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

Rajiv Ratna Panda
SARI/EI/IRADe

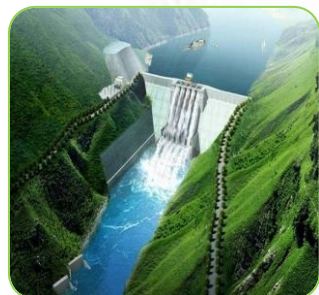


HAPUA-ASEAN-UNESCAP Workshop on ASEAN Electricity Exchange (AEE): An International Perspective
17-19 April, 2017 Hotel JS Luwansa, Jakarta, Indonesia



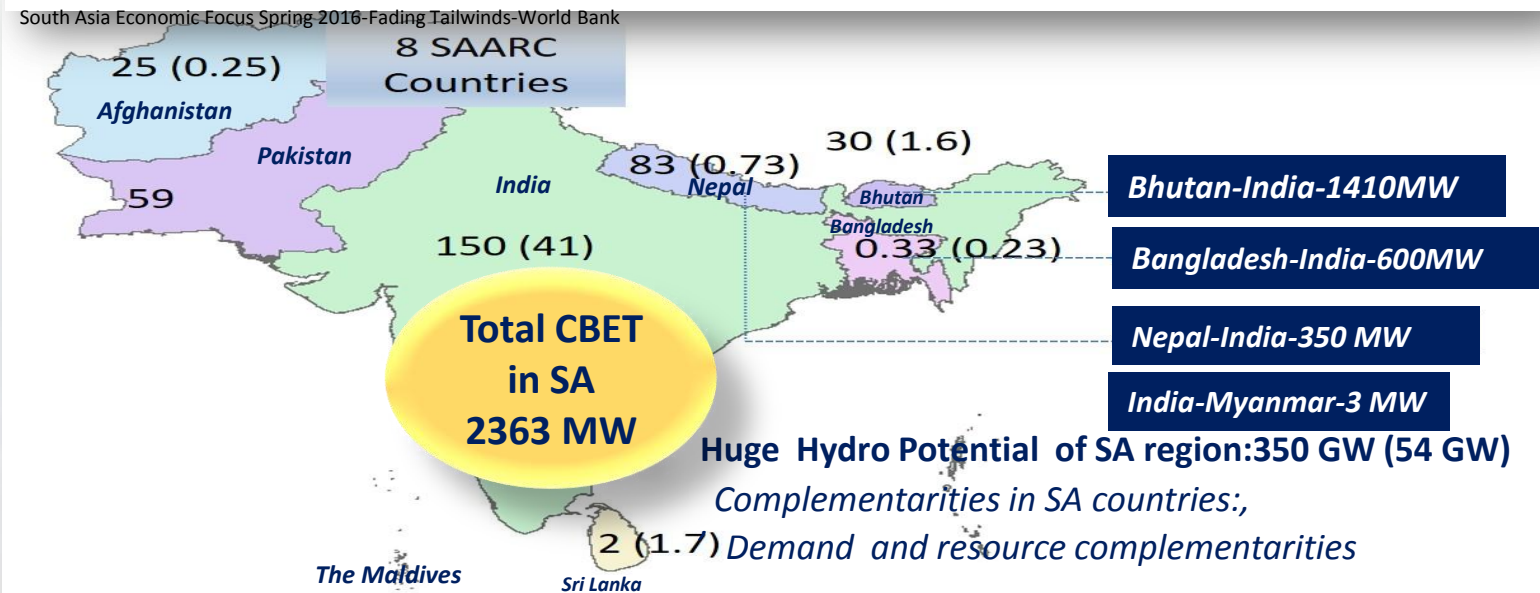
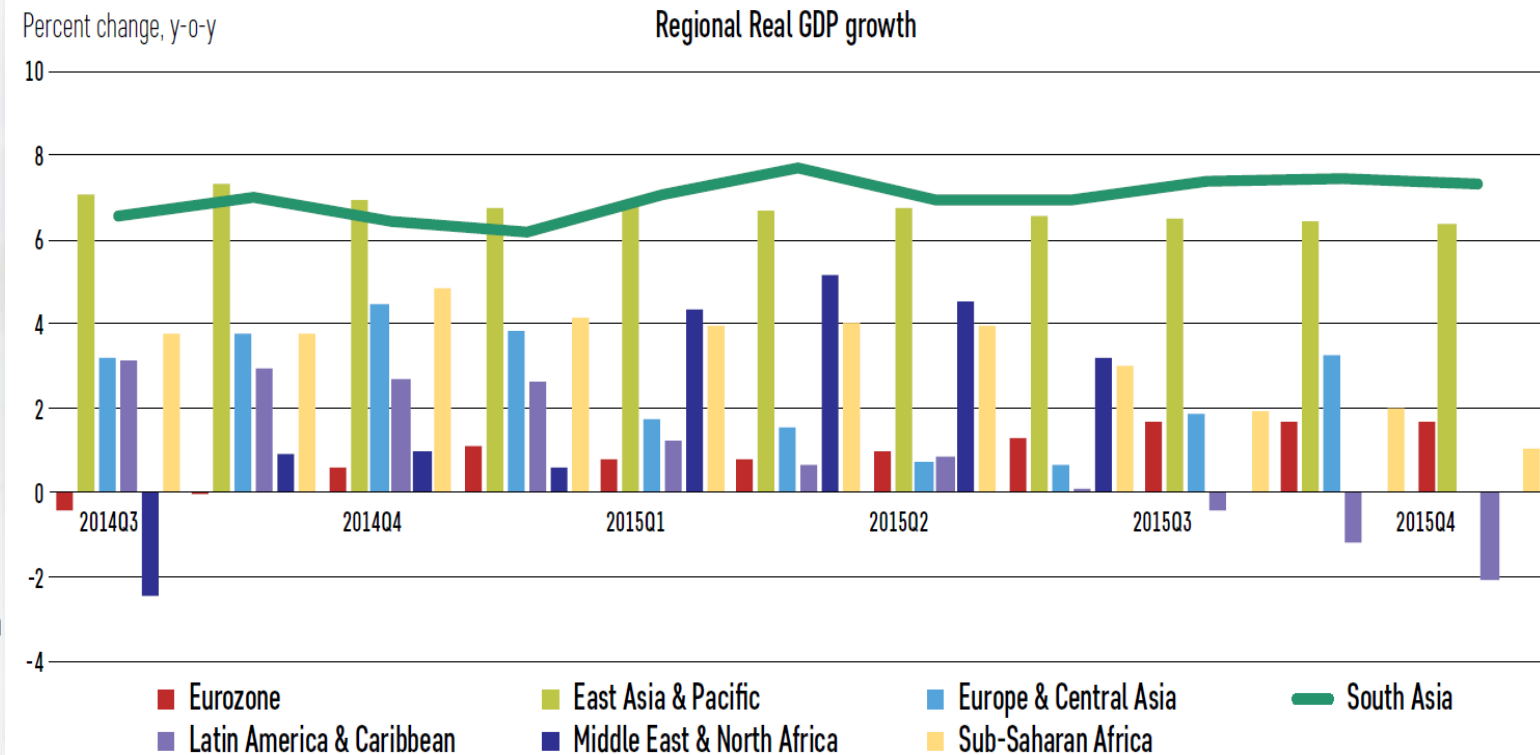
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South Asia: A Snapshot

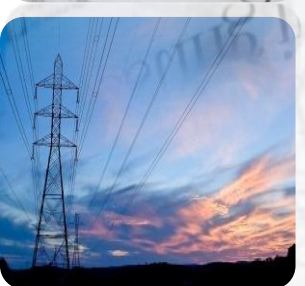
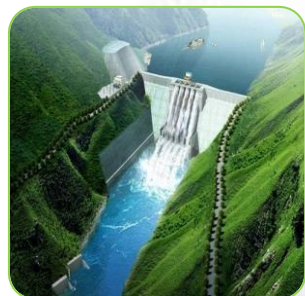
- South Asia Remains World's Fastest Growing Region.** Economic Growth (EG) expected to accelerate to 7.3 percent in 2017 from 7.1 percent in 2016.
- Home to 1/5 th of world's population.** India is the largest economy in the region and geographically centrally located.
- Most of the countries are facing 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**





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Power Market Structure in South Asian Countries



Power Market Structure in South Asian Countries

Country	Policy	Regulation	Generation	Transmission	System Operation	Power Trading/Market Structure
Afghanistan	Ministry of Energy and Water (MEW)	Electricity Regulatory Authority	DABS	DABS	DABS	Single Buyer (SB), DABS
Bangladesh 15 GW	Ministry of Power, Energy and Mineral Resources	Bangladesh Energy Regulatory Commission	BPDB, EGCB, APSCL, NWPGC, IPPs, SIPPs, Rental Plants	PGCB	PGCB	Single Buyer, BPDB, Multiple Seller (MS)
Bhutan 1.6 GW	Ministry of Economic Affairs (MEA)	Bhutan Electricity Authority (BEA)	Druk Green Power Corporation (DGPC)	Bhutan Power Corporation (BPC)	BPC (NLDC)	Export Licensee , SB Model
India 315 GW	Central: Ministry of Power under Gol, State: Power/Energy Department under the State Government	Central: CERC, State: SERCs/ JERCs	Central: NTPC, NHPC, NPCIL, UMPPs, IPPs, MPPs State: State-owned GenCos, IPPs, CPPs	Central: POWERGRID (CTU), Private/JV Licensees State: STUs, Private/JV Licensees	Central: POSOCO (NLDC & 5 RLDCs) State: SLDCs	Multiple Buyer and MS Model Central: Inter-state Licensees; State: Discoms / Trade Cos (Include State Holding Cos) / Intra-state Licensees, Power Exchange Platform
Nepal .8 GW	Ministry of Energy (MoE)	Electricity Tariff Fixation Commission (ETFC)	Nepal Electricity Authority (NEA), IPPs	NEA	NEA	SB Model –NEA, Multiple Seller (MS)
Pakistan 24 GW	Ministry of Water and Power (MOWP)	National Electric Power Regulatory Authority (NEPRA)	State-owned generating companies formed after restructuring of WAPDA (CPGCL, JPCL, LPGCL, NPGCL) & other IPPs	National Transmission & Despatch Company (NTDC)	NTDC	SB Model , CPPA, Multiple Seller (MS)
Sri Lanka 4 GW	Ministry of Power and Energy (MOPE)	Public Utilities Commission of Sri Lanka (PUCSL)	Ceylon Electricity Board (CEB), IPPs	CEB Transmission Licensees	CEB Transmission Licensees	SB Model, Multiple Seller (MS)



Vertically Integrated

Partially un-bundled

Un-bundled

☐ Afghanistan (DABS)
☐ Maldives (FENAKA)
☐ Nepal (NEA)
☐ Sri Lanka (CEB)

☐ Bangladesh (Separate Trans.Utility)
☐ Bhutan (Separate Gen.utility)

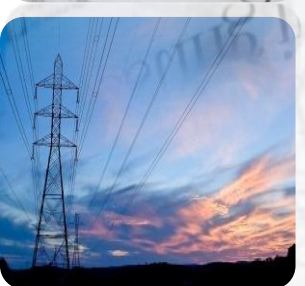
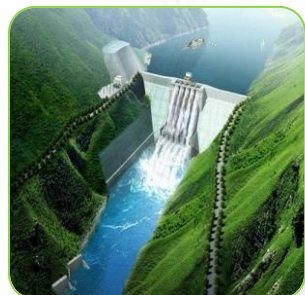
☐ India (Separate G,T,D utilities)
☐ Pakistan (Separate G,T,D utilities))

Except India most of SA countries have SB Model. Power Trading/Power exchange Platform Exist in India only



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Indian Power Sector



Power Sector in India – Profile Snapshot

● 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%

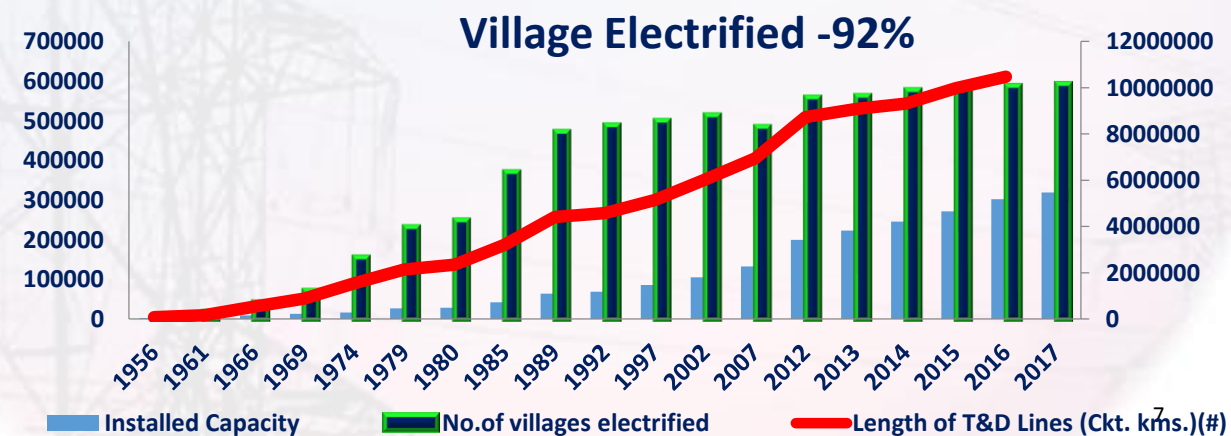
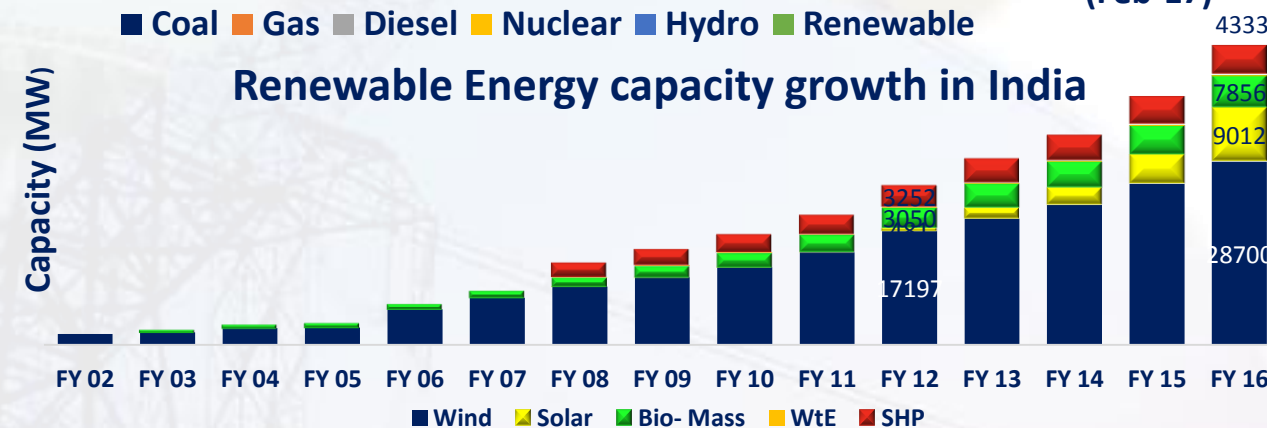
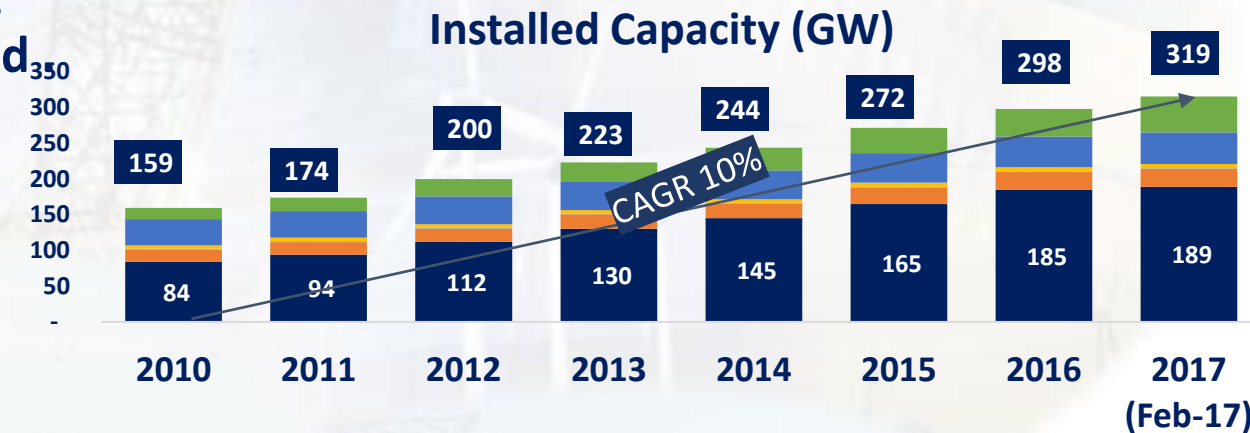
● The Per capita energy consumption-1,074 kWh (2015-16) still less than half of the world average

● 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)

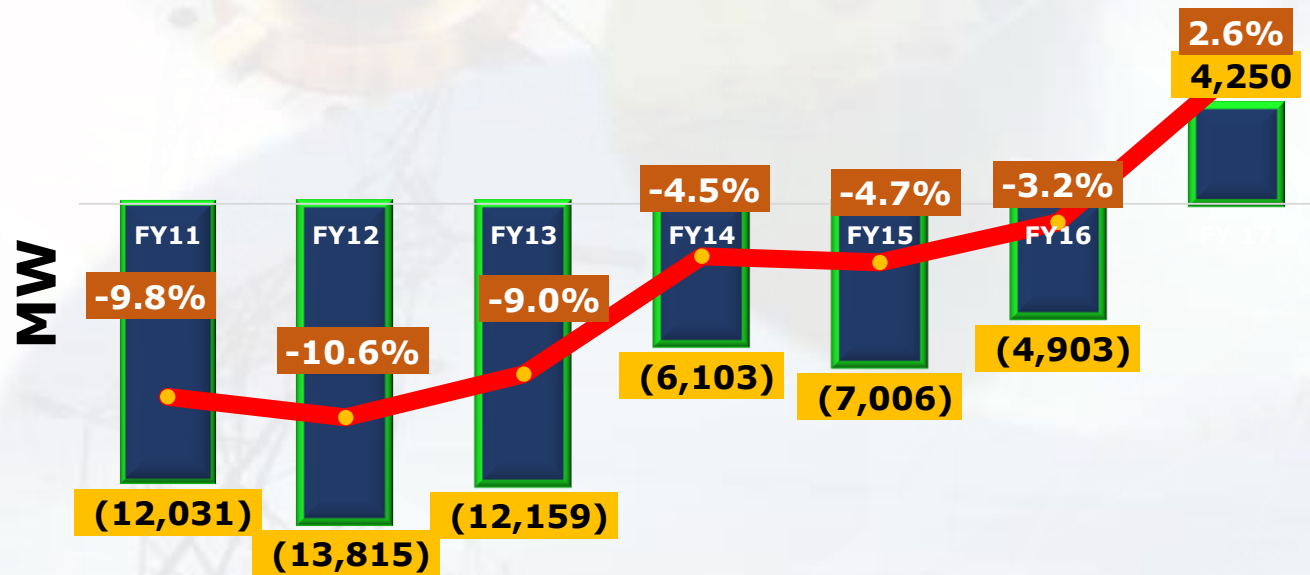


*<https://www.ibef.org/download/Power-March-2017.pdf>

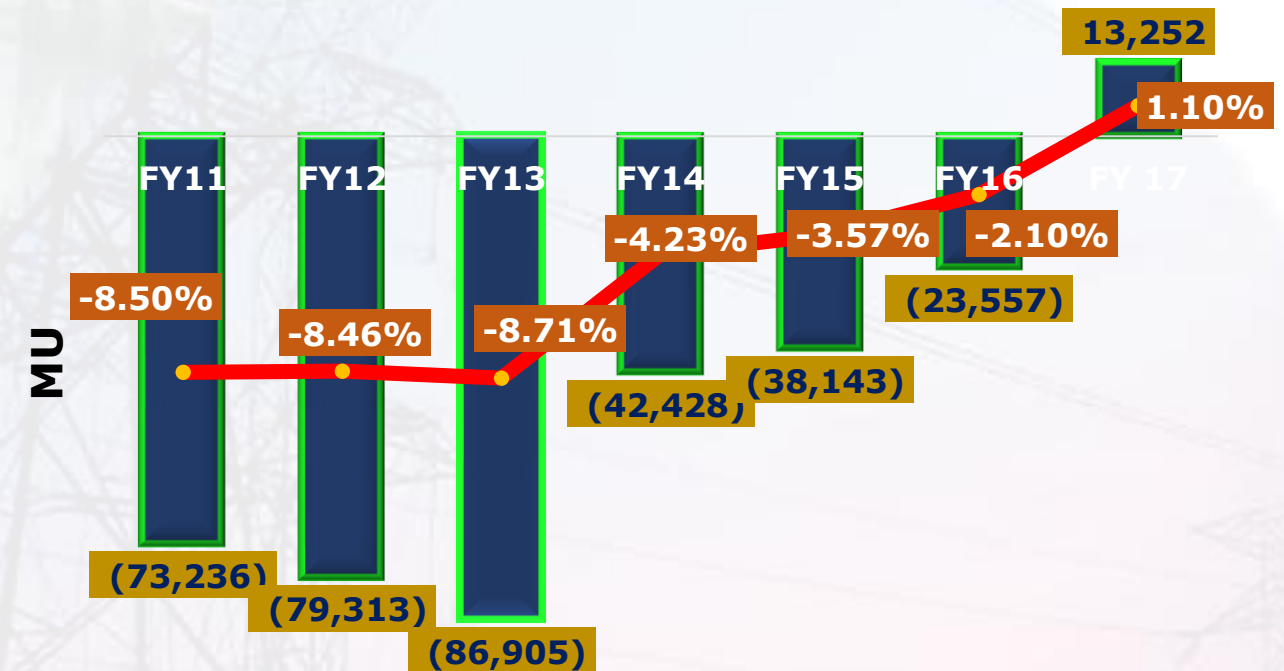
India-Demand-Supply Scenario

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)

