilateral Transactions
- The By Laws of Exchange approved by CERC
- Business Rules of Exchange approved by CERC
- Detailed Procedure for REC
- Detailed Procedure for ESCerts

**Exchange Committees**
- Risk Management Committee (RMC)
- Market Surveillance Committee
- SGF Management Committee

- Membership
- Market Operations
- Trading System
- Inspection

Experiences and lessons learnt from Power Market Development in South Asia/Rajiv Panda/SARI/EI/IRADE
Power exchanges have contributed immensely in the development of the following aspects of Indian power market.

Bringing a Culture of Power Trading and a competitive mindset & commercial outlook on part of utilities/stakeholder.

The power exchanges supported the transactions and price discovery for RECs and is expected to do the same for ESCerts.

Supported the REC market

The price splitting mechanism provided proper price signals which aided in triggering additional generation and transmission investments, especially in the southern region.

Competitive market development

Around 3% of the total generation is being traded through power exchanges.

The total trade of 35005 MU in FY 2015-16 is equivalent to about 7% of the total annual trade of Nord Pool in 2015.

Manage contingencies and utilize surplus

By offering intra-day products and extended sessions, the exchanges have offered a forum for management of intra day contingencies for the utilities.

Price signals to correct regional constraints

Congestion in Power Exchanges, 2009-10 to 2015-16

Experiences and lessons learnt from Power Market Development in South Asia/Rajiv Panda/SARI/EI/RADE

Confidential ©2017
Key Lessons: Power Market and Exchange Development in India

- Step by Step and Gradual Approach, Political Support is essential*
- Infrastructure development is the key: Interregional transfer capacity increased from 5 GW in 2002 to 67 GW by 2017*.
- Trading and Market Development mandated by the Law*.
- Recognition of the Need of comprehensive legal, policy, regulatory ecosystem for market Development.*
- Consultative Approach and conducive regulatory framework for market development*.
- System Operator/TSO is the key and coordination among system operators is important*.
- Open Access to the networks*
- Balancing interest of all stakeholders while allowing market to development.**
- Institutionalisation the power system coordination*.
- Multi Buyer Model and Imbalance Settlement Mechanism*
- Unbundling of Utilities*

Ecosystem for Market Development

- Grid Code, Open Access, Licensing, Tariff, scheduling & dispatch, loss & Congestion Management, Regulatory oversight/monitoring
- Legislative - De-licensing, Competition, Market Access, Institution & Capacity Building
- Act, Policy, Reforms enabling Trading, Power Market Development, National Electricity Policy.

Integrated System Planning, Medium Term, Long Term, Grant of Access, Protection Coordination, Standards, Metering

Planning and System Operation

Market Access
De-licensing, Competition in the Sector
A Regulatory framework and coordinated harmonization
Payment Security, Dispute Settlement, Congestion Management

* Pre requisite **Desirable

Regional Investment Framework and Policy Guidelines for promoting investment in South Asian Power Sector and in Cross-Border Electricity Trade in South Asia/Raju Panda/SARI/EI/IRADE –Confidential ©2017
Key Lessons: Power Market and Exchange Development in India

- Putting basic ingredients in place before Launching the PX*.
- PX- Voluntary, marginal pricing approach*
- POC mechanism, facilitate integration of electricity markets by obviating the need for pancaking of transmission charges.
- Learning from international experience, but customizing to suite your need.
- Policy Makers need to have a long term vision of at least 10 years for Market development.*
- The Market has evolved over a period of time.
- The market to some extent achieved the stated policy goals, including competition though still a long way to go.
- Indian experience demonstrates, that under the right conditions backed with light-handed regulation in initial years, it is possible to evolve a market even with a complex sector structure. Regulatory Oversight and Monitoring is Crucial.
- Co-existence of multiple power exchanges: In spite of dominance of one exchange, the presence of more PX offers protection and choice to the exchange trading members.

Ecosystem for Market Development

- Market Access
- Act, Policy, Reforms enabling Trading, Power Market Development, National Electricity Policy
- De-licensing, Competition in the Sector
- Grid Code, Open Access, Licensing, Tariff, scheduling & dispatch, less Management, Regulatory oversight/Monitoring
- Payment, Security, Dispute Settlement, Congestion Management
- A Regulatory framework and coordinated harmonization
- Integrated System Planning Medium Term, Long Term, Grant of Access, Protection Coordination, Standards, Metering
- Legislative - De-licensing, Competition, Market Access, Institution & Capacity Building

* Pre requisite
Prospect for Cross Border Electricity Trade (CBET) through Power Exchange in South Asia
Current CBET Policy and Regulatory Governing Framework

CBET Policy Governing Framework. It is mainly through Bilateral Agreements/MoU between Countries. Trilateral Initiative in near future

India-Bhutan(2006), Framework IG Agreement for joint venture projects. India-Bangladesh


Some Countries have adhoc Regulatory Arrangements. Countries are taking steps on Regulation, Policy side for CBET. GoI issued CBTE Guidelines. Draft Regulation issued by CERC

Open access, Trading license, Imbalance settlement, Congestion management, Grant of Connectivity etc. exist in India only. Institutional Framework Evolving

### Current CBET Trading Arrangements

<table>
<thead>
<tr>
<th>Country</th>
<th>Current CBET Trading Arrangements</th>
<th>Type of Transaction i.e. Negotiation or Market determined</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bhutan (Exporter) → India</strong></td>
<td>Chukka, Kurichhu Hydro Projects</td>
<td>Negotiated (G to G)</td>
</tr>
<tr>
<td></td>
<td>Tala Hydro Project</td>
<td>Negotiated (G to G)</td>
</tr>
<tr>
<td></td>
<td>Dagachhu Hydro Project</td>
<td>Commercial</td>
</tr>
<tr>
<td><strong>India (Net Exporter) → Bangladesh</strong></td>
<td>Long-term contract with NVVNL for 250 MW</td>
<td>Negotiated (G to G)</td>
</tr>
<tr>
<td></td>
<td>Medium-term contract with for 250 MW</td>
<td>Market determined /Commercial</td>
</tr>
<tr>
<td><strong>India (Net exporter) → Nepal</strong></td>
<td>Bilateral contracts / Treaties to the tune of 237 MW</td>
<td>Negotiated (G to G)</td>
</tr>
<tr>
<td></td>
<td>200 MW More</td>
<td>Market determined /Commercial</td>
</tr>
</tbody>
</table>