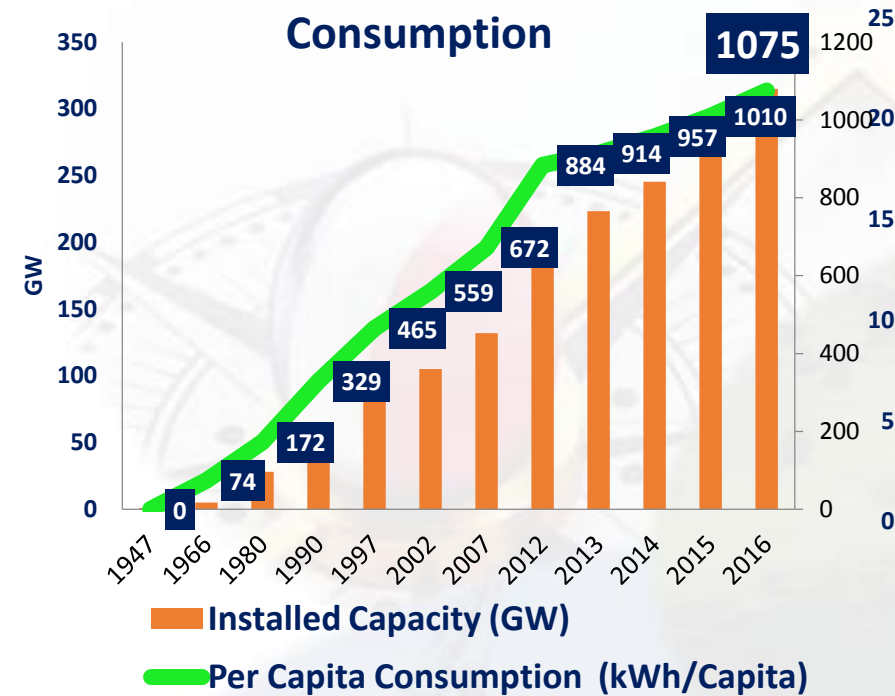


Energy Deficit (Million Units)

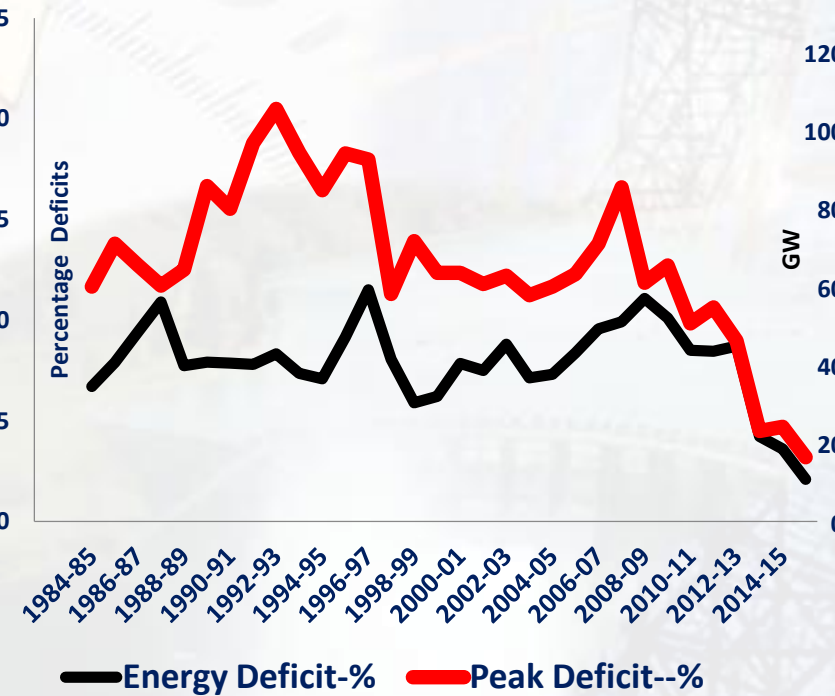


Decades back, story was very different

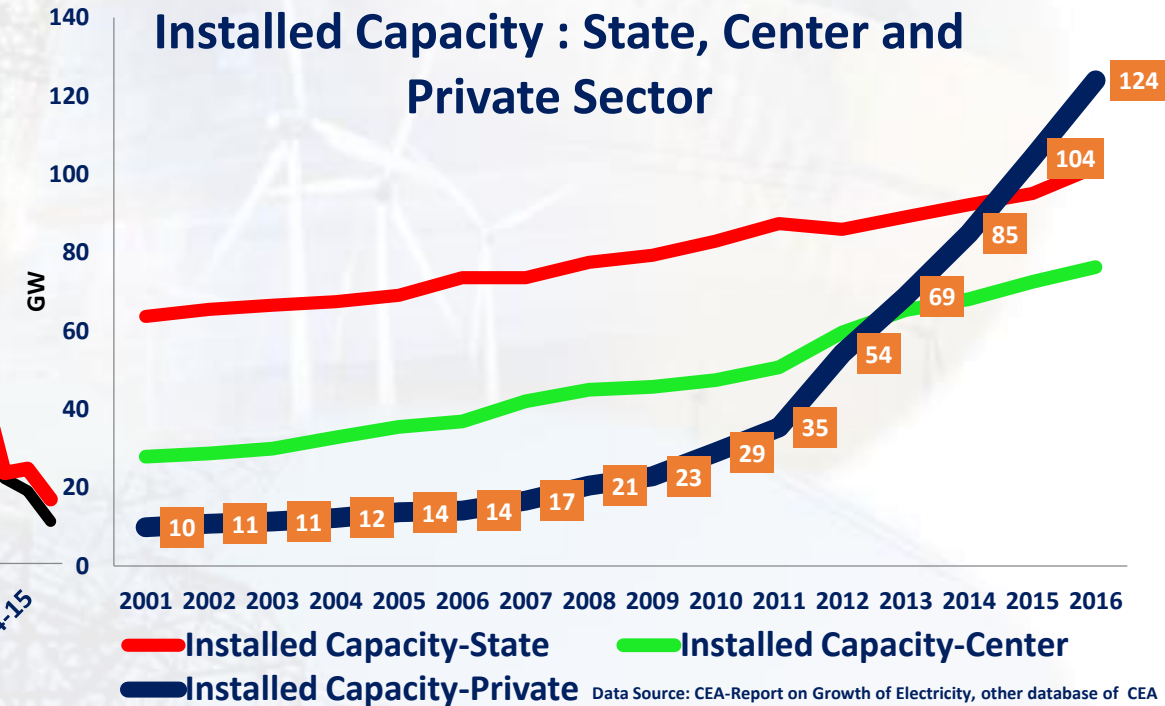
Installed Capacity and Per Capita Consumption



Energy and Peak Deficits -India



Installed Capacity : State, Center and Private Sector

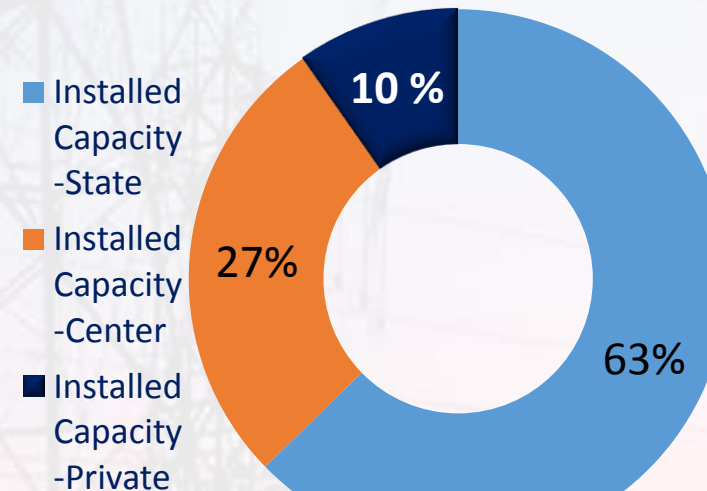


Low Per Capita: In 1990 per capita was only around 172 KWH/Capita , by 2016 -1075 KWH/Capita . IC 64 GW in 1990 to 350 GW in 2016

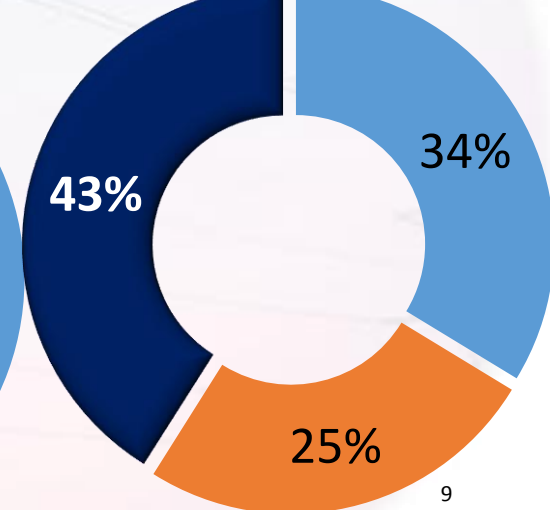
High Deficits: In 1997 Energy and peak deficits were 11.51% and 17.97% respectively, by 2016 reduced to 2.1% & 3.2 % only

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

Share of Private Sector -2001



Share of Private Sector -2016



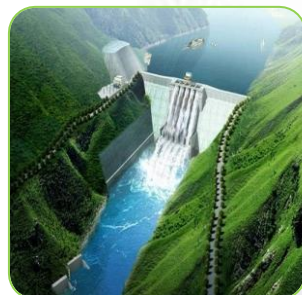


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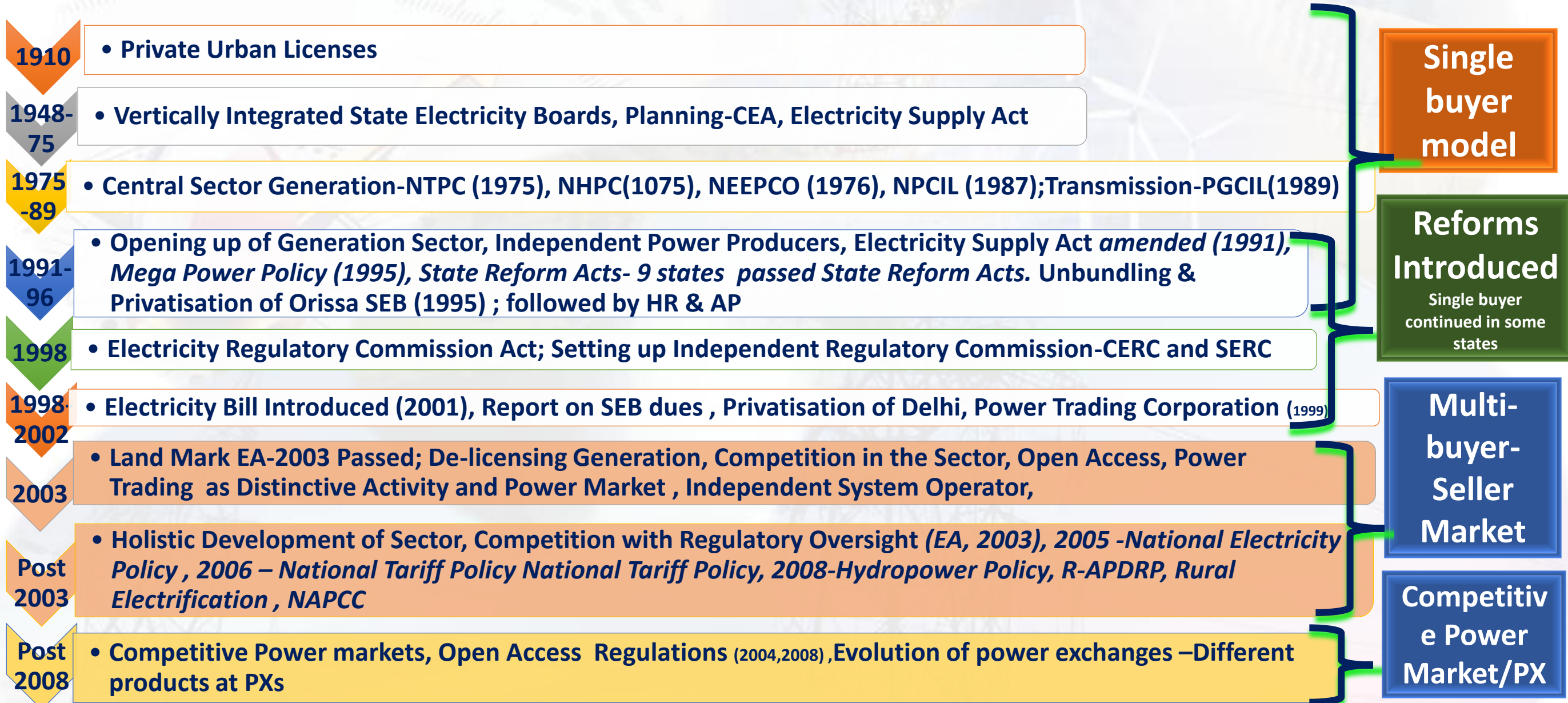
iRADe Integrated Research and
Action for Development



How all this was achieved ?



Power Sector Evolution in India



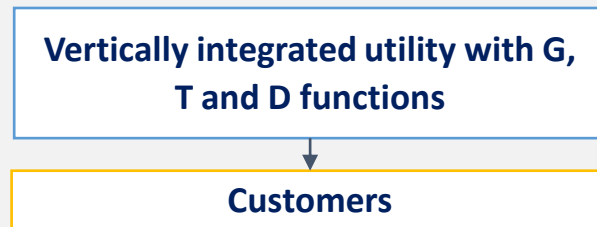
With the Legal Framework mandated under EA Act-2003, Power Trading , Power Exchange Developed – Legal, Regulatory Framework is Important , though Initially friendly Guidelines/Regulation and calibrated approach were adopted to promote Market Development

Current Power Market Structure

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

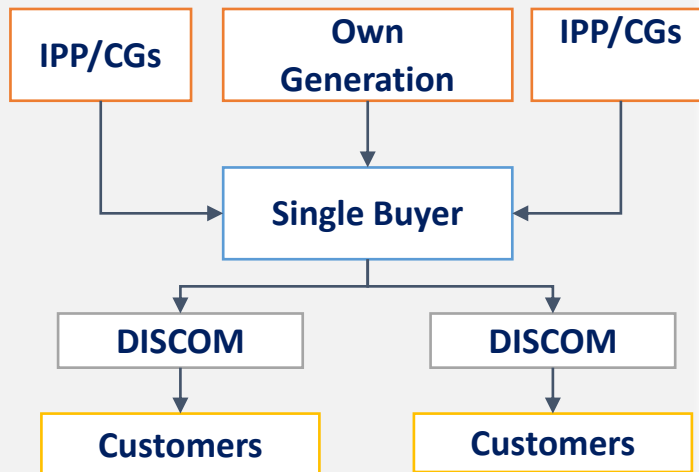
1948 - 1970s

Model I - Monopoly



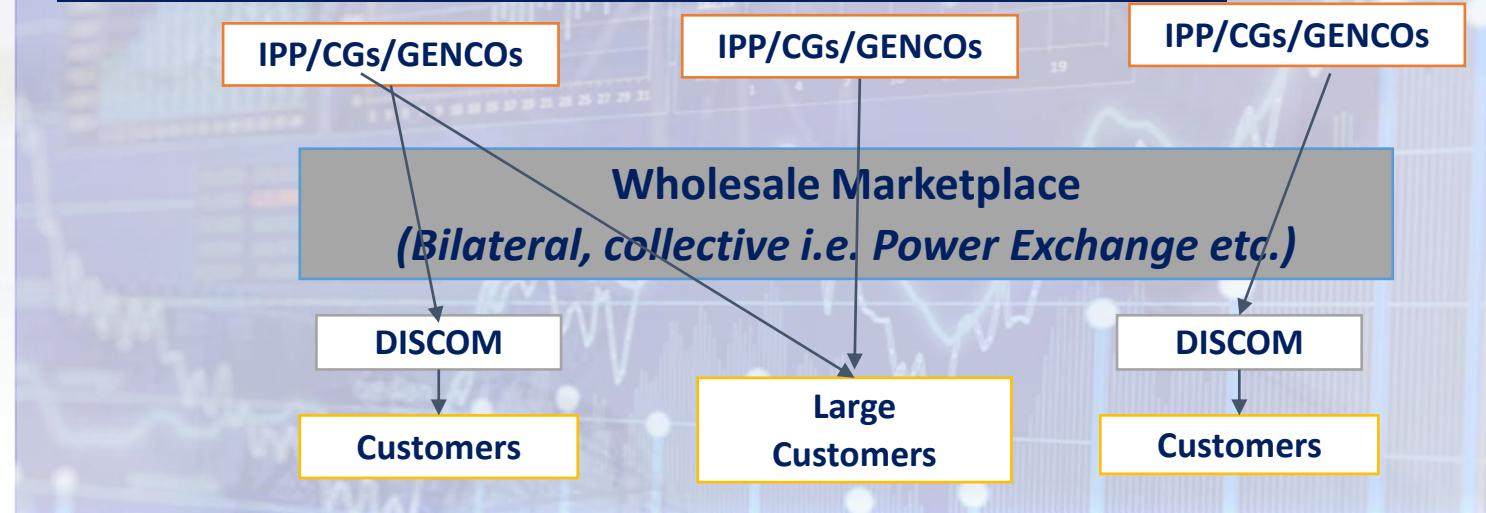
1970s-2003

Model II - Single Buyer



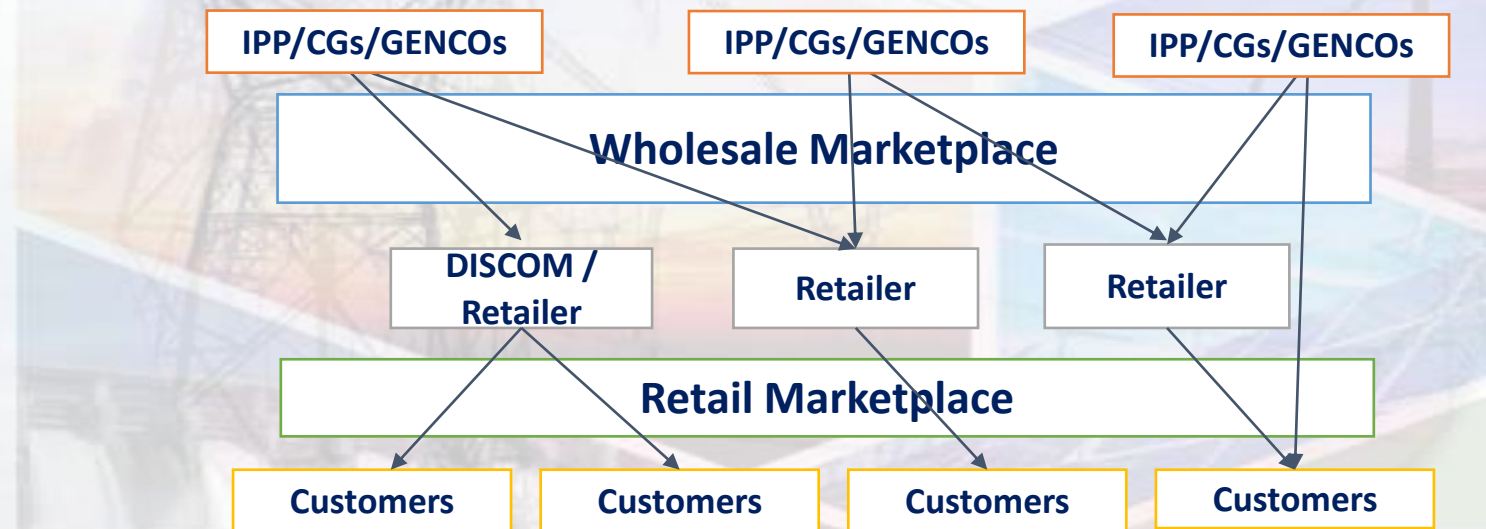
Model III - Wholesale competition

2004



Model IV - Retail competition

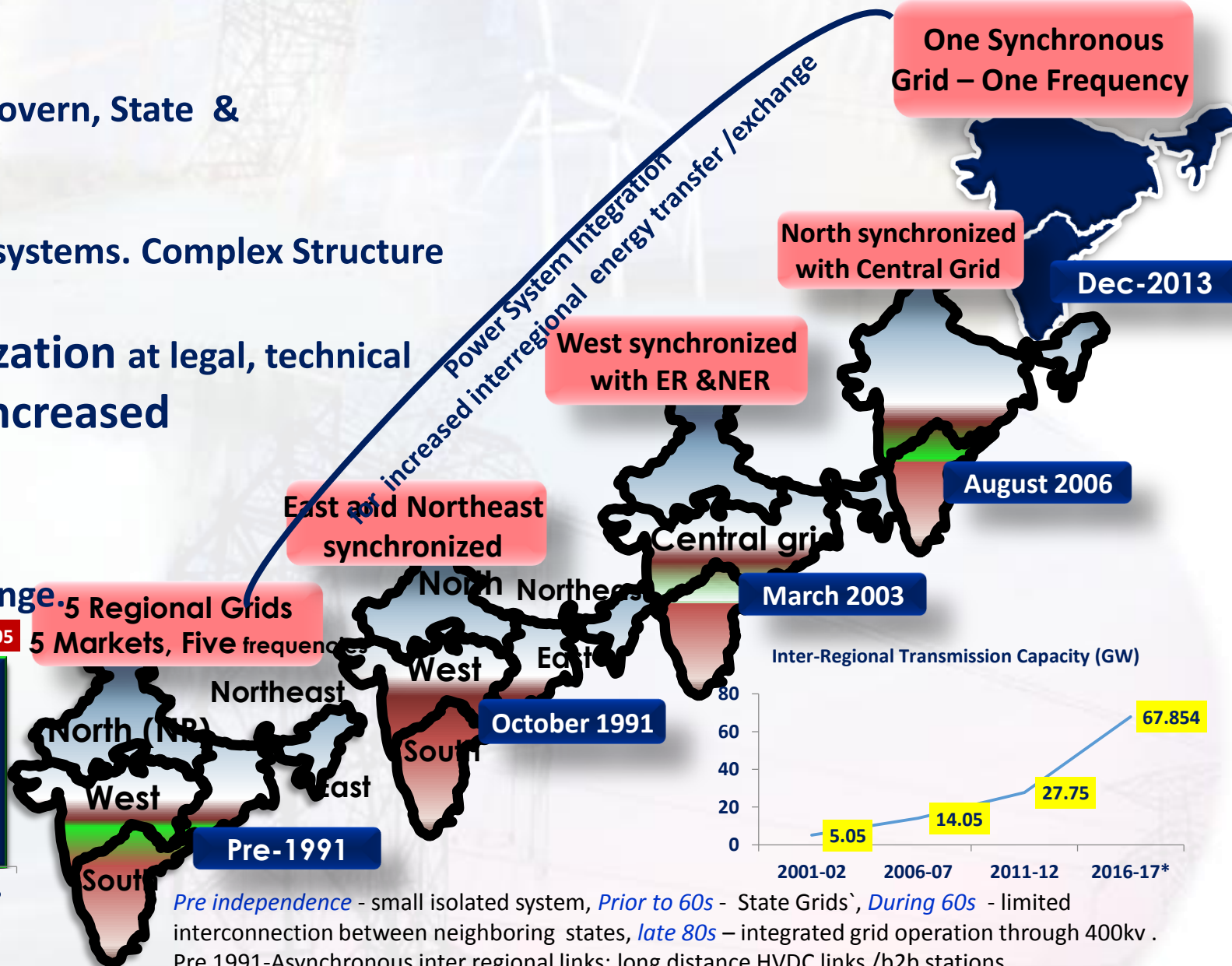
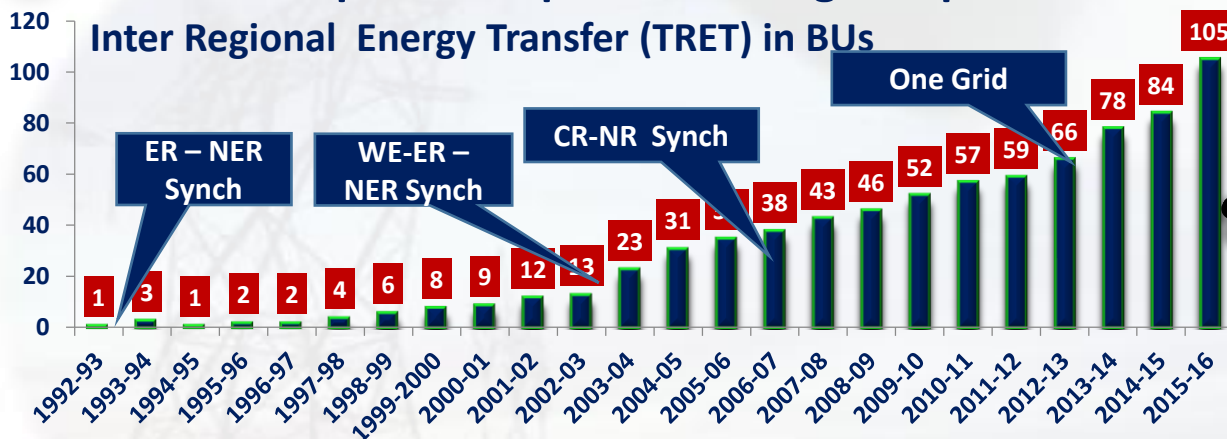
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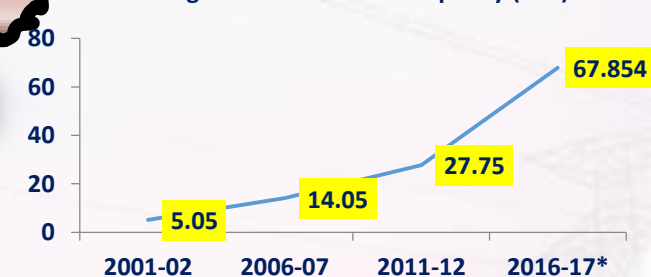
India's Power Sector Experience : It's Relevance towards Integration of Power system for inter-regional energy transfer/exchange and Market Development in Regional Context

- 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



Inter-Regional Transmission Capacity (GW)



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

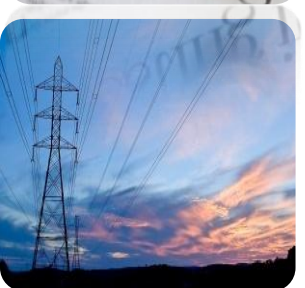
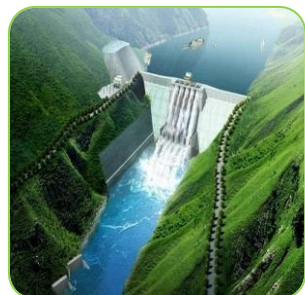
		Inter-state	Intra-state
Legislation & Regulation	Policy and legislation	Ministry of Power, Govt. of India	
		Ministry of Power / Energy / Electricity, State Govt.	
	Plan	CEA	State Government
	Regulation and tariff determination	Central Electricity Regulatory Commission	State Electricity Regulatory Commission
	Licensing	Central Electricity Regulatory Commission	State Electricity Regulatory Commission
Transmission, Distribution, Operation	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.	State Power Committee
	Distribution		SEBs, DISCOM, Distribution Licensees
Trading	Trading	Inter State Trading Licensee	Intra State Trading Licensee
	Market Platforms	Trading Platforms , Power exchanges, - PXs, Bilateral, OTC etc	
Appeal	Dispute Settlement	Appellate Tribunal	
	CBET	Ministry of External Affairs , Ministry of Power, Designated authority, CERC, POSOCO-Coordination for trans-national exchange /trade of power	SERC, DISCOMs, State Governments



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.



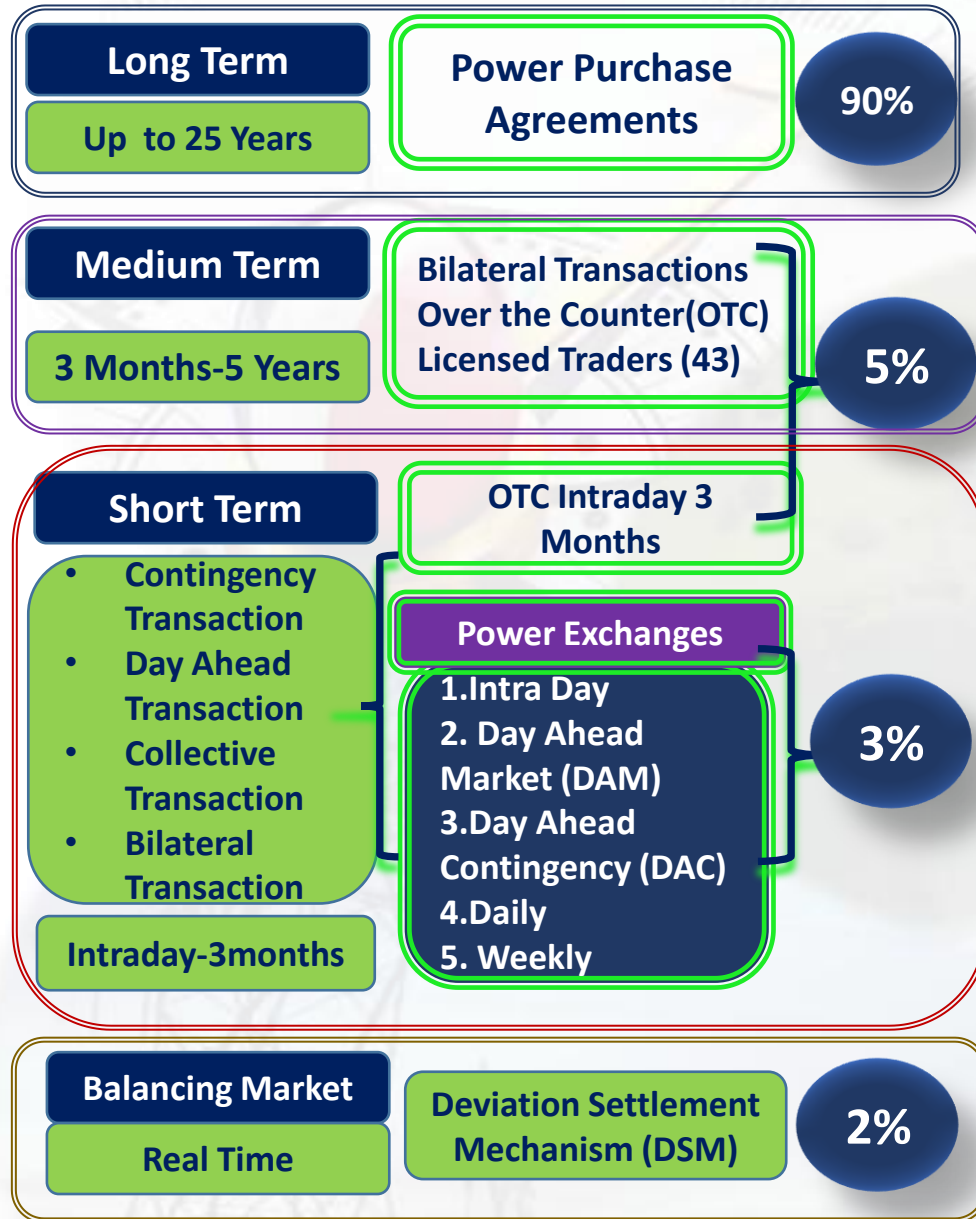
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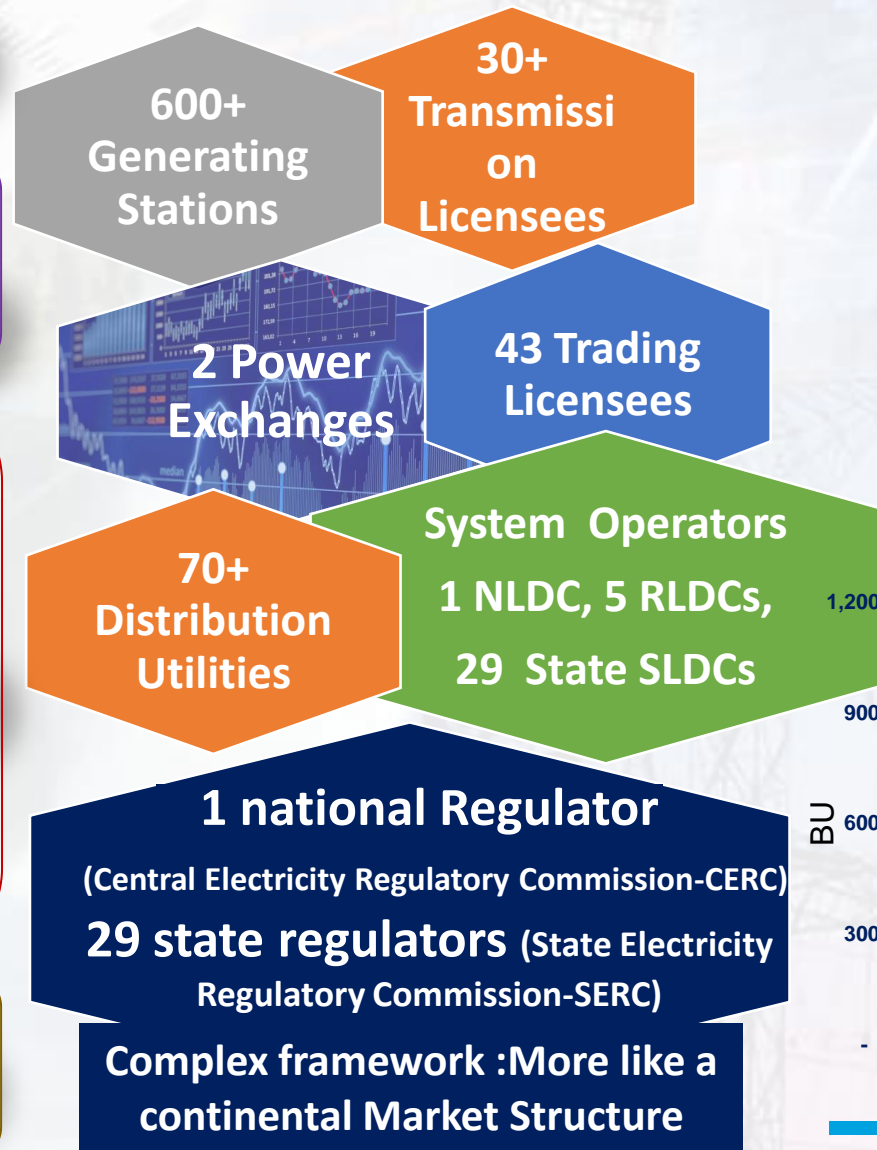
POWER MARKET IN INDIA



Power Market in India



Competitive Power Market

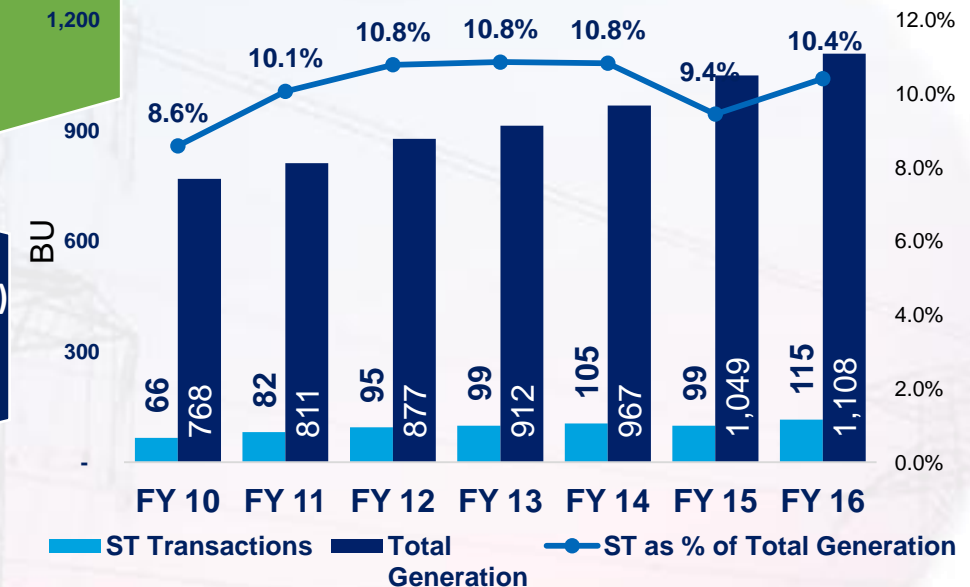


Size of Short Term Power Market
₹ 240 Billion (4.2 Billion US \$)

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

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

Note: 1 US\$= 60 ₹, Data Source: CERC Annual Report on Short-term Power Market in India, 2015-16



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

Short Term Includes bilateral trader segment, power exchange segment with transactions, DSM segment, and Direct transactions of electricity between DISCOMs.

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.

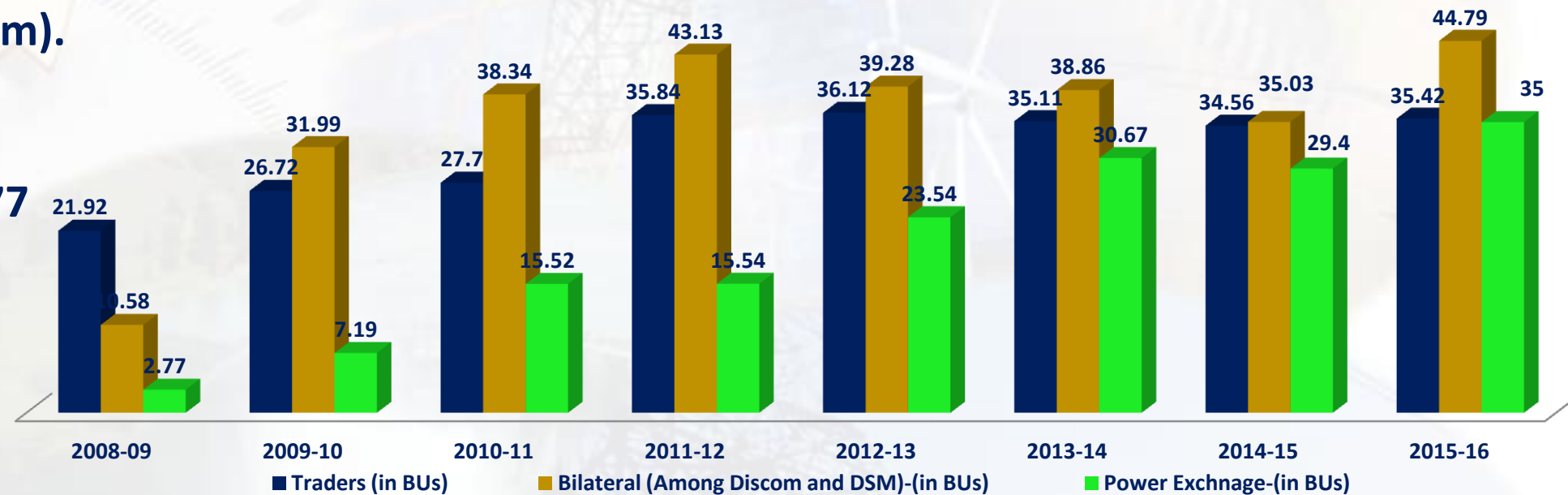
What is for the Consumer.?

● Price have gone down due to competition, Choice and market

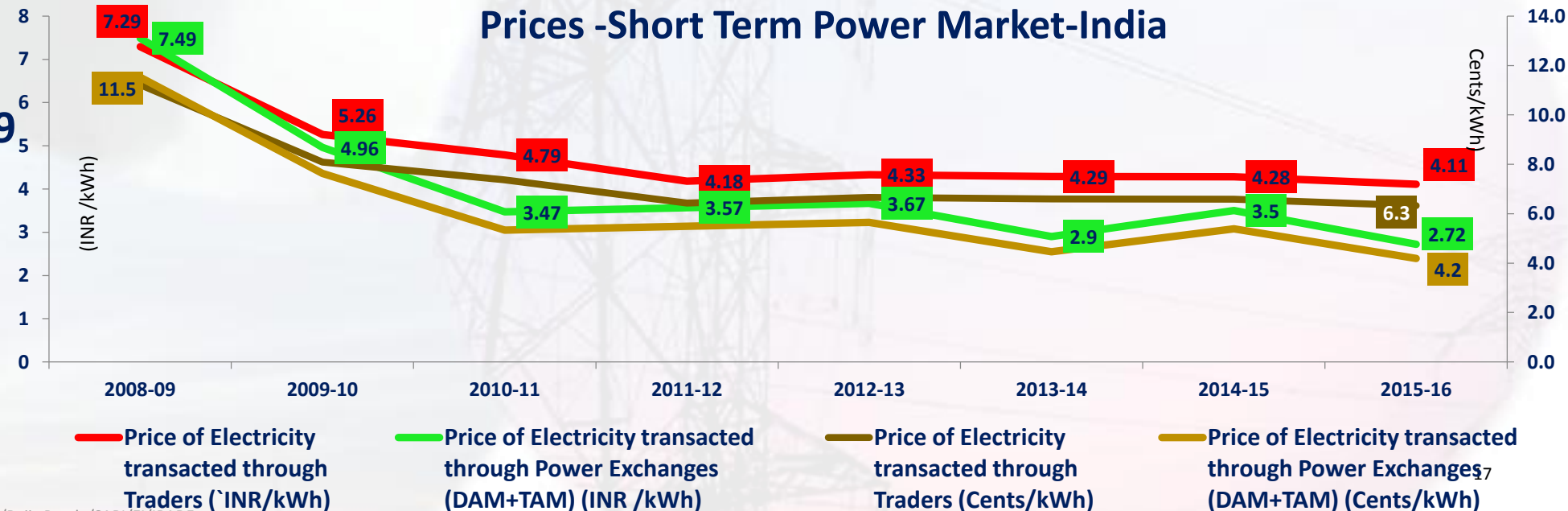
● Price through Exchange : ₹ 7.49 /Kwh (11.5 Cents) in 2009 to ₹2.72/ /Kwh (4.2 cents) in 2016

● Price of Electricity (Trader): ₹ 7.29/Kwh (11.2 Cents) in 2009 to 4.11/Kwh (6.3 Cents) in 2016

Short Term Power Market Volume (BUs) -India



Prices -Short Term Power Market-India



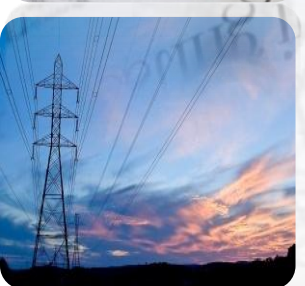
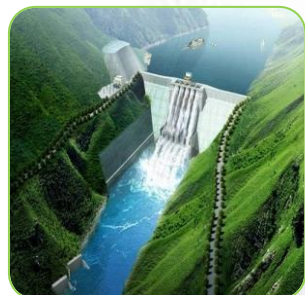


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How the power market evolved



Evolution of Power Trading/Power Market in India

Scheduling :
 ■ Metering,
 Accounting &
 Settlement
 ■ Availability Based
 Multi – Part Tariff
 ■ Imbalance Pricing