Trilateral Memorandum of Understanding between Bangladesh, Bhutan and India for Cooperation in the field of Hydroelectric Power had been worked out and noted that it would be signed at an occasion when leaders of all three countries would be present together. India - Bangladesh Joint Statement April 08, 2017

Confidential ©2017
### Challenges and Approach for Cross Border Electricity Trade (CBET) in South Asia Regional Power Market Development in South Asia

#### Approach
- Deepening the bilateral trade, accelerating the implementation of planned projects.
- Disseminate the positive benefits of trade, making consumer central in CBET argument.
- While deepening bilateral trade, recognising the market form of trade - allowing bilateral trade on commercial/market basis. (Out of 2303 MW, 550 MW - commercial/market basis).
- Bottom up Approach for Regional Regulatory Framework (RRFs) for CBET & Institutionalisation of CBET process: Coordinated Harmonization through existing mechanism for CBET only, This will make preparation/ adoption of regional regulation acceptable, easy and acceptable. RRFs are important.
- Strong level of operational, system operator, technical/grid code harmonization, Joint Planning, imbalance settlement mechanism via formal/informal Institutionalised process is a prerequisite.
- Innovative ways to address legal issues, without pursuing long process for amending Laws.
- Opening up of electricity sector guided by respective national priorities with the aim of promoting competition*, Regulatory & Technical capacity building. Opening of PX for CBET.
- No preconditions such as sector reform, unbundling etc for CBET, Co-existence of different degree of market reform.
- Taking steps for trilateral cooperation/trade, sub regional, transit trade (India-Bangladesh-India) Road to Regional full scale Multilateral trade is through bilateral, trilateral and sub regional route. Allowing CBE Trade through Power Exchange (Gradual opening of Products**).

#### Challenges
- Different of policy, legal, and regulatory mechanisms.
- Countries are Different stage of power sector, depth of regulatory framework.
- Building Strong of transmission system interconnections.
- Developing Regional Electricity Markets from bilateral markets.

---

*SAARC Framework agreement for energy cooperation (electricity)
**Term Ahead, intraday/contingency Markets are allowed now.
Regional Transmission Interconnection Capacity by 2036 and Development of Cross Border Transmission Infrastructure

Additional 36.9 GW Cross Border Grid Interconnection by 2036

Bangladesh is in the process of planning to import around Apprx. 6000 MW by 2034 (PMSP 2015-JICA Presentation, 4th June, 2015)

Approach for Development of Cross Border Transmission Infrastructure & its economic utilization

1200 MW Capacity Corridor

720 MW Long Term

240 MW Short/Medium Term

240 MW through Power Exchange

Balance Product Portfolio

Source Data: http://www.cea.nic.in/reports/others/ps/pspa2/ptp.pdf
Perspective Transmission Requirements for 2022-36 Bangladesh is in the process of planning to import around Apprx. 6000 MW by 2034 (PMSP 2015-JICA Presentation, 4th June, 2015)

Disclaimer: By making any reference to a particular geographic area or by using the term “country” and Map in this document, IRADe/USAID does not intend to make any judgement as to the legal or other status of any area/Map. The map used 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
Why Short Term Spot Market? - Cross Border Electricity Trade through Power Exchange in South Asia: Recent Developments

- The significant diversity of demand among the South Asian countries
  - Non-Coincident Peaks
  - Daily demand variation etc.
  - Variation of seasonal demand provides complementarities and opportunity of optimal utilization of resources.
- These variation are substantial in South Asian region and providing a sizable opportunity for a short-term market and a regional day ahead market.

Government of Nepal and the Government of India signed agreement on electric power trade, cross-border transmission interconnection and grid connectivity which allows power trade through power exchange. (2014)

IEX Petition to CERC for CBET through Power Exchange (2014)

Tata Power Trading Company petition-To allow/enable the to sell the power procured from the Dagachhu Hydro Power Corporation, in Bhutan, through power exchanges (2015).

Both Petition disposed of. Commission has to frame regulations for facilitating cross border power trade*.

Government of India CBTE guidelines have allowed the trading through power exchange for Term Ahead , intraday/contingency Markets (Dec, 2016).

Draft Regulation by CERC has been issued, public hearing has been conducted (Feb, 2017)

Seasonal complementarity—Monthly Electricity Load Profiles across South Asia

<table>
<thead>
<tr>
<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India-North-East</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bhutan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India-East</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India-North</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India-West</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India-South</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: How Much Could South Asia Benefit from Regional Electricity Cooperation and Trade? World Bank Group policy research working paper 7341, June 2015

International Experience: Key Messages for Cross Border Electricity through Exchange – Options for South Asia

• Existing power exchanges in one country in the region was graduated to operate as cross border power exchange. Other countries of the region start joining the exchange (Nord Pool*)

• No existing power exchange in the Region, Countries together Jointly form a Regional Power Pool (SAAP, WAAP).

• Power exchange exist in various countries of a Region, power exchanges coordinated among themselves through coupling for cross border power exchange (Europe).

• Cross Border Power Exchanges mostly have TSOs, national PXs or market operators as owners.

• In South Asia, India** has two operating power exchanges. In India power exchange are private sector initiative.

Summary: one Existing Liquid Market were extended. In case of no existing market, new Regional Exchange is formed. In case of Existing of Multiple Exchange, coordinated exchange operation.