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

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

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

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

1999

2002

2003

2004

2005

2006

2008

2009

2010

2011

2014

2015

**Grid
 Code
 (1999)**

Incorporation of
**Power
 Trading
 Corporation of
 India Ltd**

**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

**IEGC 2006,
 2005-06-
 Tariff
 Policy,
 Competitive
 bidding,
 Ultra Mega
 Power
 Projects
 (2005-06)**

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

**IEGC
 2010
 REC**

**Transm
 ission
 Pricing
 (POC)**

**POC
 Regulations:
 Transmission
 Pricing
 rationalized
 DSM
 Regulations**

**CERC Ancillary
 Services
 Regulation
 RE Framework
 Ancillary
 Services**

Four Pillars of Market Design

**Congestion
 Management**

**Ancillary
 Services**

Imbalances

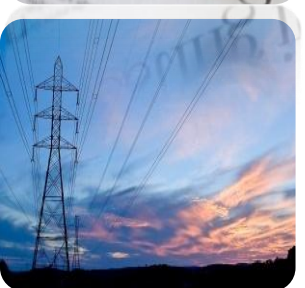
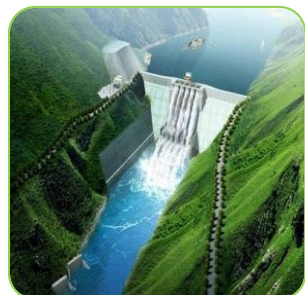
**Scheduling
 & Dispatch**

"Making Competition Work in Electricity" Sally Hunt

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



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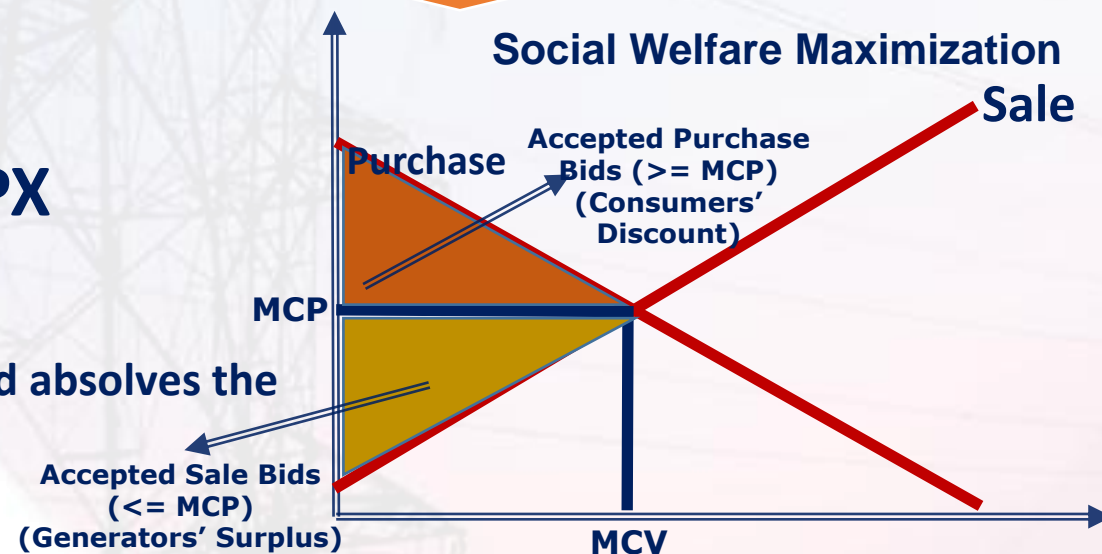
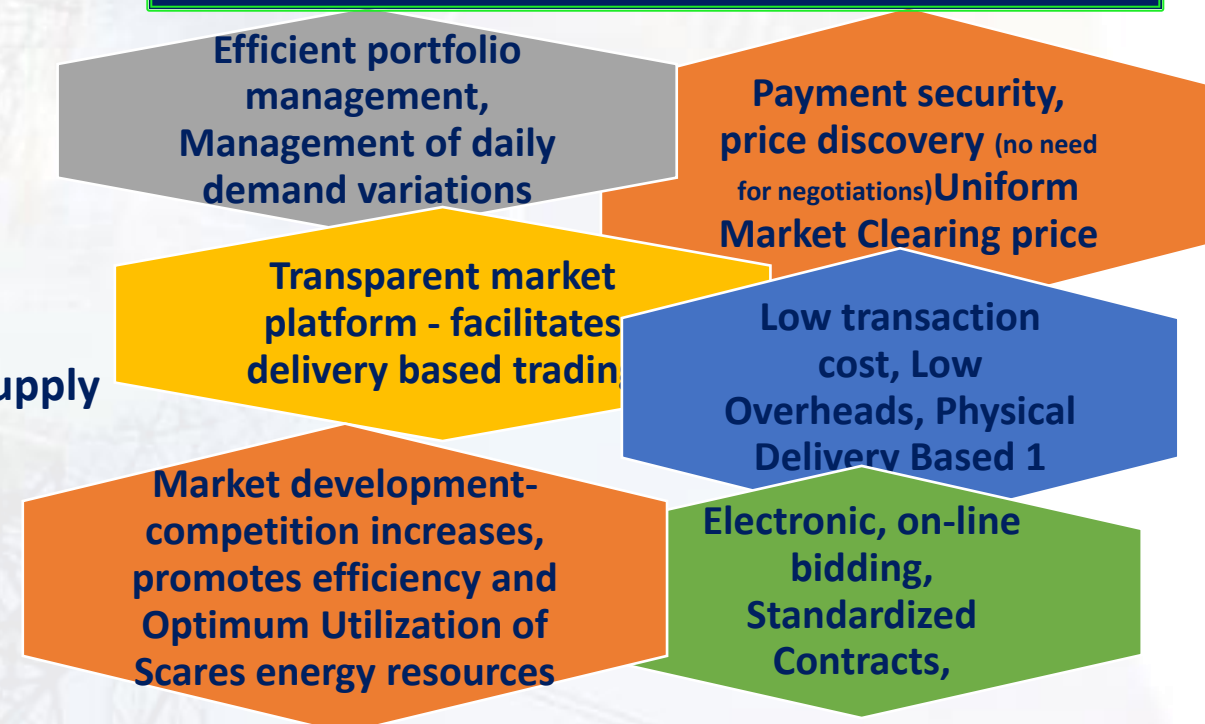
POWER Exchange in India



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.

Why Power Exchange



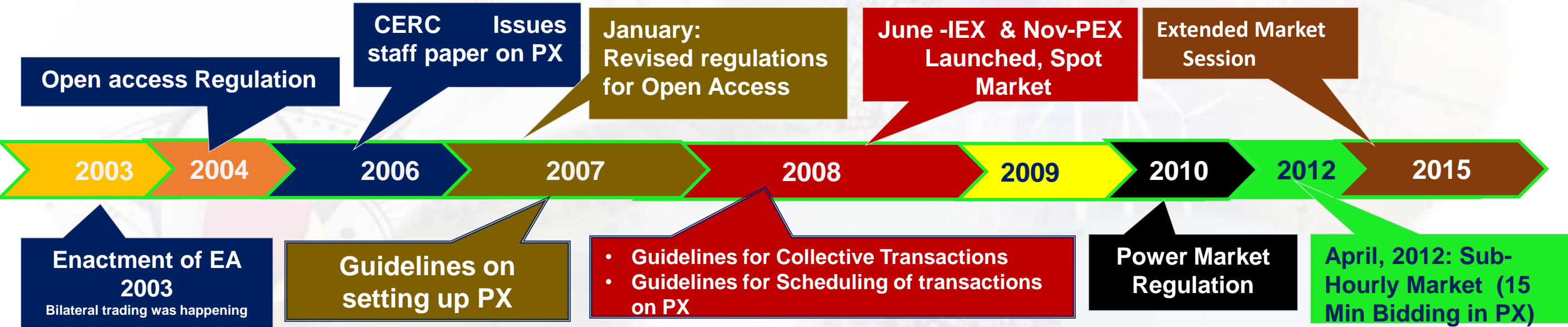
No Financial products such as Derivatives and Forward contracts **-DAM Market

* Restructuring Developments and Issues in Indian Power System, <http://searchdl.org/public/journals/2011/IJRTET/5/2/587.pdf>

http://www.cercind.gov.in/2013/orders/180_2010.pdf https://www.ee.iitb.ac.in/~npsc2008/NPSC_CD/Data/Oral/BIC3/p288.pdf

1:Physical delivery-based market – not susceptible to any kind of manipulation

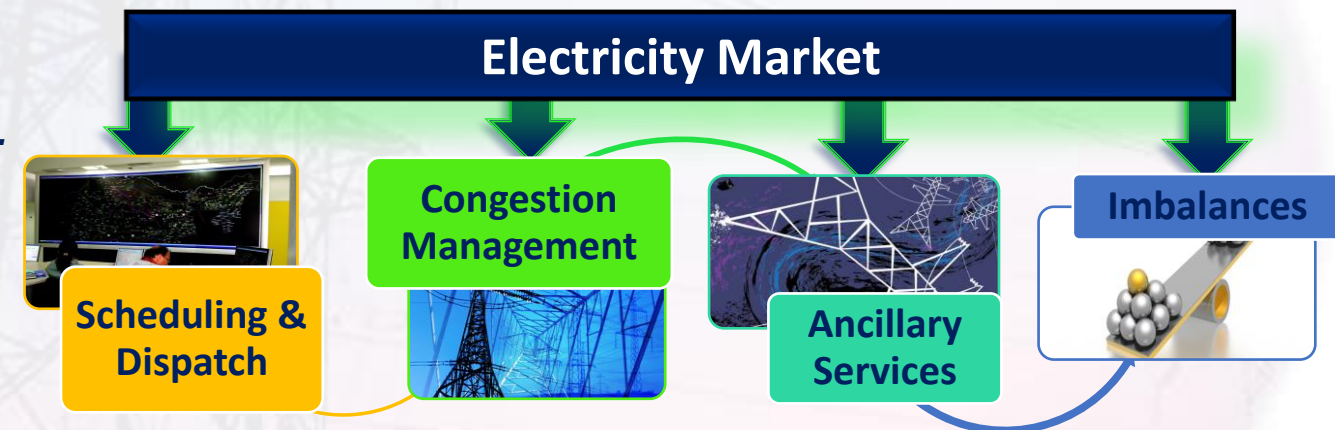
Development of Power Exchanges in India



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.*

Four Pillars of Market Design



"Making Competition Work in Electricity" Sally Hunt

Power Market Regulation came after power exchange started functioning

Products on Power Exchange

Day Ahead Market
Since June 2008

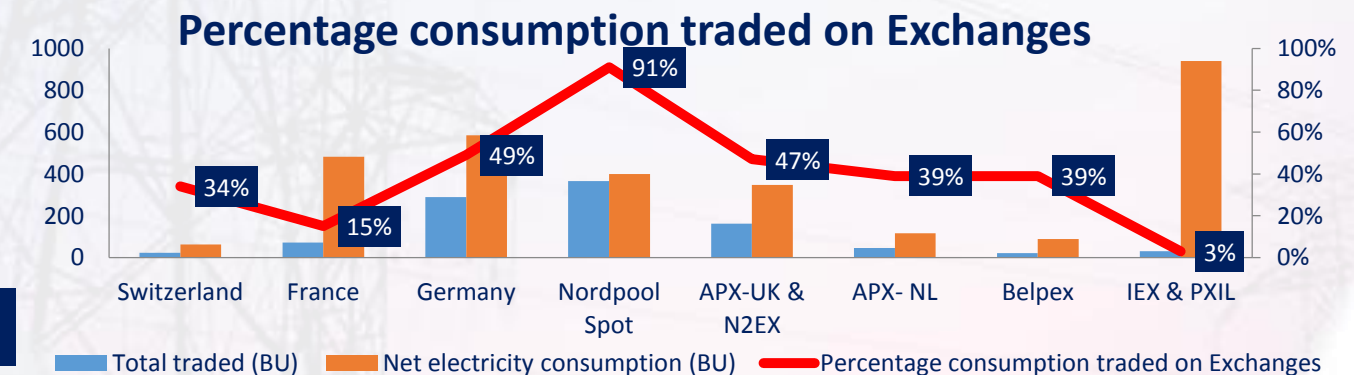
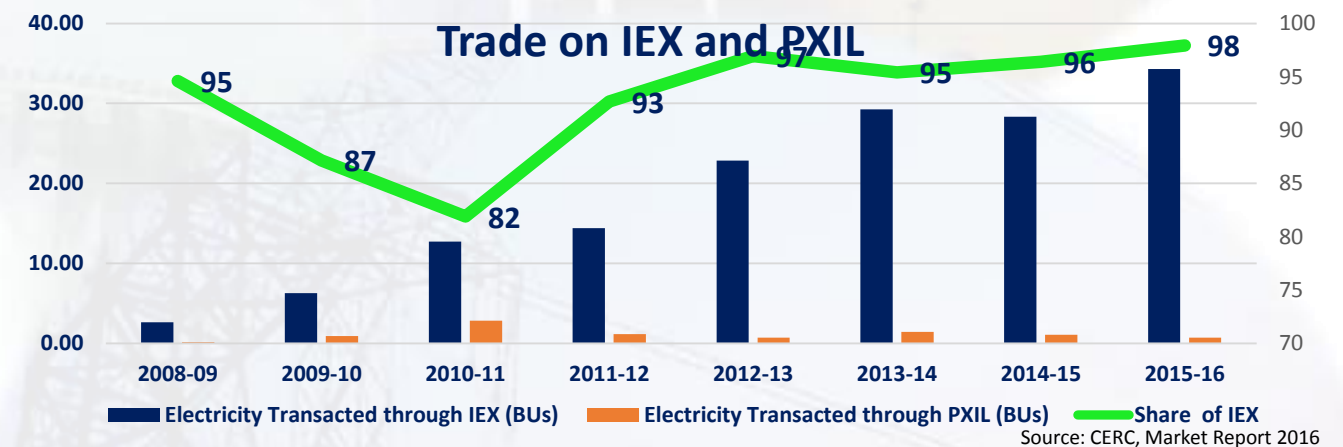
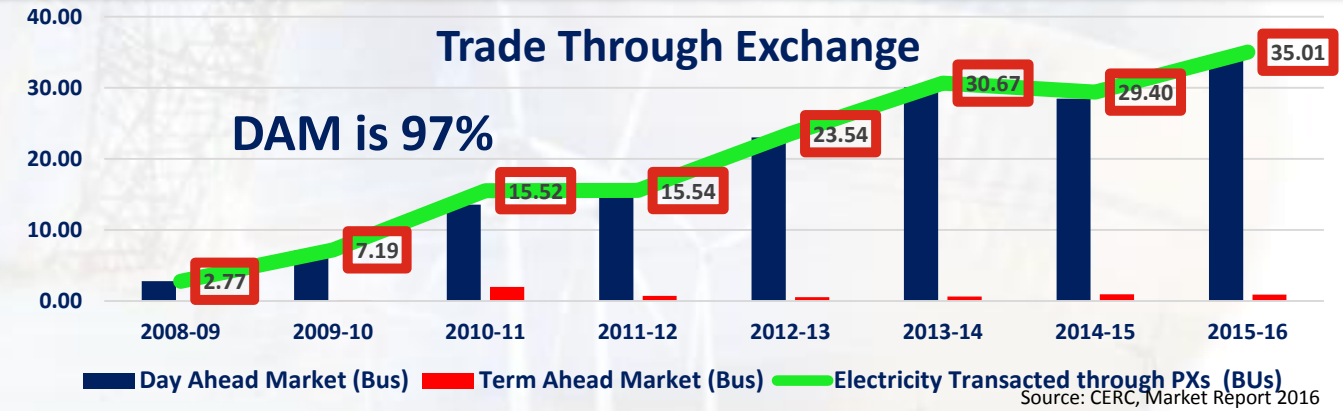
Term-Ahead Market
Since Sep 2009
Extended Markets
Since July 2015
(TAM provides a range of products allowing participants to buy/sell electricity on a term basis for a duration of up to 11 days ahead.)

Renewable Energy Certifications
Since Feb 2011

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

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)



>90,000 MWh -Daily Trade , 3688 Industrial Consumers, 379 Generator

Source: https://www.iexindia.com/Uploads/Presentation/13_12_2016IEX_DAM_TAM_WEB_Dec'16.pdf The above data are of India Energy Exchange

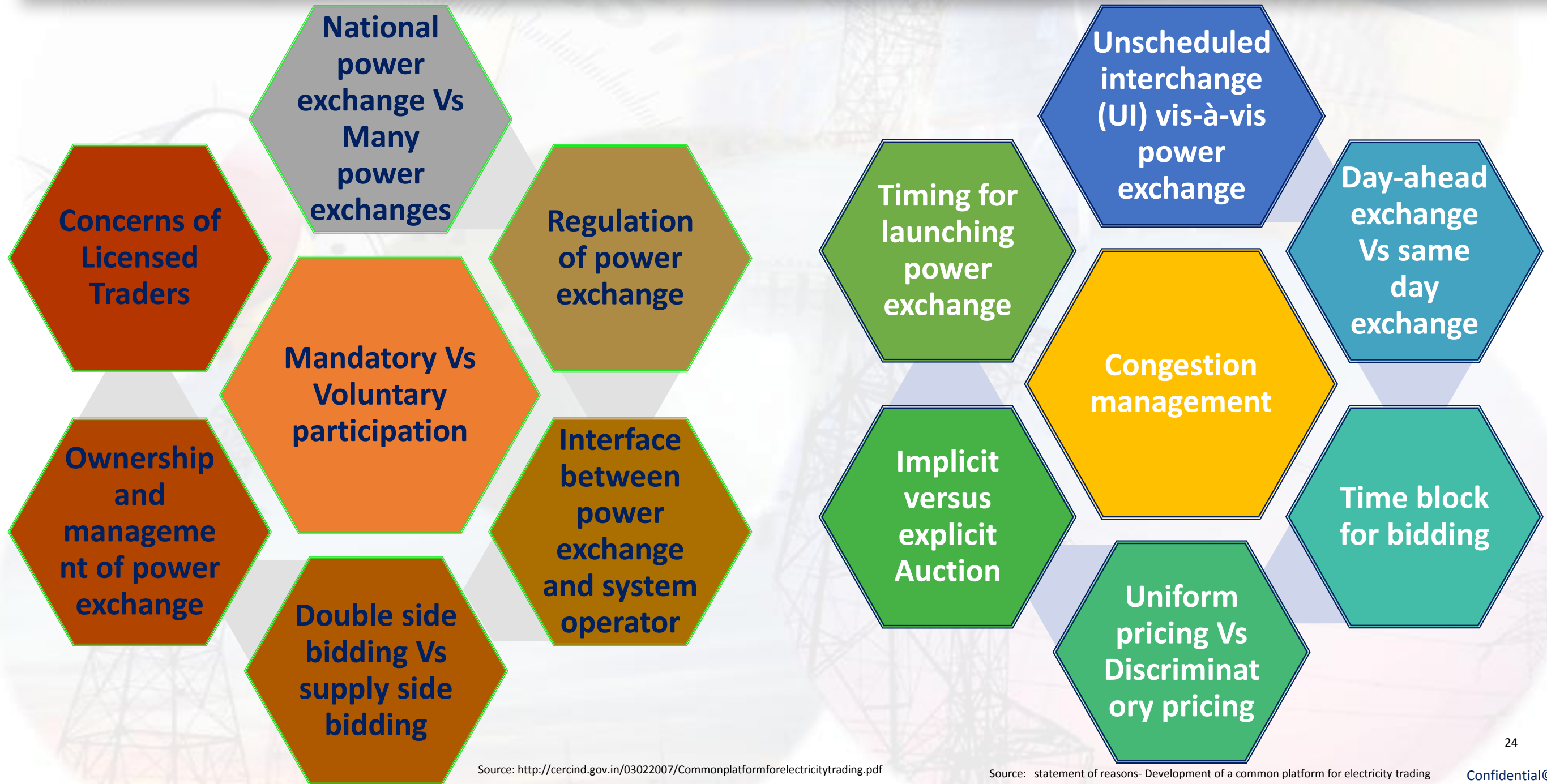


Power Exchanges provides an electronic platform to facilitate the trading of electricity at a national level in following products

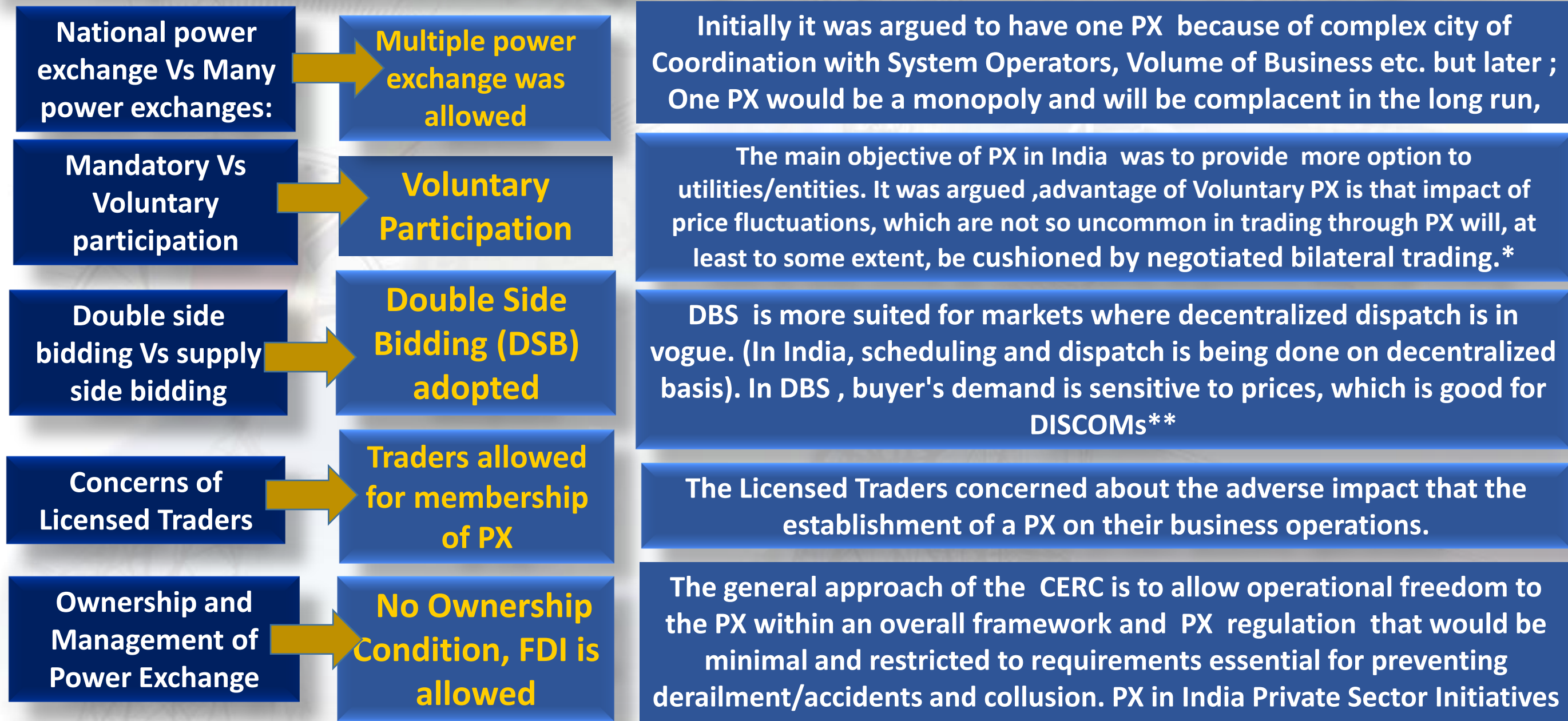
Power Exchanges witnessed growth at a CAGR of 62% (FY-09 to FY 15).

Source: Annual Reports 2014 of all the Power Exchanges and World Energy Statistics, IEA 2014

Some key Issues/factors discussed/debated Prior to setting of PX



Key PX Issues raised & Appropriately resolved Prior to setting of PX



**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

Regulations

Guidelines

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 (Terms and Conditions for Dealing in Energy Savings Certificates) Regulations, 2016

CERC (Deviation Settlement Mechanism & related matters) Regulations, 2014

Procedure for Scheduling of Collective Transaction

Procedure for Scheduling of Bilateral Transactions

Self regulation by PXs

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

Electricity Act, 2003

Contribution of power exchanges

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.

Price signals to correct regional constraints

Competitive market development

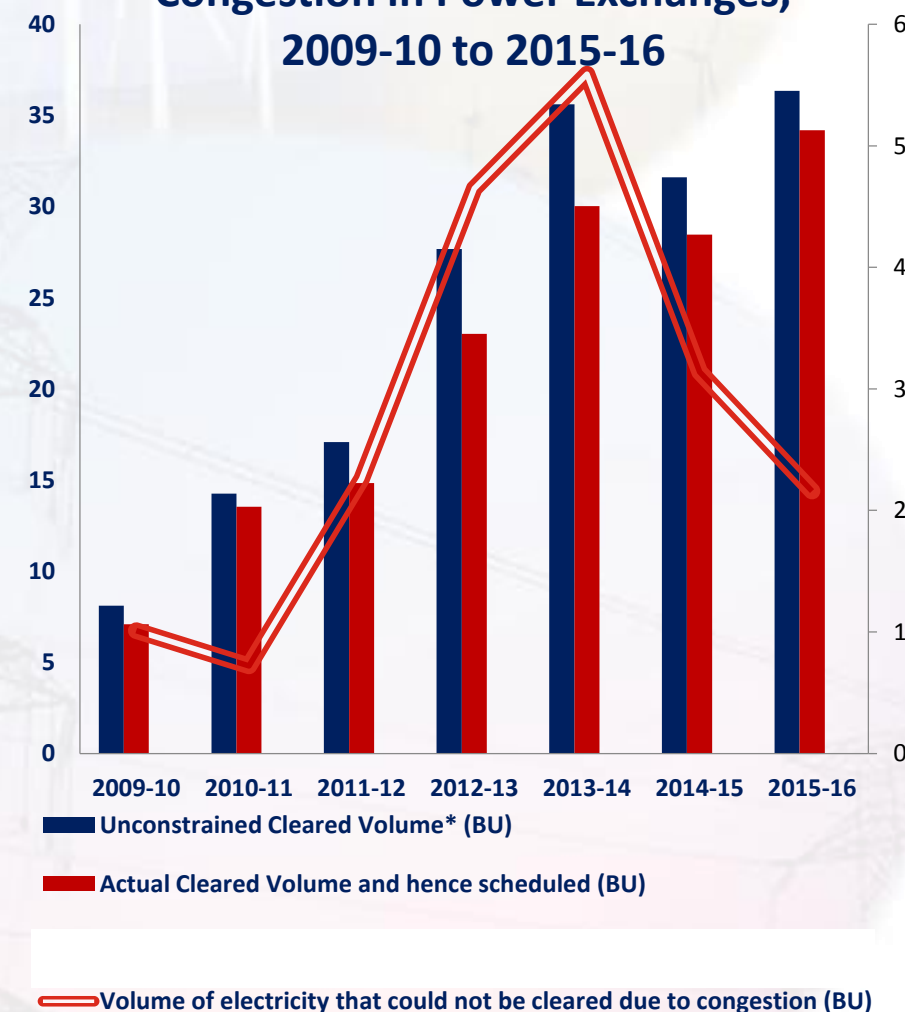
Around 3% of the total generation is being traded through power exchanges.

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.

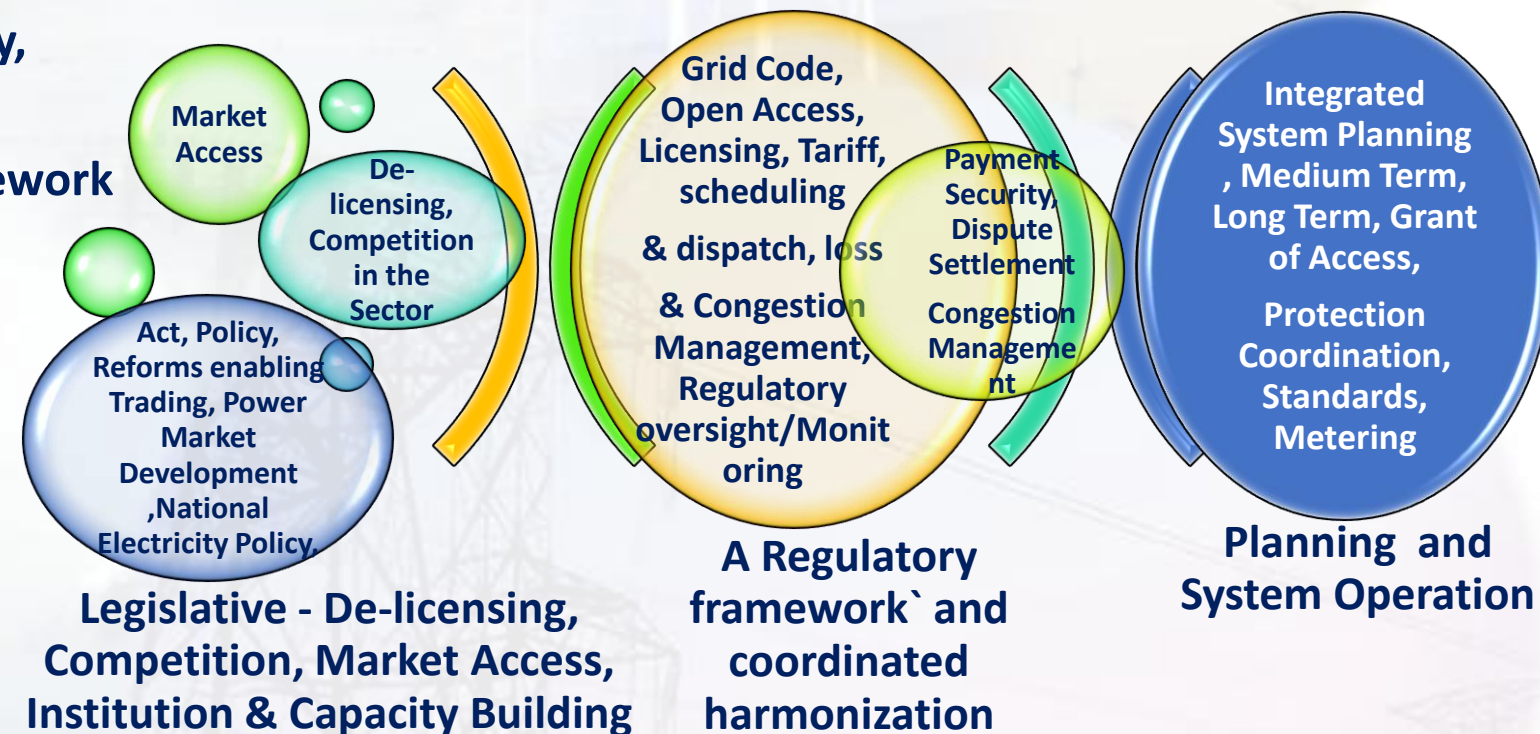
Congestion in Power Exchanges, 2009-10 to 2015-16



Key Lessons :Power Market and Exchange Development in India

- Step by Step and Gradual Approach, Political Support is essential*
- Infrastrucure 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



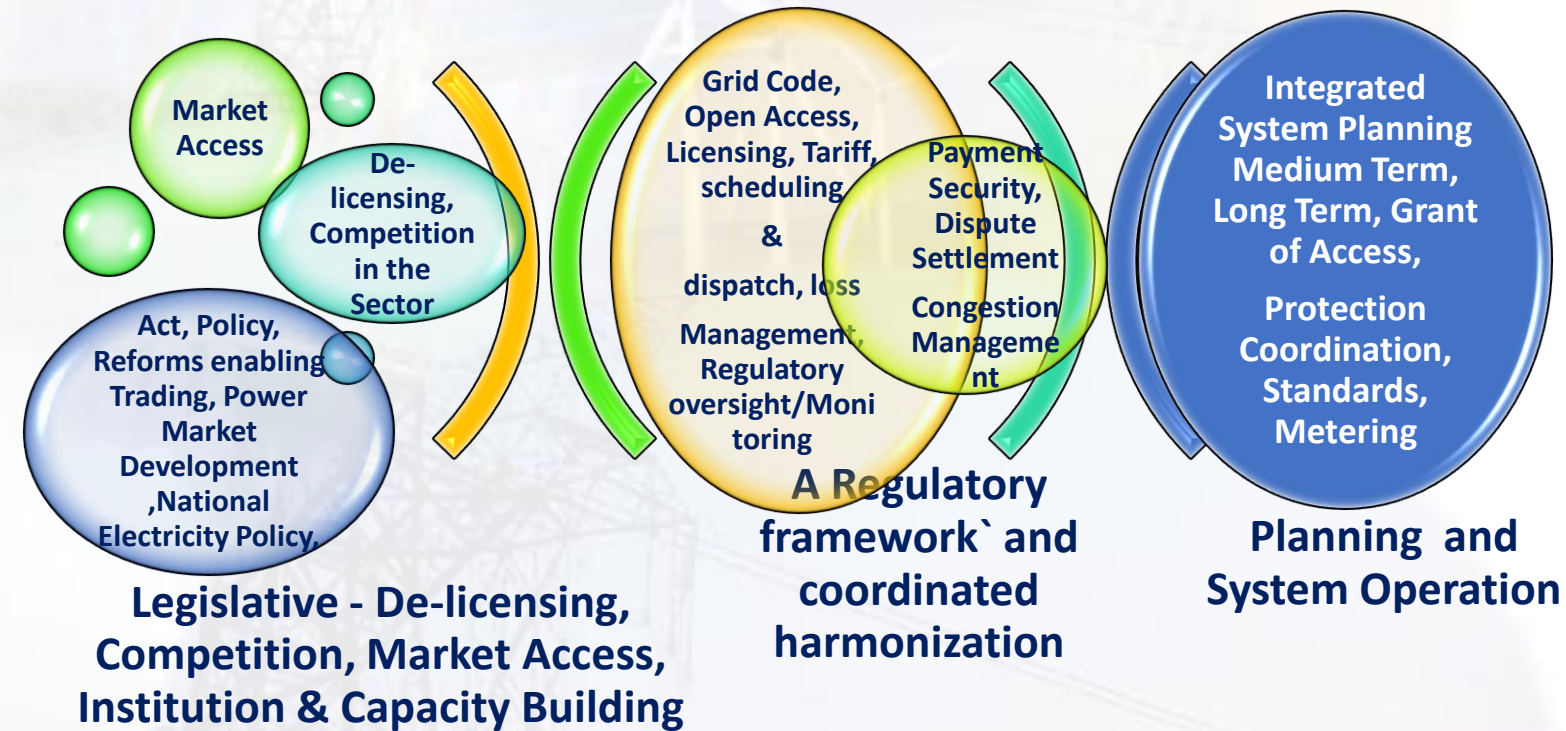
* Pre requisite

**Desirable

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



* Pre requisite

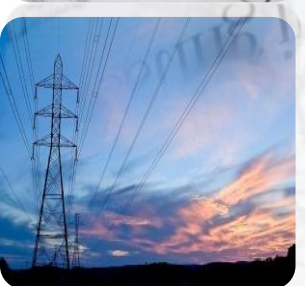
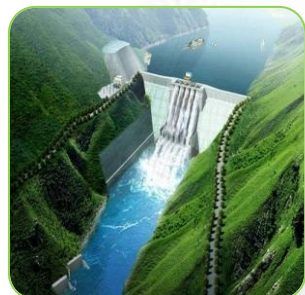


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Prospect for Cross Border Electricity Trade (CBET) through Power Exchange in South Asia



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

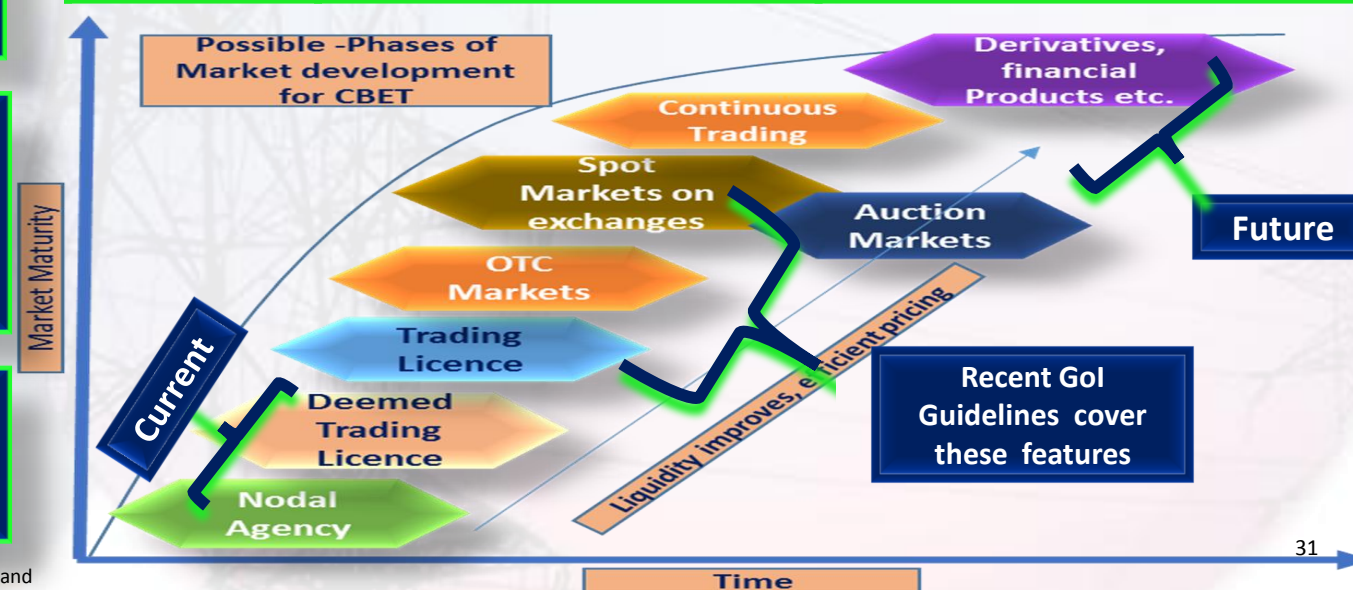
India-Nepal:- 1.Power Exchange Treaty 2. Agreement on electric power trade, cross-border transmission interconnection 3. River Treaties

SAARC-Regional Agreement: SAARC Framework Agreement on Energy (Electricity) Cooperation.

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

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



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

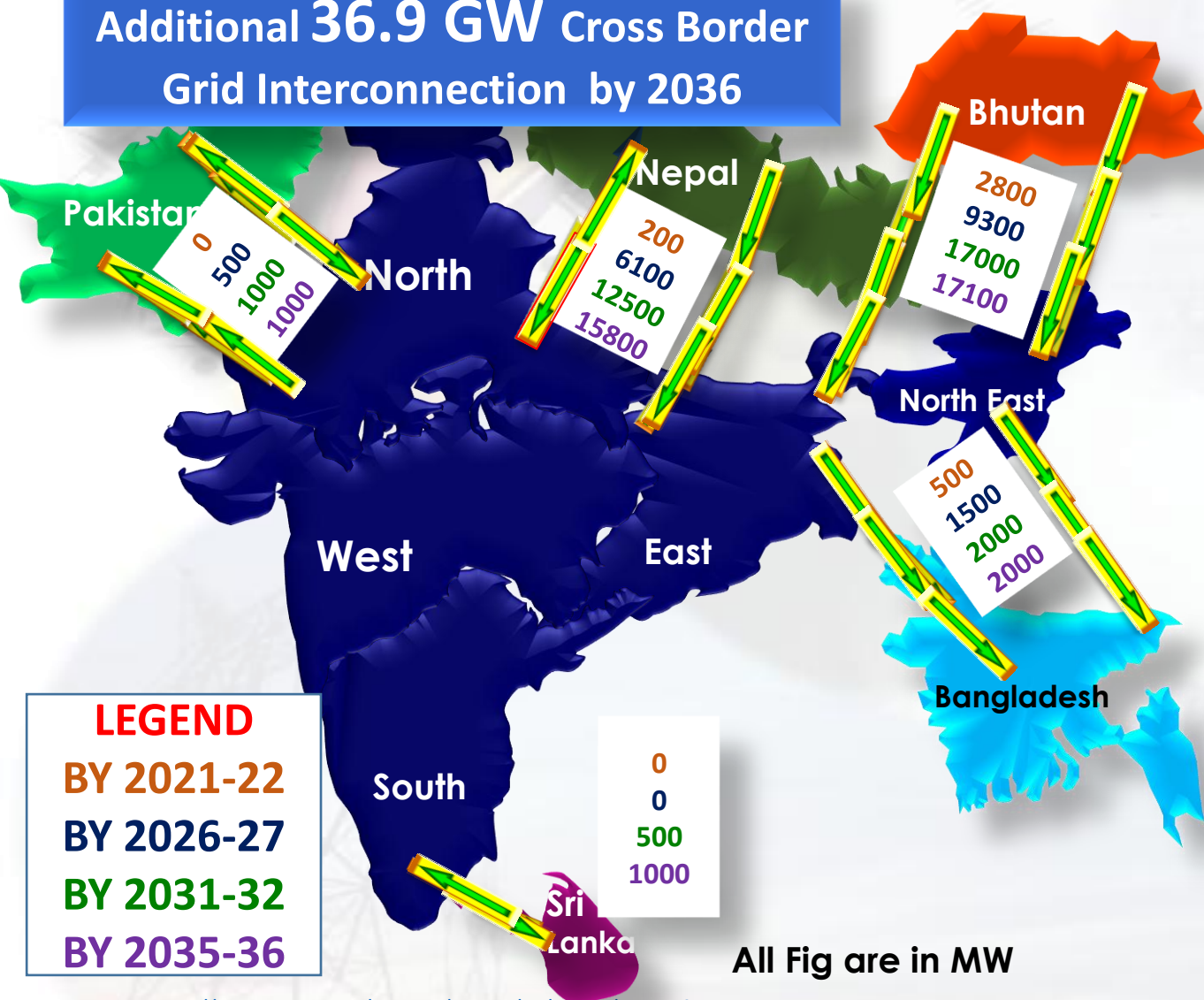
✓ Countries are Different stage of power sector , depth of regulatory framework

✓ Building Strong of transmission system interconnections;

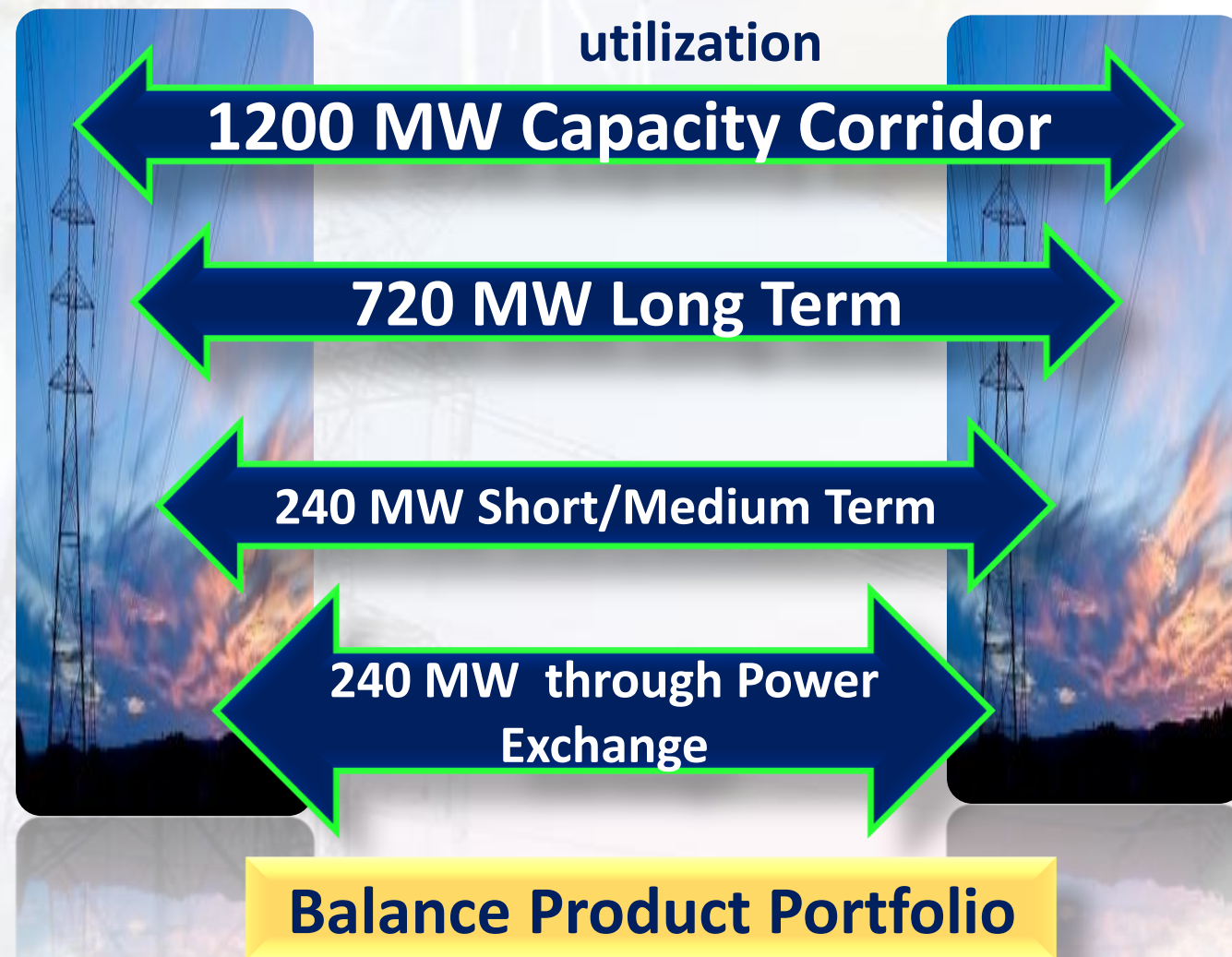
✓ Developing Regional Electricity Markets from bilateral markets

Regional Transmission Interconnection Capacity by 2036 and Development of Cross Border Transmission Infrastructure

Additional 36.9 GW Cross Border Grid Interconnection by 2036



Approach for Development of Cross Border Transmission Infrastructure & it's economic utilization



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).