Options for South Asia

Immediate Step

Existing Power exchange of India can be extended to operate as Cross Border Power Exchange

Some legal, regulatory changes will be required and some very Basic Perquisite such as trading as distinct activity, Regional Scheduling & dispatch, imbalance settlement, open access and regulatory coordination, some basic technical harmonization etc. to be put in place. The Business Rules, Bye-laws of PXs needs modifications

Medium/Long Term

South Asian Countries can come together to build a Regional Power Exchange

If other SA countries have build their own exchange in future, then the power exchange can come together to develop a coordinated power exchange mechanism for cross border trade of power

Four Pillars of Market Design

Scheduling & Dispatch

Congestion Management

Ancillary Services

Imbalances

CTU, STU, System Operator been barred from engaging in the business of Trading in Electricity as per EA Act 2003

* In 1996, A joint Norwegian-Swedish power exchange is established. The exchange is renamed Nord Pool ASA. Spot markets may exist as Pools or Exchanges, Exchanges use the market clearing and competition Work in Electricity “Sally Hunt

Confidential©2017
Why Regional Power Exchange

- Daily demand variation is substantial in South Asian region and providing a sizable opportunity for regional day ahead market.
- Need to explore the short term Market Opportunities.
- To extract the full benefit of regional power trade through a Short term market trade, a Regional Power Exchange is an credible Option.
- Power Exchange Experience in India provides Ground for the Concept for Regional Power Exchange in the Region.
- Mock exercise will run as a Day Ahead Market

Objective of this Exercise

- Ascertain the feasibility of SARPEX.
- Drafting the market design and rules for the South Asian Regional Power Exchange
- Enhance/Capacity Building of participants from South Asian countries on the function and Operation of Power Exchange.

Parties are Involved in the Execution of SARPEX

- Market Advisory Committee
  - Key Expert of Power Market and Exchange
- Nominated Government officials from respective country Governments for SARPEX
  - Core Team
- SARI/EI & Consultant Team

Residual Mode
- 60 days of bidding

Unified Mode
- Double Sided Closed Bids (DSCB) auction
- Uniform Pricing mechanism UMP,UMV

Step wise clearing algorithm for price discovery

Exercise aims for Unconstrained Market Price (UMP) and Unconstrained Market Volume (UMV)
No impact of transmission constraints is considered
Way Forward for creation of South Asia Regional Power Exchange

- Political Support at Regional Level is essential for Regional Power Market and Power Exchange Formation.
- Coordinated Harmonization of Legal, Regulatory and Policy Framework form the perspective of Cross Border Electricity Trade only. A minimalist approach is advised to be followed from the view of CBET only, But no compromise on transparency, accountability.
- However Basic Requirements of trading and power exchange to be put in place such as
  - Power Trading as distinct activity.
  - Regional Scheduling & dispatch mechanism and procedures, imbalance settlement Mechanism
  - Open access in Transmission.
  - Regulatory coordination, Coordinated system planning.
  - Efficient and Independent system operator; rule, process and guidelines coordination of trade transactions among system operators.
- Legal, Regulatory changes may be time consuming, a very basic framework in the form of non binding guidelines may be devised and agreed upon for voluntary power exchange based trading in the transition phase until formal Harmonization.
- Strong transmission Interconnection infrastructure will be crucial, regional transmission pricing mechanism.

Regional Investment Framework and Policy Guidelines for promoting investment in South Asian Power Sector and in Cross Border Electricity Trade in South Asia/Rajiv Panda/SARI/El/IRADE – Confidential ©2017
Thank You

Contact
rajivratnapanda@irade.org
rajivratnapanda@gmail.com
Short Term Electricity Trades

• PX Volumes in FY 16 increased by 19% and comprised 61% of ST transactions
  ▪ Day Ahead Market (DAM): 48.4%
  ▪ Bilaterals - Traders: 50.3%, TAM: 1.3%
• Volume of transactions between Discoms directly was 21% of the total short term transactions, an increase of 3% over FY 2015
• Volume of energy transaction through DSM was 18% of the total short term transactions
  - Weighted average price of electricity transacted in FY 2016 through
    ▪ Bilaterals - Traders :Rs 4.11/kWh
      • Round the clock (RTC) basis: 80.68% (Rs 4.24 / kWh)
      • Periods other than RTC and Peak (OTP): 17.70% (Rs 3.53 /kWh), Peak hours: 1.62% (Rs 3.46 / kWh)
    ▪ Power exchanges: Rs 2.72/kWh
      • Day Ahead Market sub-segment of PX: Rs 2.72/kWh
      • Term Ahead Market sub-segment: Rs 2.96/kWh

In monetary terms, short-term market size was Rs 24,096 crore, which was 4% less than in the year 2014-15
**India-Bangladesh Interconnection**

- **Reduction in load shedding with round the clock availability of power** from India (500 MW: 5th October, 2013) (100 MW: March 23, 2016)

- **Access to Cheaper source of Electricity**

- **The estimated Annual savings would be around Taka 40 billion (US$500 million approx.)** (Shahi 2014).

**India-Bhutan Interconnection**

- **Bhutan envisages the development of at least 10,000 MW by 2020.**
- **95% of Population Electrified.**
- **Close to 75% of all electricity generated is exported to India.**
- **Hydropower exports (only surplus) provided more than 40% of Bhutan’s revenues, and constitute 25% of its GDP.** Now it is around average 12.28%. Since 2010.
- **Helps in Sustaining High GDP Growth Rate, Modernization of power infrastructure.**

**Bhutan - Electricity Access (% Population)**

- **1990:** 65.61%
- **2000:** 68.45%
- **2012:** 75.56%
- **2015:** 95.54%

**Bhutan - Electricity Access (% Population)**

- **1990:** 0%
- **2000:** 50%
- **2012:** 100%
- **2015:** 150%

**GNI Per Capita PPP (current international $)**

- **2010:** $2,850
- **2012:** $4,000
- **2014:** $6,500

**Load Shedding in Bangladesh (MW)**

- **2009-10:** 1459
- **2010-11:** 1335
- **2011-12:** 1058
- **2012-13:** 1048
- **2013-14:** 932
- **2014-15:** 307

**BPDB IPP Rental Public Plants Import from India**

- **Avg power purchase cost:** 6.27 Tk/KWh

**Source:** http://www.ideasforindia.in/article.aspx?article_id=1589

**Experiences and lessons learnt from Power Market Development in South Asia/Rajiv Panda/SARI/EI/IRADE**

**http://thediplomat.com/2016/06/india-and-bhutan-cross-country-power-connectivity/**

**http://www.oecd.org/countries/bhutan/48651659.pdf**
REC Market - Salient Features

- **Number of Solar RECs transacted in FY 2016**
  - IEX were 4,65,456
  - PXIL were 1,82,745

- **Market clearing price of Solar RECs**
  - Market clearing price of Solar RECs was Rs 3500/MWh on both IEX and PXIL

- **Market clearing volume of Non-Solar RECs transacted in FY 2016**
  - IEX were 26,73,434
  - PXIL were 16,33,518
  - Market clearing price of Non-solar RECs was Rs1500/MWh on both IEX and PXIL

- **REC Inventory - FY 2017**
  - Opening Balance (Apr 2016): 165,91,968
  - Closing Balance (Feb, 2017): 178,79,467
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Term Open Access</td>
<td>&gt; 7 years and up to 25 years</td>
<td>&gt; 7 years</td>
<td>Two Part Tariff</td>
<td>CTU for Inter-state STU for Intra-state</td>
</tr>
<tr>
<td>Medium Term Open Access</td>
<td>1 – 5 years</td>
<td>3 months to 5 years</td>
<td>Single or Two Part Tariff</td>
<td>CTU for Inter-state STU for Intra-state</td>
</tr>
<tr>
<td>Short Term Open Access</td>
<td>Upto 1 year</td>
<td>Upto 3 months</td>
<td>Single Part Tariff</td>
<td>Buyer RLDC for Inter-state SLDC for intra-state</td>
</tr>
<tr>
<td>Short Term Open Access – Bilateral</td>
<td>Day Ahead Market (1 day)</td>
<td>1 day</td>
<td>Single Part Tariff</td>
<td>NLDC</td>
</tr>
<tr>
<td>Short Term Open Access – Power Exchange</td>
<td>Term Ahead Market (up to 10 days)</td>
<td>Upto 10 days in advance</td>
<td>Single Part Tariff</td>
<td>NLDC</td>
</tr>
<tr>
<td>Deviation Settlement Mechanism</td>
<td>Real Time</td>
<td>NA</td>
<td>Frequency linked</td>
<td>RLDC</td>
</tr>
</tbody>
</table>
Power Exchange Market Products -- Term Ahead Market (TAM)

- Term-Ahead-Market (TAM) provides a range of products allowing participants to buy/sell electricity on a term basis for a duration of up to 11 days ahead.
- Products in the Term Ahead Market include Intra-day, Day-Ahead Contingency, Daily and Weekly contracts to help participants manage their electricity portfolio for different durations.

  - Key features
    - Trading of Region specific contracts
    - Firm Delivery: Contracts under Term Ahead Market can be used to ensure delivery of electricity for a few days in advance
    - Delivery Blocks:
      - Round the Clock (RTC)
      - Day
      - Night
      - Peak
      - Hourly

Power Exchange Market Products - Day Ahead Contingency (DAC)

- Day-Ahead Contingency auction for all the 24 hours, subdivided into hourly contracts.
- Allows Sell bids region wise for the first hour of trade followed by Buy bids
- Buyers allowed to see price and the region of the Seller but the seller identity will not be revealed. Buyer can bid for any region that is feasible for him.
- Auction mechanism is used with Differential pricing
- Bids matched are included in the day-ahead schedules
  - Buy trades settled at or below the quoted price and Sell trades are settled at or above the quoted price
  - There is complete anonymity of the bids between members
  - There is a Bilateral contract between Buyers and Sellers.
  - Financial settlement and clearing is done by the exchange.

- DAC market comes under the Bilateral Transactions.
- Scheduling procedure is handled by Nodal RLDC (Buyers region RLDC) in case of DAC
- Congestion management through curtailment or re-routing of trade as per the instructions of Nodal RLDC or SLDC

Source: www.powerexindia.com
Power Exchange Market Products - Intra-Day

- Intra-Day market allows participants to trade electricity for specified hours of the same day. Participants can place bids for each hour or for a block of hours as required.
- Power procured through Intra-Day allows the market participants to manage contingent spikes in demand and supply unforeseen on a day-ahead basis.
- This brings the participants much closer to the real-time market in an organized way without resorting to UI mechanism.

- Salient Features of Intra-Day Product:
  - Allows participants to trade power within the day for delivery starting three hours from the trading.
  - Intra-Day Auction applies for delivery up to 24 hrs of next day.
  - Each contract sub-divided into hourly contracts - 8 time blocks ahead to 24 hr basis on 15 min or multiples thereof.
  - Discriminatory pricing mechanism used as the matching methodology whereby the exchange ensures that the maximum benefit is given to both buyers and sellers.
  - Intra-day market is traded on a bilateral basis with financial settlement and clearance taken care by the Exchange.

Renewable Energy Certificate (REC)

- REC mechanism introduced to ease the purchase of renewable energy by the state utilities and obligated entities.
- REC framework seeks to create a national level market for renewable generators to recover their cost.
- A generator can generate electricity through renewable resources in any part of the country. For the electricity part, the generator receives the cost equivalent to APPC while the environment attribute is sold through the exchanges at the market determined price.

<table>
<thead>
<tr>
<th>Participation</th>
<th>Voluntary / RPO Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>REC Denomination</td>
<td>1 MWh</td>
</tr>
<tr>
<td>Validity</td>
<td>3 years after issuance</td>
</tr>
<tr>
<td>Categories</td>
<td>• Solar REC • Non-Solar REC</td>
</tr>
<tr>
<td>Trading Platform</td>
<td>Power Exchanges only</td>
</tr>
<tr>
<td>Banking</td>
<td>Not Allowed</td>
</tr>
<tr>
<td>Transfer Type</td>
<td>Single transfer only, repeated trade of the same certificate is not possible</td>
</tr>
<tr>
<td>Penalty for Non-compliance</td>
<td>Forbearance’ Price (Maximum Price)</td>
</tr>
<tr>
<td>Price Guarantee</td>
<td>Through ‘Floor’ Price (Minimum Price)</td>
</tr>
</tbody>
</table>
Why Cross-border Electricity Trade Investment are Risky

- Project risks in general tend to be high with out a comprehensive Policy, Regulatory framework for large CBET project development.