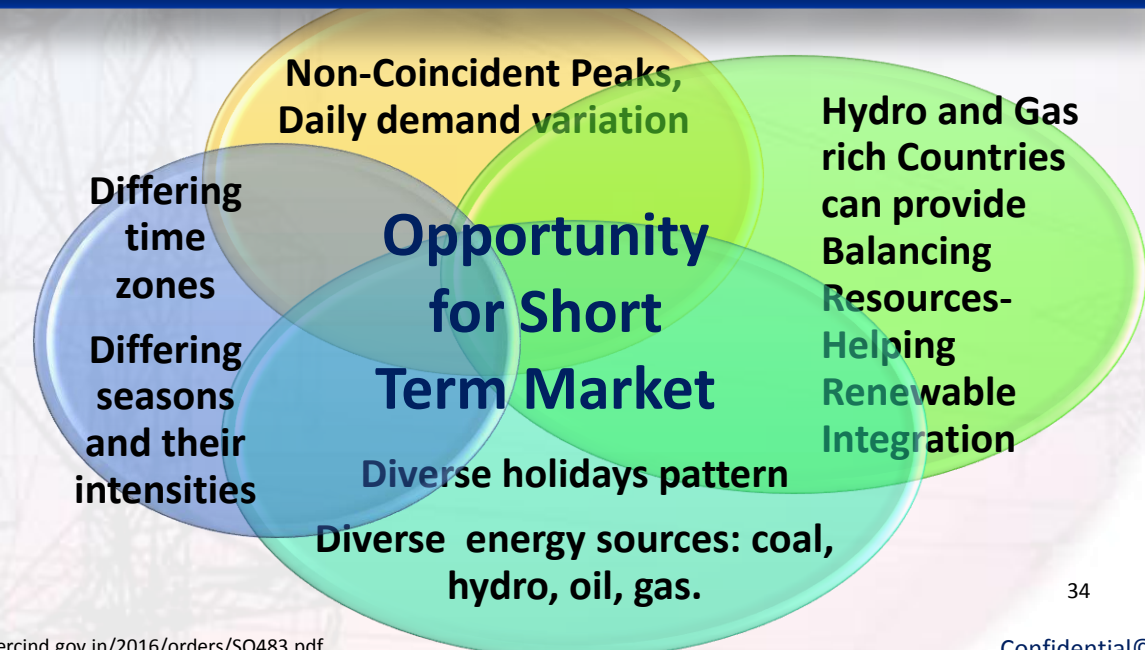
Draft Regulation by CERC has been issued , public hearing has been conducted(Feb,2017)

Seasonal complementarity– Monthly Electricity Load Profiles across South Asia

	January	February	March	April	May	June	July	August	September	October	November	December
Bangladesh												
India-North East												
Bhutan												
India-East												
Nepal												
India-North												
India-West												
Pakistan												
India-South												
				Low	Medium	High						

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

Diversity Among South Asian Countries



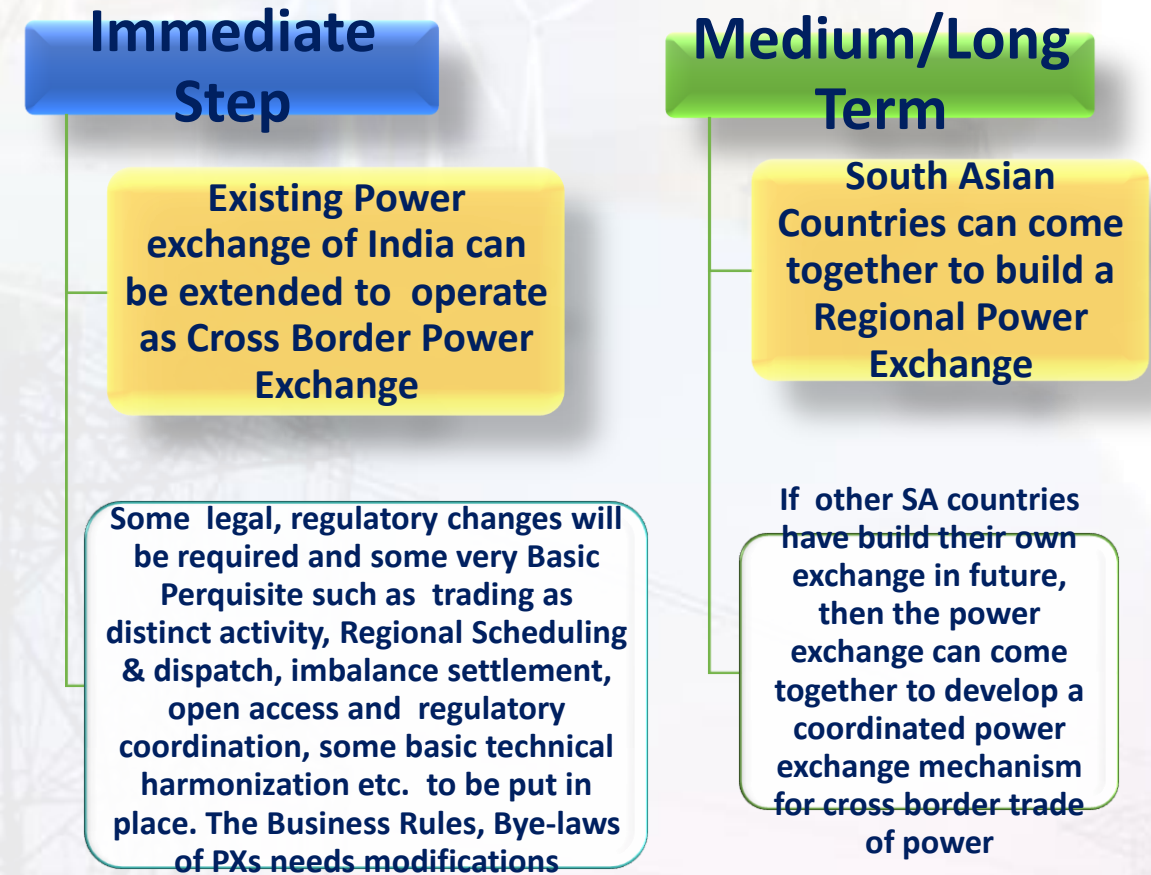
*<http://www.cercind.gov.in/2016/orders/SO483.pdf>

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



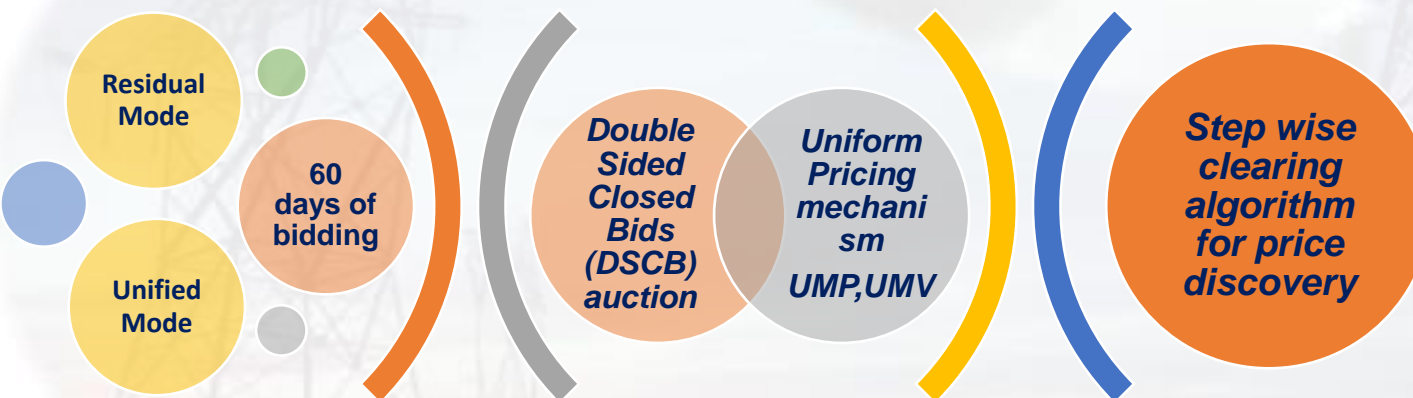
Four Pillars of Market Design



SARI/EI: South Asian Regional Power Exchange- SARPEX (Mock Trading Exercise & Capacity Building)

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



Exercise aims for Unconstrained Market Price (UMP) and Unconstrained Market Volume (UMV)

No impact of transmission constraints is considered

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.

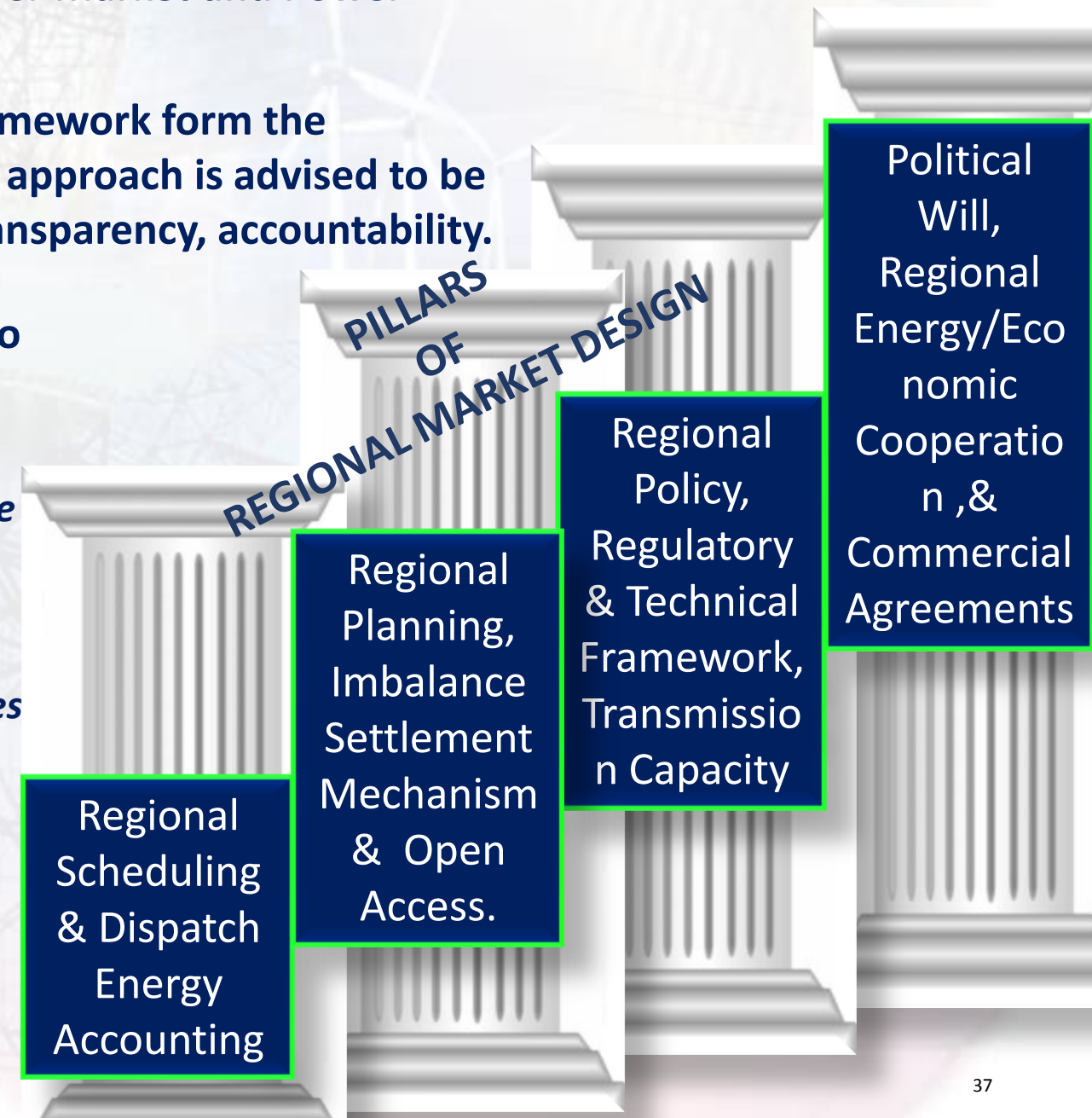
Core
Team



SARI/EI &
Consultant
Team

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.**

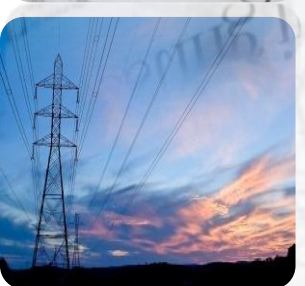
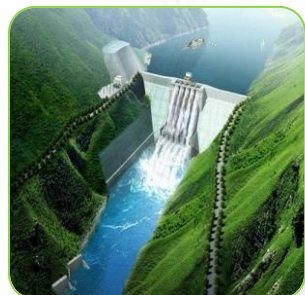




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Thank You

Contact

rajivratnapanda@irade.org

rajivratnapanda@gmail.com



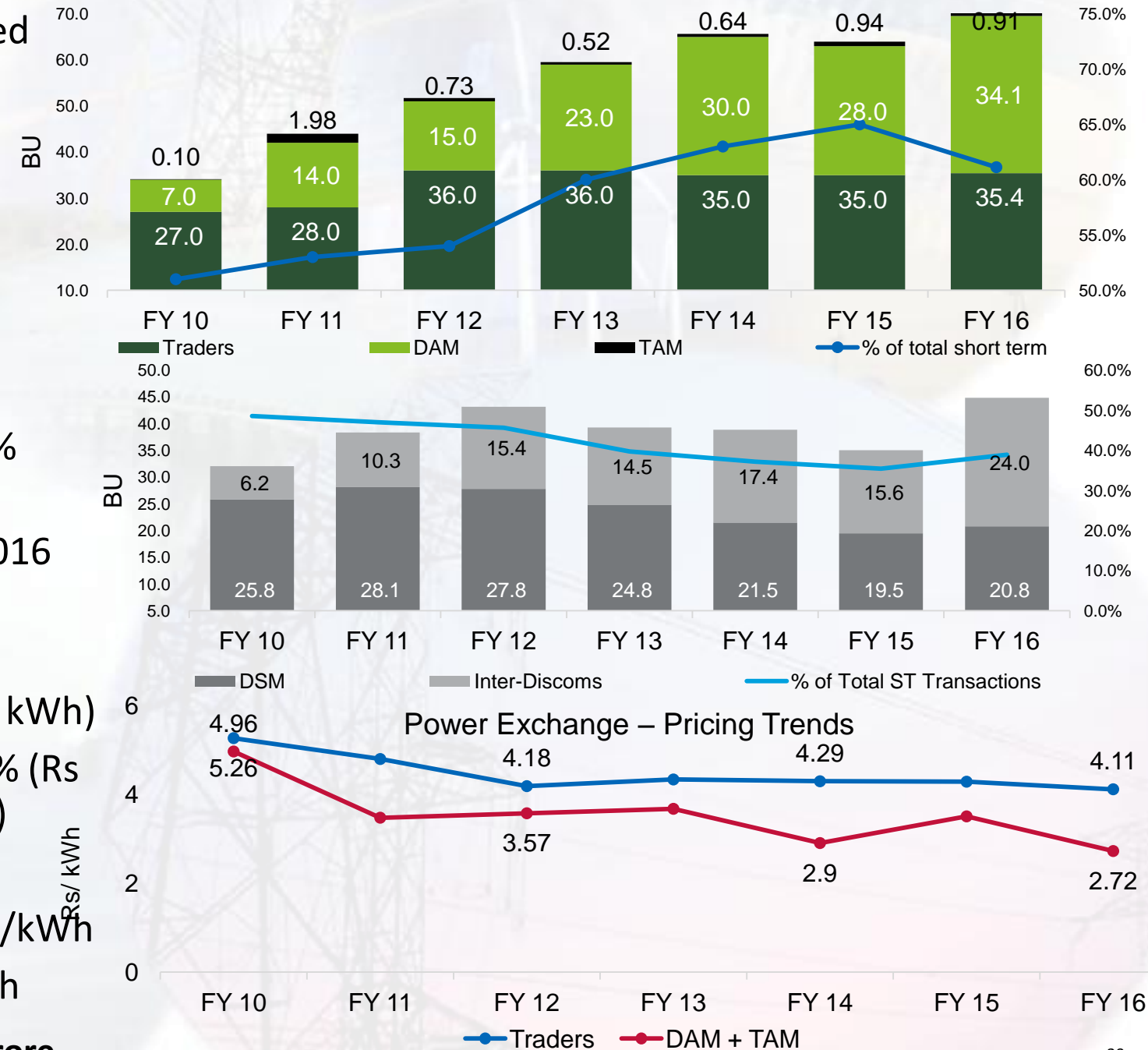
Short Term Electricity Trades

- 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

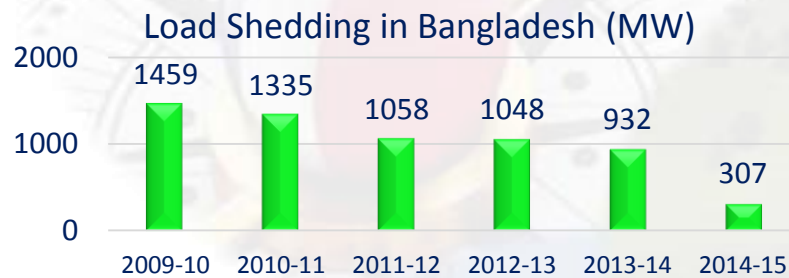
In monetary terms, short-term market size was Rs 24,096 crore, which was 4% less than in the year 2014-15



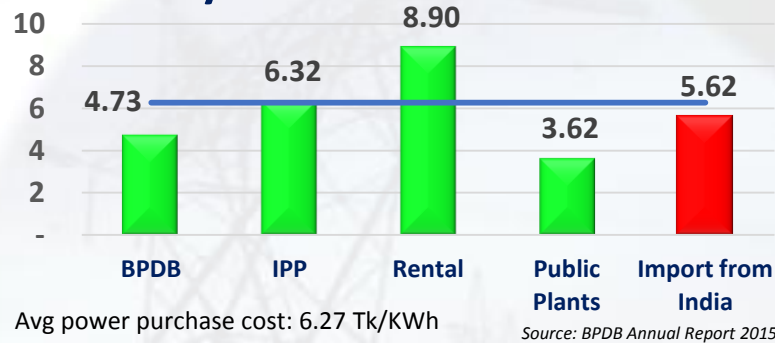
Cross Border Electricity Trade in South Asia and Key Message for ASEAN

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)