- Cross-border element greatly amplifies the risks due to geopolitical, economic and trade related factors.

- Even projects that appear to have feasible, rationale, economical in practice struggle to get it financed and built.

- Project risks in general tend to be high in countries without wide experience on large project development.

Political: What happens if for political reasons the flow is prevented in the exporting, intermediary (if relevant) or importing country?

Regulatory: What happens if the domestic Policy, regulatory framework changes which impacts CBET project/Investment? What is the protection available to buyers/sellers/Investor?

Economic: What happens if the economic assumptions on the project changes? What is the protection available to buyers and sellers?

Trade Barrier: What happens if a tax or duty that affects the economic fundamentals is imposed?

Infrastructure: What happens if the infrastructure to transfer the energy is not built or is not available when needed?
Total CBET in SA 2363 MW

- Small power system
- Import heavy
- Limited spare capacity (FO)
- Importer (from Turkmenistan)

- Very small power system
- Hydro based
- Deficit
- Importing (now) from India
- Potential exporter and importer

- Large power system
- Gas/FO heavy,
- Large deficits
- No trade at present (but trade proposed with India)

- Very small power system
- Hydro based
- Surplus
- Spare capacity
- Exporting nation (to India)

- Very large power system
- Coal heavy,
- Reducing deficits
- Contract (89%) and markets (11%) driven
- Significant spare capacity
- Importing and exporting nation

- Small power system
- Gas heavy
- Large deficits
- No spare capacity
- Importing nation (from India)

- Fragmented power system
- High costs (diesel based)
- Limited trade possibilities

- Small power system
- Balanced
- Limited spare capacity
- No trading at present
- Potential exporter and importer

Confidential©2017
South Asia Regional Power Market Development for CBET

- Currently most of the Cross Border Electricity Trade projects are backed by government and rightly so as it brings confidence.

- Currently trade is facilitated by G2G bilateral agreements, Nodal agencies facilitates the trade.

- However looking at the scale of investment required, there is need for market form of development of CBET with Government playing a strong facilitator role.

- There is a need to create a Regional Power Market to support these development.

- Development of power exchange in India opens up new oppourtunities for CBET and building Trans Power Exchange

<table>
<thead>
<tr>
<th>Principle of determinati on</th>
<th>Bhutan-India</th>
<th>India-Bangladesh</th>
<th>India-Nepal</th>
</tr>
</thead>
<tbody>
<tr>
<td>The tariff for both Tala and Dagachhu PPAs was determined on a negotiated basis</td>
<td>The tariff for NVVNL PPA is as per CERC regulations (agreed based on negotiation). On the other hand, tariff for PTC PPA was determined through competitive bidding</td>
<td>The tariff in both Treaty/Bilateral arrangement and PTC PPA was agreed based negotiation</td>
<td></td>
</tr>
</tbody>
</table>

Bhutan- JV-IG Projects Tariffs

- 1st year Tariff (Nu/INR per kWh)
- Levelised-Tariff (Nu/INR per kWh)

Source: Complied from various sources. Note: Tariff for 1st year for IG projects of PHPA, MHPA, CHP, THP, KHP are not Available.
• ST power market size in FY 2016 was 115.23 BU or 10.4% of total power procured

• This was about 16% higher than market in the year 2014-15 (98.99 BU)

• Short Term Overall volume has grown at CAGR of 27% between FY 2008 and FY 2016

• The growth in FY 16 (16.24 BU) mainly on account of positive growth in transactions through power exchanges (5.60 BU) and by direct bilateral transactions between the DISCOMs (8.47 BU)

• The top 5 trading licensees together contribute 72% of the overall trading market volume.

• The top 10 trading licensees together contribute 92% of the overall trading market volume

Source: CERC
DAM Time Line

By 9.30 HRs
Initial Margin check

10:00 am to 12:00 pm
Power Bid Call session
Bids for 15-min each or block bids can be placed - DSCB

12.00 - 13.00 Hrs
PX calculates the MCP & MCV, Communicated the Unconstrained solution to the NLDC. Communicates to the bank to confirm and block pay-in form buyers member’s account.

By 13.00 - 14.00 Hrs
NLDC to check for congestion. In case of congestion, NLDC intimates the PX the period of congestion and available margin. Corridor availability and funds verified

By 14.30 Hrs
Buyers pay to IEX (Pay-in)

by 15:00 Hrs.
Final ACV and ACP calculated. Market split if congestion.IEX calculates the Area clearing price based on transmission network available and send scheduling request to NLDC

by 17:30 Hrs
Collective transaction confirmation by NLDC. IEX send the detail schedule to SLDCs

by 18:00 Hrs
Final Schedule sent to RLDC for incorporation/RLDC and SLDC incorporate the collective transaction in the daily schedule

D+1, By 14.00 Hrs
IEX Makes payment to the seller

---

DAM and TAM Trading Timeline at IEX

Energy Overview of South East Asia

Myanmar
Low levels of energy access and high reliance on biomass and hydropower; increasing domestic gas production.

Thailand
Second-largest energy consumer; oil and gas producer, but increasingly dependent on imports; gas is primary fuel in electricity.

Cambodia
Low levels of energy access and low per-capita energy demand; potential for oil and gas production.

Singapore
Key global refining and petrochemical hub and developing gas-trading hub; almost entirely dependent on energy imports.

Indonesia
Largest energy consumer, rising domestic needs has led it to reorient some energy production to domestic market; world’s largest coal exporter and major LNG exporter.

Lao People’s Democratic Republic (LAO PDR)
Significant hydropower potential with aims to export to neighboring countries.

Viet Nam
Growing energy demand has led to increasing imports despite domestic production of fossil fuels; making progress towards introduction of nuclear power.

Philippines
Heavily dependent on imports; world’s second-largest geothermal power producer.

Malaysia
Third-largest energy consumer; world’s second-largest LNG exporter in 2014; oil exporter, but not a net producer.

Brunei Darussalam
Significant producer and exporter of oil and gas; gas is dominant fuel in electricity.

Disclaimer: By making any reference to a particular geographic area or by using the term “country” and map in this document, USAID does not intend to make any judgment as to the legal or other status of any area/map. The map used 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.
Potential implications and benefits of enhanced power grid interconnections South East Asia

- **Myanmar**
  Could boost export earnings from export-oriented hydropower projects.

- **Lao PDR**
  Expanding interconnection capacity with other countries could help attract investment to further develop export-oriented hydropower resources.

- **Viet Nam**
  Electricity imports could reduce the need to build new gas-fired and coal-fired power plants, thereby reducing LNG and coal imports.

- **Thailand**
  Electricity imports could reduce the need to build new gas-fired power plants to meet growing domestic electricity demand.

- **Cambodia**
  Could increase export earnings by fostering the development of export-oriented hydropower projects.

- **Philippines**
  Electricity imports could enhance its energy security, particularly as it currently imports most of the fuel for power generation.

- **Singapore**
  Electricity imports could enable greater diversification of its power supply, away from the existing heavy reliance on natural gas, and possibly reduce electricity costs.

- **Brunei Darussalam**
  Electricity imports from neighbouring countries could enable gas exports to be increased, by reducing use of gas in the power sector.

- **Malaysia**
  Electricity trade could enable increased hydropower generation in Sarawak.

- **Indonesia**
  Connections with Peninsular Malaysia could enable more efficient operation of power plants; a connection between Kalimantan and Sarawak could reduce the use of expensive oil- and diesel-fired generation in Kalimantan.

Source: IEA-WEO-2015-Southeast Asia Energy Outlook

Disclaimer: By making any reference to a particular geographic area or by using the term “country” and Map in this document, IRADe/USAID does not intend to make any judgement as to the legal or other status of any area/Map. The map used 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.
## Energy Resource in ASEAN/ South East Asia and South Asia

**Hard coal reserves:** 17 billion tonnes
- Indonesia 80%
- Vietnam 18%

**Natural gas reserves:** 6.8 trillion m³
- Indonesia 43%
- Malaysia 35%
- Vietnam 9%
- Thailand 4%
- Brunei 4%

**Crude oil reserves:** 2.1 billion tonnes
- Malaysia 38%
- Vietnam 28%
- Indonesia 23%
- Brunei 7%
- Thailand 3%

**Lignite reserves:** 11 billion tonnes
- Indonesia 82%
- Thailand 10%
- Laos 5%

---

### Renewable Energy Potential in ASEAN

**Source:** The 4th ASEAN Energy Outlook

<table>
<thead>
<tr>
<th>Country</th>
<th>Coal (million tons)</th>
<th>Oil (million barrels)</th>
<th>Natural Gas (trillion cubic feet)</th>
<th>Biomass (million tons)</th>
<th>Hydro (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>440</td>
<td>NA</td>
<td>15</td>
<td>18-27</td>
<td>25</td>
</tr>
<tr>
<td>Bhutan</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>26.6</td>
<td>30</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>884</td>
<td>12</td>
<td>8</td>
<td>0.08</td>
<td>0.33</td>
</tr>
<tr>
<td>India</td>
<td>90,085</td>
<td>5,700</td>
<td>39</td>
<td>139</td>
<td>150</td>
</tr>
<tr>
<td>Maldives</td>
<td>0</td>
<td>0</td>
<td>0.06</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nepal</td>
<td>NA</td>
<td>0</td>
<td>0</td>
<td>27.04</td>
<td>83</td>
</tr>
<tr>
<td>Pakistan</td>
<td>17,550</td>
<td>324</td>
<td>33</td>
<td>NA</td>
<td>59</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>NA</td>
<td>150</td>
<td>0</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>108,961</td>
<td>5,906</td>
<td>95</td>
<td>223</td>
<td>349.33</td>
</tr>
</tbody>
</table>

**Source:** SAARC Secretariat (2010) for Bangladesh, Bhutan, India, Nepal, Sri Lanka; CWC (2005) for Indian States and WAPDA (2011) for Pakistan

---

### Average Solar (kWh/m²/day)

- Afghanistan: 4.7-5.47
- Bangladesh: 4.51-4.99
- India: 3.95-6.07
- Nepal: 5.03-5.37
- Bhutan: 4.63
- Pakistan: 4.02-5.54
- Sri Lanka: 4.8-5.88

### Wind (MW)

- Afghanistan: NA limited
- Bangladesh: 151,918
- India: 3,000
- Nepal: 4,825
- Pakistan: 24,000
- Sri Lanka: 25,000 MW

Disclaimer: By making any reference to a particular geographic area or by using the term “country” and Map in this document, IRADe/USAID does not intend to make any judgement as to the legal or other status of any area/Map. The map used 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.
IEX Membership Types and Some Key Statics

### Membership Category: Proprietary / Professional Member

The financial criteria for payment options available on IEX are:

<table>
<thead>
<tr>
<th>Membership Type</th>
<th>Fees</th>
<th>Professional &amp; Proprietary &amp; Electricity Trader (Full Payment Option)</th>
<th>Proprietary Member (Light Payment Option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission fee</td>
<td>Rs. 35,00,000</td>
<td>Rs. 10,00,000</td>
<td></td>
</tr>
<tr>
<td>Interest Free Security Deposit</td>
<td>Rs. 25,00,000</td>
<td>Rs. 10,00,000</td>
<td></td>
</tr>
<tr>
<td>Annual Subscription Fees</td>
<td>Rs. 5,00,000</td>
<td>Rs. 2,50,000</td>
<td></td>
</tr>
<tr>
<td>Processing Fees</td>
<td>Rs. 10,000</td>
<td>Rs. 10,000</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>Rs. 65,10,000</td>
<td>Rs. 22,60,000</td>
<td></td>
</tr>
<tr>
<td>Exchange Transaction</td>
<td>2p/kWh</td>
<td>3p/kWh</td>
<td></td>
</tr>
</tbody>
</table>