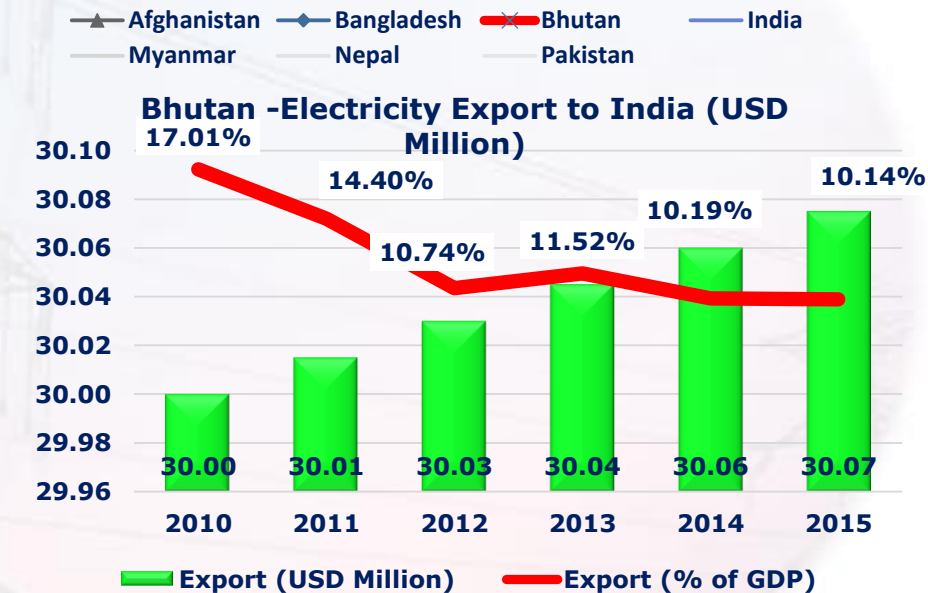
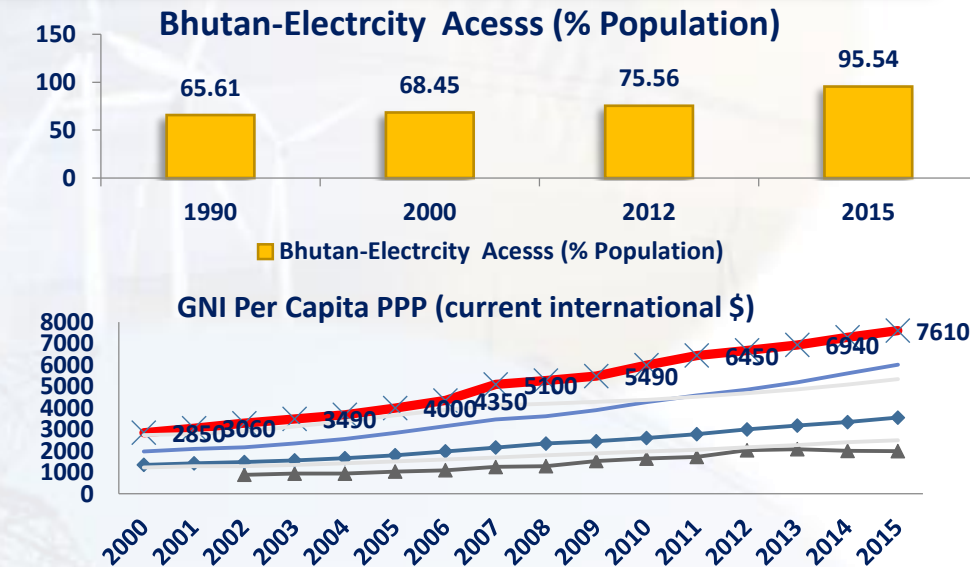
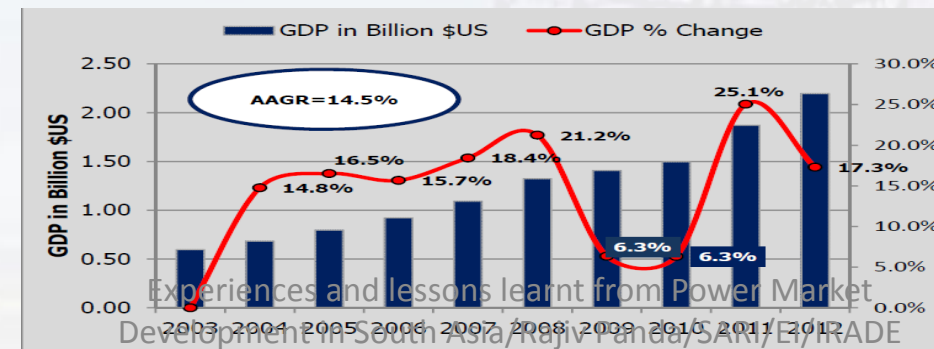
Access to Cheaper source of Electricity



- 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.
- Emergency Support -During the 2012 blackout in India**

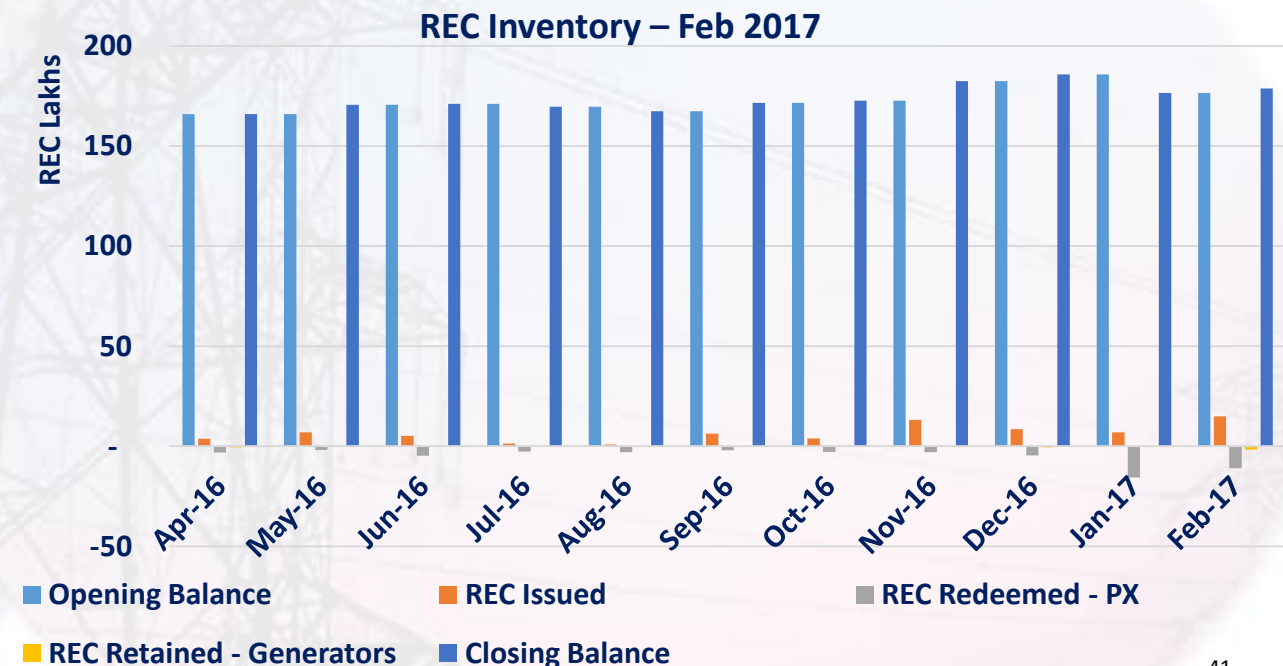
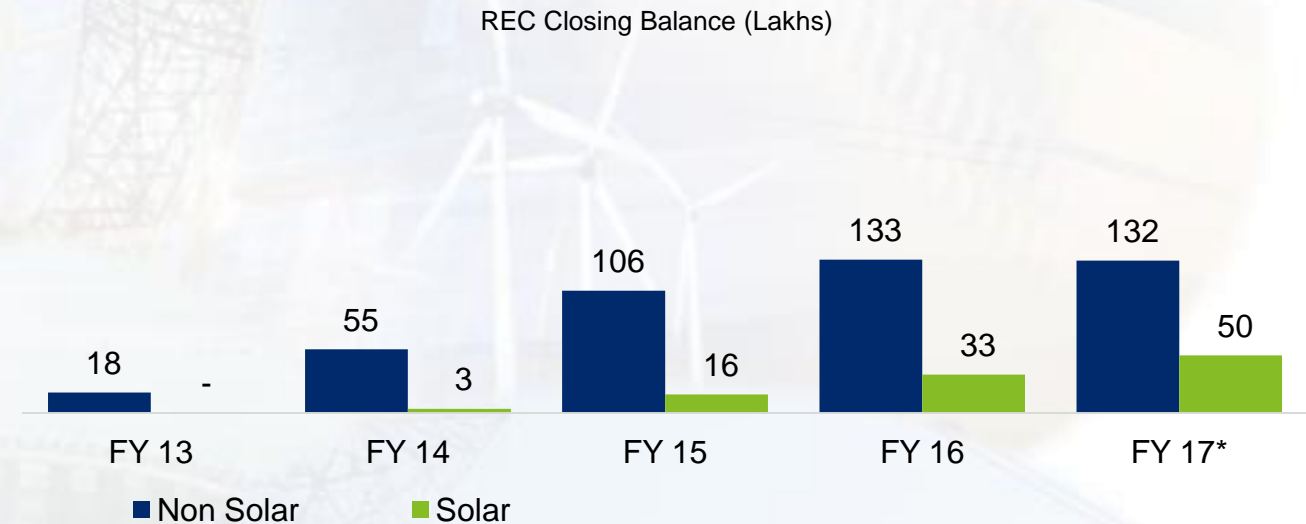


** <http://thediplomat.com/2016/06/india-and-bhutan-cross-country-power-connectivity/>

* <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 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



India Power Market Design

Nature of Contract	Duration of Contract	Transmission Open access availability	Gen. Tariff Structure	Nodal Agency
Long Term Open Access	> 7 years and up to 25 years	> 7 years	Two Part Tariff	CTU for Inter-state STU for Intra-state
Medium Term Open Access	1 – 5 years	3 months to 5 years	Single or Two Part Tariff	CTU for Inter-state STU for Intra-state
Short Term Open Access	Upto 1 year	Upto 3 months	Single Part Tariff	Buyer RLDC for Inter-state SLDC for intra-state
Short Term Open Access – Bilateral	Day Ahead Market (1 day)	1 day	Single Part Tariff	NLDC
Short Term Open Access – Power Exchange	Term Ahead Market (up to 10 days)	Upto 10 days in advance	Single Part Tariff	NLDC
Deviation Settlement Mechanism	Real Time	NA	Frequency linked	RLDC

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
 - Risk Management by collection of margins as specified in the Bye-Laws, Rules and Business Rules of the Exchange

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

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 upto 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

Participation	Voluntary / RPO Compliance
REC Denomination	1 MWh
Validity	3 years after issuance
Categories	<ul style="list-style-type: none">• Solar REC• Non-Solar REC
Trading Platform	Power Exchanges only
Banking	Not Allowed
Transfer Type	Single transfer only , repeated trade of the same certificate is not possible
Penalty for Non-compliance	Forbearance' Price (Maximum Price)
Price Guarantee	Through 'Floor' Price (Minimum Price)

Cross Border Electricity Trade Investments: Risk

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 CBETproject/Investment ? What is the protection available to buyers/sellers/Investor ?



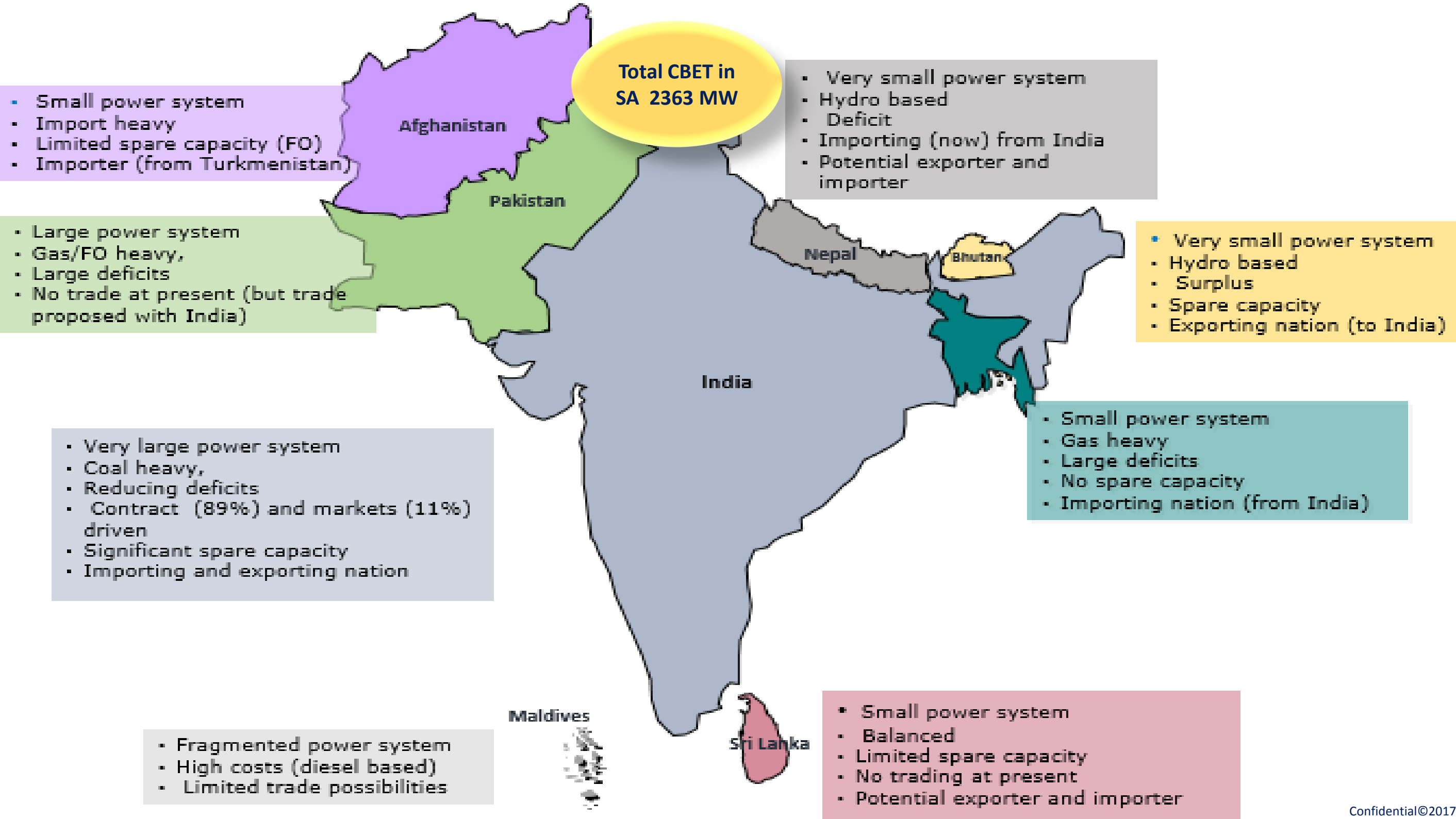
Economic: What happens if the economic assumptions on the project changes? What is the protection available to buyers and sellers ?



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 ?

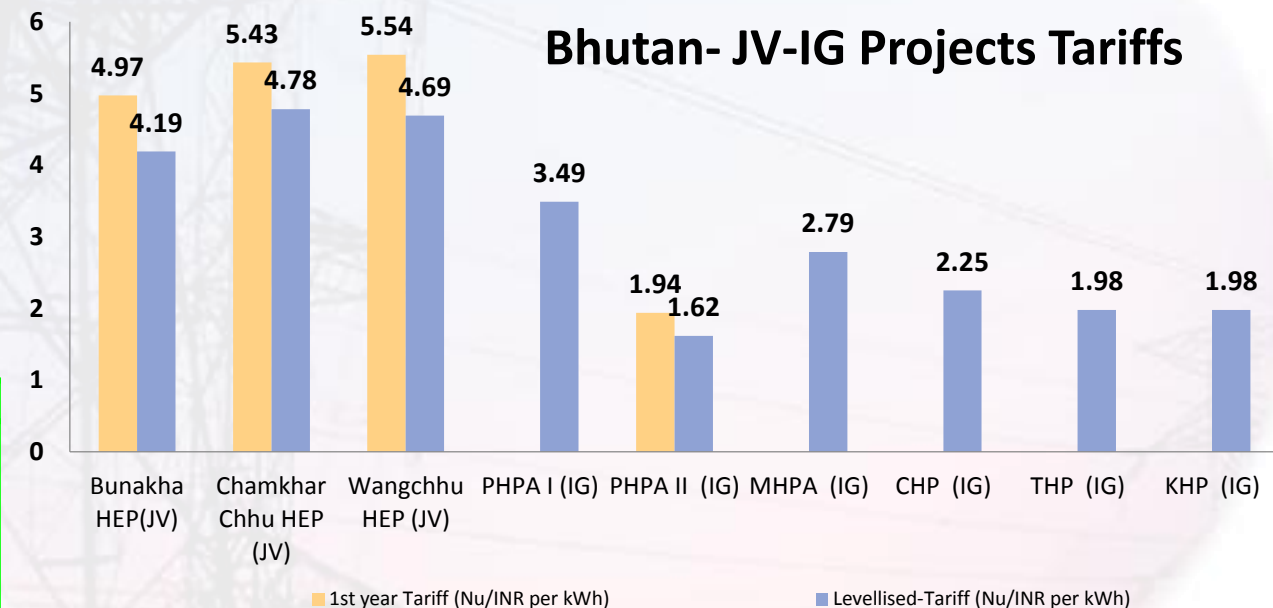
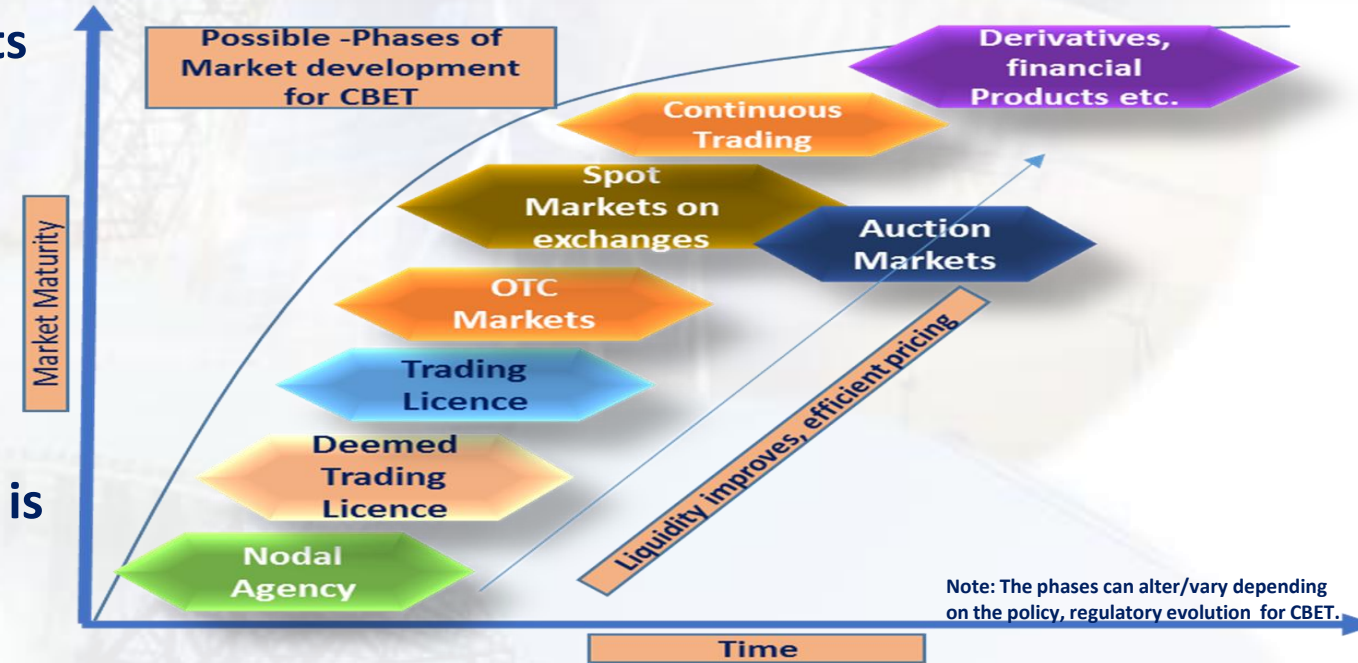


South Asia Regional Power Market Development for CBET

- 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.