**Clients:** Grid Connected, Generator, Distribution licensees, IPPs, CPP, MPP, OA consumers, Trader Client, With valid PPA

### IEX Data as on 30 November, 2016

<table>
<thead>
<tr>
<th>IEX</th>
<th>Electricity</th>
<th>REC</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Utilities</td>
<td>29 States 15 UTs</td>
<td>16 States 15 UTs</td>
</tr>
<tr>
<td>Generators</td>
<td>379</td>
<td>847</td>
</tr>
<tr>
<td>Industrial Consumers</td>
<td>3688</td>
<td>2489</td>
</tr>
<tr>
<td>Average Daily Volume</td>
<td>&gt;90,000 MWh</td>
<td>&gt;6 million RECs</td>
</tr>
<tr>
<td>Highest</td>
<td>144,649 MWh</td>
<td>865,675 RECs</td>
</tr>
</tbody>
</table>


IEX: It was promoted by Financial Technologies (India) Limited and PTC India Limited. Other key shareholders include Lanco Infratech Limited, Tata Power Company Limited, Jindal Power Limited, Reliance Infrastructure Limited, Adani Enterprises Limited, Rural Electrification Corporation Limited and Infrastructure Development Finance Company Limited.

Some of the major power exchanges across the globe

Nord Pool

- World’s first multi-national exchange for trading in power, established in 1993.
- Covers Nordic region (Norway, Finland, Sweden, Denmark), Baltic region (Estonia, Latvia, Lithuania), UK and Germany
- Provided Day Ahead, Intra Day and balancing products in a voluntary pool. Also supports procurement of reserves.
- Also trades in derivatives.
- Total physical trade of 489 TWh in 2015
- 380 trading members

European Energy Exchange – EPEXSPOT

- EEX established in 2002, with head quarters in Germany. Runs electricity spot exchange EPEXSPOT.
- Covers power spot markets in Germany, Belgium, Netherlands, Austria, France, Switzerland and United Kingdom.
- Provides day ahead and intra day markets along with derivatives. Also provides capacity product in the French market.
- Total physical trade of 500 TWh in 2015.

OMIE

- OMIE manages the wholesale electricity market on the Iberian Peninsula (Spain and Portugal).
- It is regulated by the Santiago International Agreement, regarding the implementation of an Iberian electricity market (MIBEL) between the Kingdom of Spain and the Republic of Portugal.
- Provides day ahead and intra day markets along with derivatives.
- Total physical trade of 259 TWh in 2015.

Have we learned something from these for customized adaptation?
### Energy Supply Industry Structure of HAPUA Members Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Utility Serves</th>
<th>Market Structure</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>Department of Electrical Services (DES)</td>
<td>Vertical Integrated Utility (VIU)</td>
<td>827</td>
</tr>
<tr>
<td>Cambodia</td>
<td>Electriite Du Cambodge (EDC)</td>
<td>VIU</td>
<td>732</td>
</tr>
<tr>
<td>Indonesia</td>
<td>PT PLN (persero)</td>
<td>VIU</td>
<td>40524</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>Electricite Du Laos</td>
<td>VIU</td>
<td>2978</td>
</tr>
<tr>
<td>Malaysia</td>
<td>Tenaga Berhad, SESB, SESCO SESB</td>
<td>VIU Peninsular Malaysia VIU Serawak State VIU Sabah</td>
<td>27179</td>
</tr>
<tr>
<td>Myanmar</td>
<td>Ministry of Electric Power</td>
<td>Transmission and Distribution Hydro Power Generation</td>
<td>3494</td>
</tr>
<tr>
<td>Philippines</td>
<td>National Power Corporation Trans Co</td>
<td>Power Generation Company Transmission Company</td>
<td>16924</td>
</tr>
<tr>
<td>Singapore</td>
<td>SP Power Grid</td>
<td>Gencos, T &amp; D</td>
<td>9951</td>
</tr>
<tr>
<td>Thailand</td>
<td>EGAT MEA &amp; PEA</td>
<td>Generation, SO &amp; Transmission Distribution/Retail Supply</td>
<td>34335</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Electricity of Vietnam (EVN)</td>
<td>VIU</td>
<td>26926</td>
</tr>
</tbody>
</table>

---

**Experiences and lessons learnt from Power Market Development in South Asia/Rajiv Panda/SARI/EI/IRADE**

Source: http://aperc.ieej.or.jp/file/2015/8/14/Mr_Syaiful_ASEAN_POWER_MARKET_INTEGRATION.pdf

Source: The 4th ASEAN Energy Outlook

---

**South Asia Electricity Generation (TWh)**

<table>
<thead>
<tr>
<th>Country</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>0.3%</td>
<td>5.7%</td>
<td>1%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>0.0%</td>
<td>0.1%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Bhutan</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.2%</td>
</tr>
<tr>
<td>India</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>


---

**South Asia Installed Capacity (GW)**

<table>
<thead>
<tr>
<th>Country</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>1.2%</td>
<td>1.6%</td>
<td>1%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>0.2%</td>
<td>0.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Bhutan</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>India</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>


---

**South Asia Electricity Generation (TWh)**

<table>
<thead>
<tr>
<th>Country</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>0.1%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Bhutan</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>India</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Total</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Evolving Institutional Framework

The Recent MoP CBTE Guidelines and Draft Regulation of Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2017 gives some indication of the Institutional framework that may evolve which are as follows:

- **Ministry of Power and Ministry of External Affairs**: CBTE Guidelines and Policy
- **Central Electricity Regulatory Commission (CERC)**: Regulation for facilitating cross border trade of electricity with neighbouring countries in accordance with these guidelines.
- **Designated Authority (CEA)**: Designated Authority shall coordinate with the nodal agency of the neighbouring country
  1. process of approval and laying down the procedure for cross border trade;
  2. planning, monitoring and coordinating the commissioning of cross border transmission lines for cross border transactions;
  3. the grid security, safety and operation;
- **Transmission Planning Agency (TPA) of each neighbouring country**: Responsible for Transmission System planning in respective neighbouring country for the purpose of facilitating cross border trade of electricity.
- **Settlement Nodal Agency (SNA) of each neighbouring country**: Responsible for settling all charges pertaining to grid operations including operating charges, charges for deviation and other charges related to transactions.
- **National Load Dispatch Centre (NLDC) Central Transmission Utility (CTU)**: Responsible for granting and facilitating short-term open access with respect to cross border trade of electricity between India and its neighboring country. for billing, collection and disbursement of the transmission charges for short term open access transactions as per CERC (Sharing of Inter State Transmission Charges and Losses) Regulations, 2010 or any other Regulations.
Key Features of Electricity Act -2003-A Framework for Competition

- Creating competition in the industry
- Non-discriminatory open access in transmission
- Delicensed generation
- Single buyer model dispensed.
- Ensuring supply of electricity to Provision for open access in distribution to be implemented in phases.
- Electricity trading is recognized as a distinct licensed activity.
- Development of market (including trading) in electricity made the responsibility of the Regulatory Commission.
- Encouraging autonomous regulation with the separation of policy regulation and operational aspects.

Challenges of making competition work in electricity

- Electricity cannot be stored
- Political-Economy of the Sector
- Demand of electricity varies intra-day and seasonally
- Electricity has demand side flaws
- Electricit y travels at the speed of light
- Electricity travels in accordance with laws of Physics

Source: staff paper on “Developing a Common Platform for Electricity Trading".
Experiences and lessons learnt from Power Market Development in South Asia/Rajiv Panda/SARI/II/IRADE
<table>
<thead>
<tr>
<th></th>
<th>Nord Pool</th>
<th>PJM</th>
<th>AEMO</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Participation</strong></td>
<td>Voluntary for DAM</td>
<td>Compulsory for Real Time</td>
<td>Compulsory for DAM</td>
<td>Voluntary</td>
</tr>
<tr>
<td><strong>Market Offerings</strong></td>
<td>DA spot, hour-ahead, forward, futures, options</td>
<td>DA spot, real-time balancing, capacity credit markets</td>
<td>DA spot, Short term forwards</td>
<td>DAM, TAM</td>
</tr>
<tr>
<td><strong>Bidding Type</strong></td>
<td>Double Sided</td>
<td>Double Sided</td>
<td>Double Sided</td>
<td>Double Sided Closed, Open Auction &amp; Continuous</td>
</tr>
<tr>
<td><strong>Real-time / Balancing market</strong></td>
<td>Counter trade</td>
<td>Balancing Market</td>
<td>Purchase of ancillary services &amp; reserve capacity</td>
<td>UI charge for deviations</td>
</tr>
<tr>
<td><strong>Pricing Rule</strong></td>
<td>Zonal Pricing</td>
<td>Nodal Pricing</td>
<td>Zonal Pricing</td>
<td>Zonal Pricing</td>
</tr>
<tr>
<td><strong>Risk Management</strong></td>
<td>Forwards, futures, options</td>
<td>FTRs, Bilateral OTC, Multisettlement, virtual bidding</td>
<td>Bilateral OTC, Derivatives on Sydney Exchange</td>
<td>Bilateral OTC</td>
</tr>
<tr>
<td><strong>Congestion Management</strong></td>
<td>Area splitting</td>
<td>Security constrained economic dispatch</td>
<td>Locational signals for transmission</td>
<td>Area splitting</td>
</tr>
<tr>
<td><strong>Transmission Losses</strong></td>
<td>Included in zonal price</td>
<td>Included in LMP</td>
<td>To be purchased by generators</td>
<td>To be purchased by participants</td>
</tr>
</tbody>
</table>


Experiences and lessons learnt from Power Market Development in South Asia/Rajiv Panda/SARI/EI/IRADE
Power Exchange Market Products: Day Ahead Market (DAM)

Key Features

- Physical delivery based market (Min 100kW) - for any/some/all 15 minute time blocks in 24 hours of next day
- Electronic: Bid entry, price discovery etc all done through the electronic platform
- Prices and quantum of electricity to be traded determined through a double sided closed anonymous auction for each 15-min time block for the following day bidding process.
  - Closed: Bids entered cannot be seen by other participants
  - Double-sided: Both buyers and sellers enter the price and quantum range they are ready to buy/sell electricity at
  - Uniform: Each selected bidder receives the same price (as applicable to its bid area) irrespective of the quoted price for every accepted bid
  - Price Discovery: Price is discovered for every 15 min after aggregating the buy and sell request posted at the Exchange using advanced algorithm based on the economic principle of Social Welfare Maximization
- Clearance obtained from SLDC by buyers and sellers based on availability of network & ABT meters
- Congestion Management through market splitting and determining Area Clearing Price (ACP)
- Risk Management through the requisite Margin as specified for the respective trading segment or the type of contracts - Buyers pay in advance (D-1), sellers paid post delivery
- NLDC is the Nodal Power Exchange Market Products: Day Ahead Market (DAM)
Key Lessons: Power Exchange in India

The power exchange operations in India in the last 9 years offer some lessons that similar countries which are planning to introduce power exchanges can consider.

- **Power exchanges as key enablers of market competition and open access**
  60% of the total purchase volumes in the two power exchanges in FY 2015-16 was by open access consumers. The open access consumers in the two exchanges totalled 4177.

- **Co-existence of multiple power exchanges**
  The two power exchanges, which started their operations in around the same time in 2008, have so far competed with each other in attracting market volumes.
  In spite of possibility of dominance of one exchange over another, the presence of more than one exchange offers protection and choice to the exchange trading members.

- **Case for regular monitoring by the regulating agency**
  The power exchange operations will need to be regularly monitored by the regulating agency to ensure that consumers’ interests are protected. In spite of well defined regulations, exchange bylaws etc., the market still required special intervention by the Central Regulatory Commission in instances such as:

  1. In 2009, exchange prices were capped to 8 Rs./kWh for a period of 45 days to control the high prices (Petition No 178/2009)

  2. In 2015, CERC ordered a comprehensive review of the power exchanges, which revealed some violations of the provisions of the Power Market Regulations. (Petition No. 7/SM/2015)* and taking corrective action.