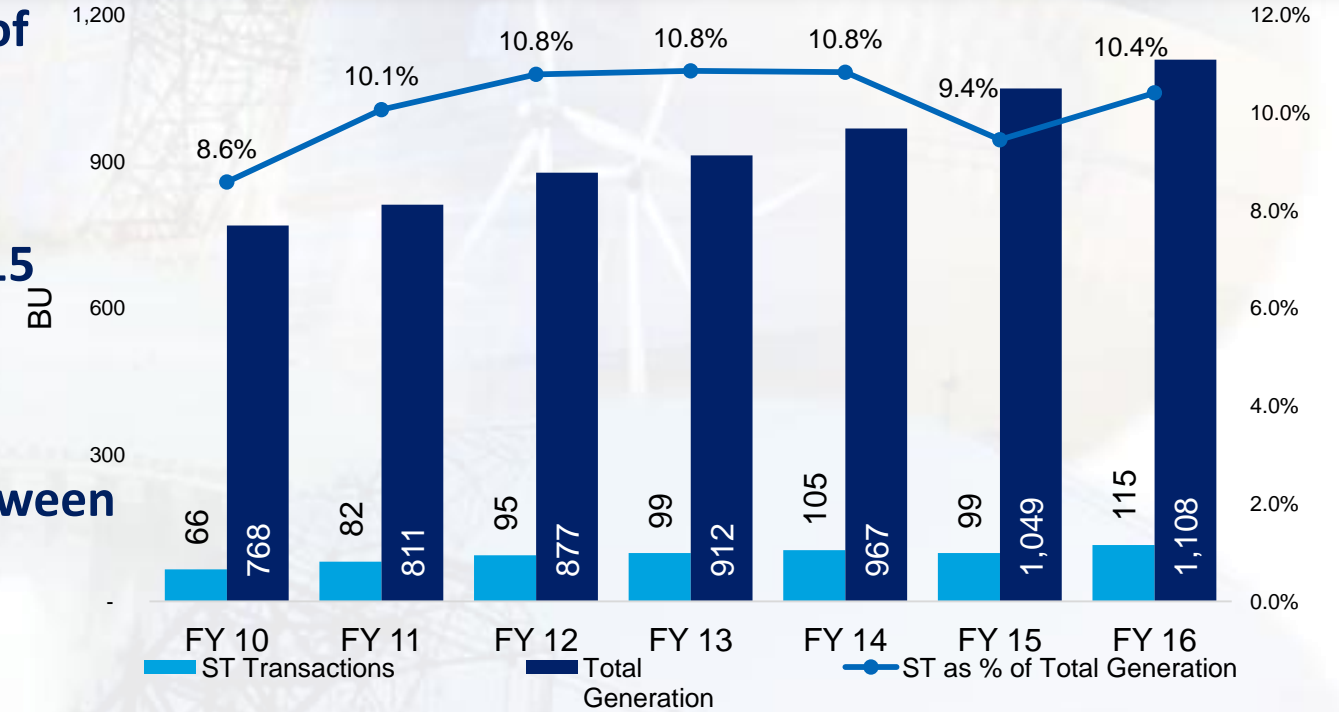
•Development of power exchange in India opens up new oppourtinutes for CBET and building Trans Power Exchange

	Bhutan-India	India-Bangladesh	India-Nepal
Principle of determinati on	The tariff for both Tala and Dagachhu PPAs was determined on a negotiated basis	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	The tariff in both Treaty/Bilateral arrangement and PTC PPA was agreed based negotiation

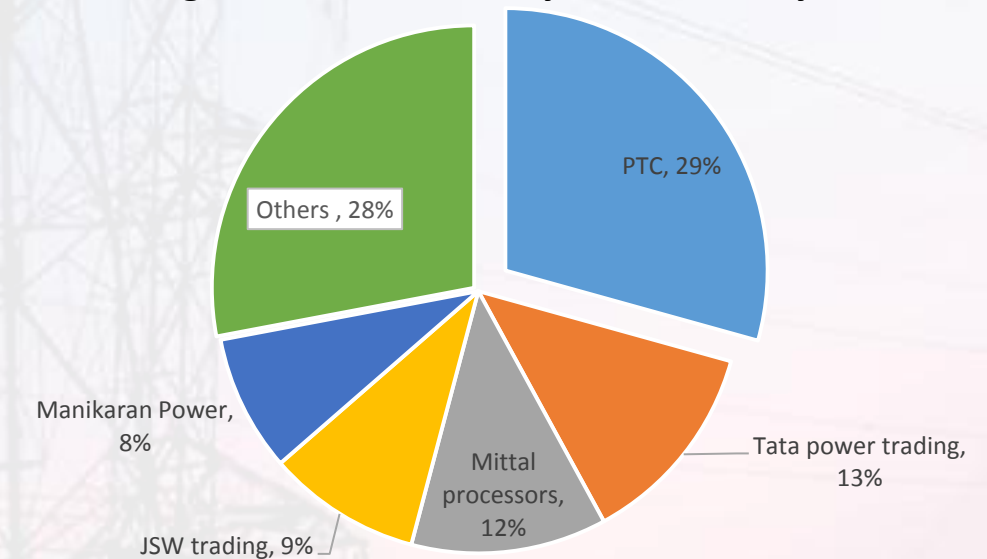


Power Trading Profile

- 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



Percentage share of Electricity Transacted by Traders in 2015-16



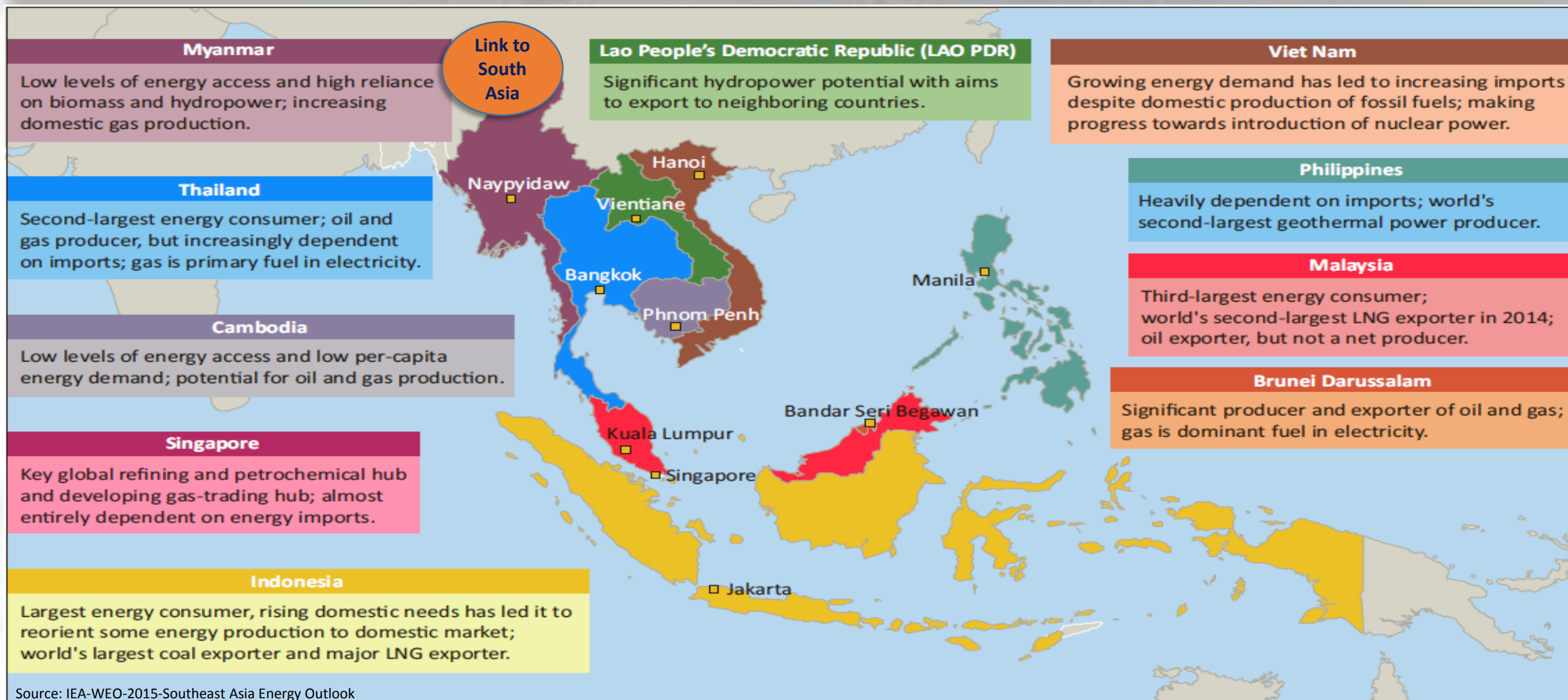
DAM Time Line



DAM and TAM Trading Timeline at IEX



Energy Overview of South East Asia

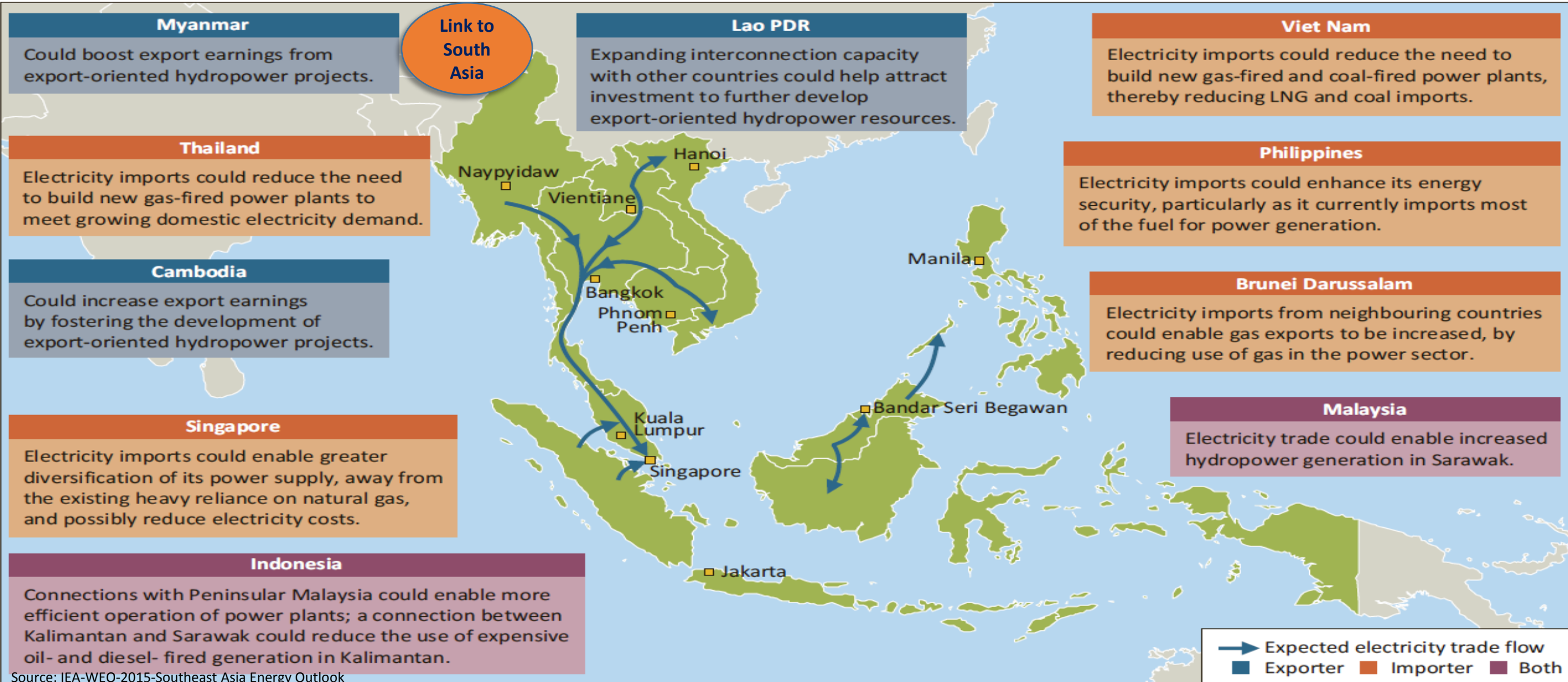


Source: IEA-WEO-2015-Southeast Asia Energy Outlook

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.

Accelerating Cross Border Electricity Trade and Hydro power Development between Myanmar and South Asia: Opportunities and Challenges/Myanmar/Yangon/16th August Rajiv/SARI/EI/IRADe

Potential implications and benefits of enhanced power grid interconnections South East Asia



Energy Resource in ASEAN/ South East Asia and South Asia

ASEAN RENEWABLE
ENERGY DEVELOPMENT

21

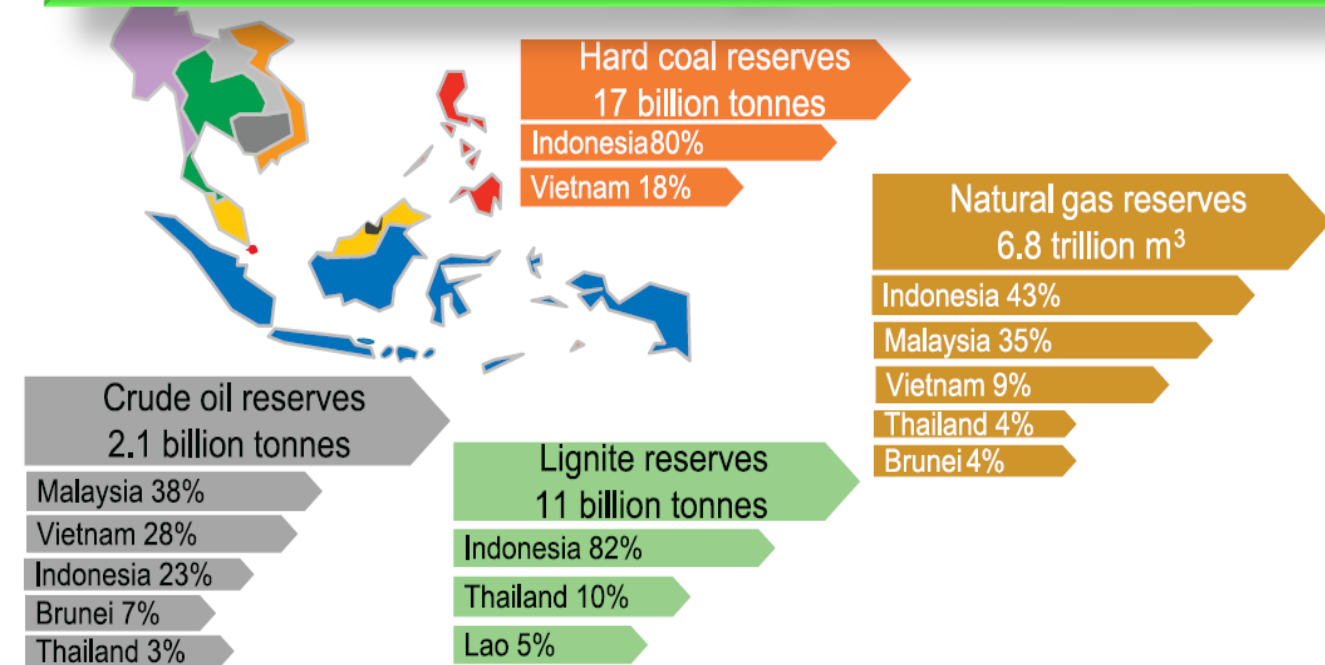
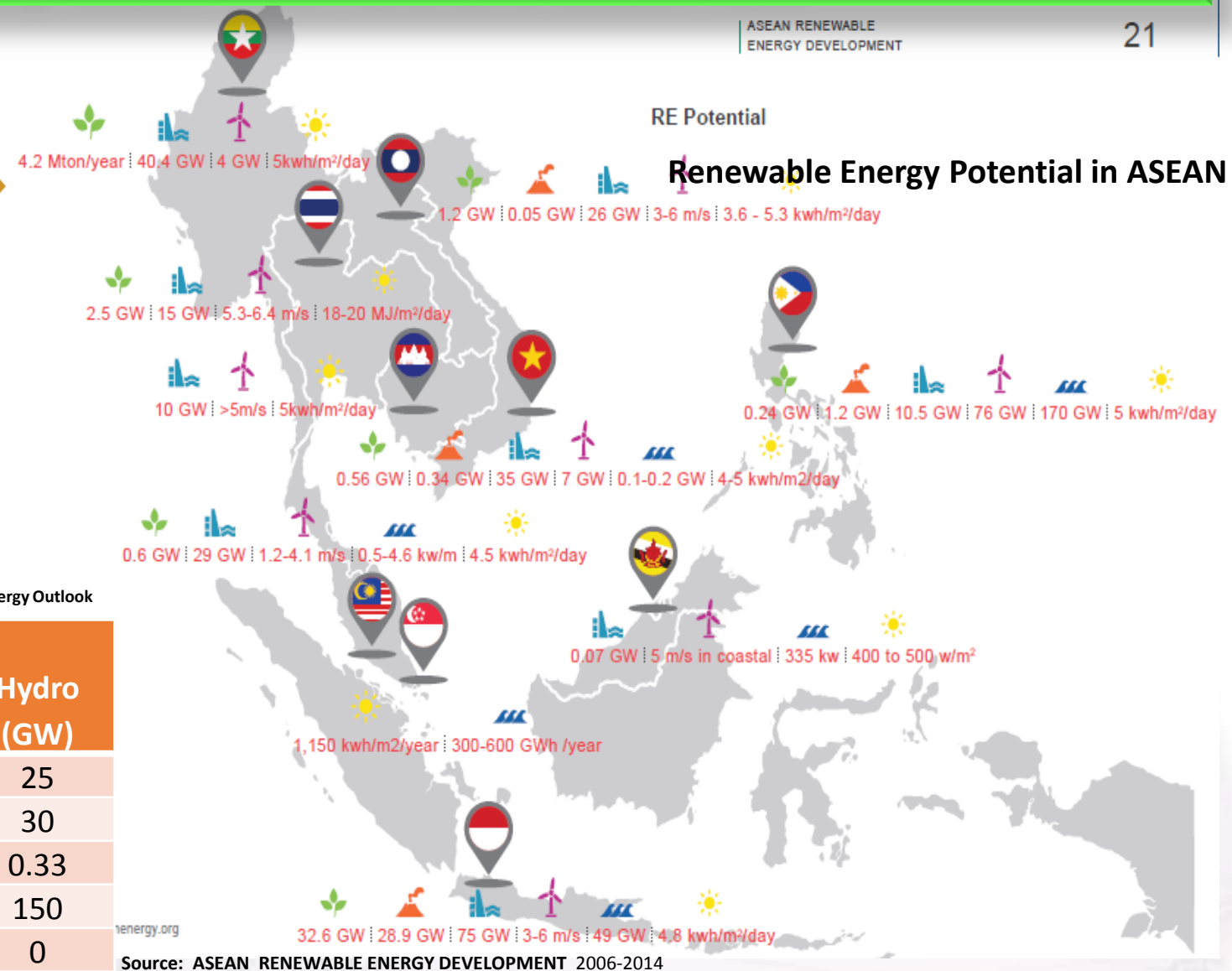


Figure 4 Fossil Fuel Reserves in ASEAN, as of 2013 Source: The 4th ASEAN Energy Outlook

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

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



Renewables	Afghanistan	Bangladesh	India	Nepal	Bhutan	Pakistan	Sri Lanka
Average Solar (kWh/m ² /day)	4.7-5.47	4.51-4.99	3.95-6.07	5.03-5.37	4.63	4.02-5.54	4.8-5.88
Wind (MW)	NA	limited	151,918	3,000	4,825	24,000	25,000MW

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

Proprietary, Trader & Professional

- Right to trade and clear on its own account
- Generator-Distribution licensees- IPPs - CPP- MPPs –O A consumers
- Exchange Transaction -3p/kWh

Professional Member

- Trade and clear on behalf of its Clients
- Professional members can trade facilitate in trading of clientele but cannot provide financial security
- No credit /financing
- Exchange Transaction- 2p/kWh

Electricity Traders

- Trade and clear on behalf of its Clients
- Members are inter-State trading licensees who can trade on behalf of clients
- Credit /financing
- Exchange Transaction -2p/kWh

Membership Category: Proprietary / Professional Member The financial criteria for payment options available on IEX are:

Fees	Professional & Proprietary & Electricity Trader (Full Payment Option)	Proprietary member (Light Payment Option)
Admission fee	Rs. 35,00,000	Rs. 10,00,000
Interest Free Security Deposit	Rs. 25,00,000	Rs. 10,00,000
Annual Subscription Fees	Rs. 5,00,000	Rs. 2,50,000
Processing Fees	Rs. 10,000	Rs. 10,000
TOTAL	Rs. 65,10,000	Rs. 22,60,000
Exchange Transaction	2p/kWh	3p/kWh

IEX	Electricity	REC
State Utilities	29 States I 5 UTs	16 States I 5 UTs
Generators	379	847
Industrial Consumers	3688	2489
Average Daily Volume	>90,000 MWh Highest : 144,649 MWh	>6 million RECs Highest: 865,675 RECs

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

Source: https://www.iexindia.com/Uploads/Presentation/13_12_2016IEX_DAM_TAM_WEB_Dec'16.pdf IEX Data as on 30 NOVEMBER, 2016

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.

PXIL: It was promoted by National Stock Exchange of India Limited and National Commodity & Derivatives Exchange Limited. Other key shareholders include GMR Energy Limited, Power Finance Corporation Limited, Gujarat Urja Vikas Nigam Limited, West Bengal State Electricity Distribution Company Limited and Tata Power Trading 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

The Nord Pool markets with major interconnectors indicated



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.



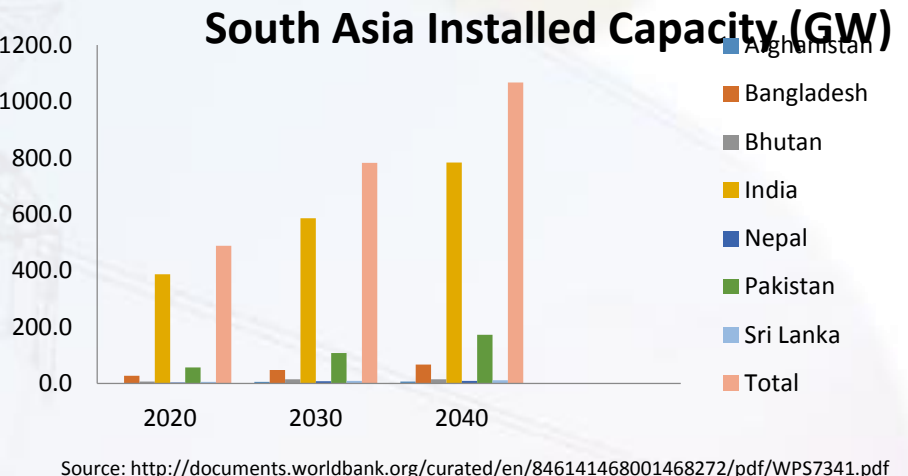
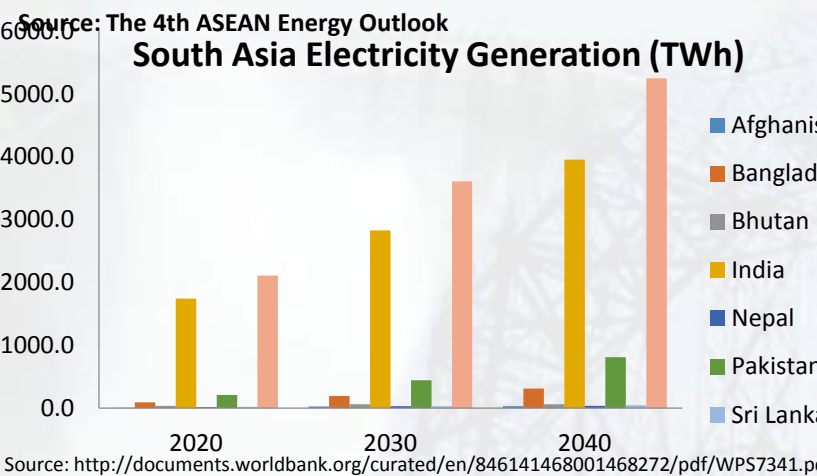
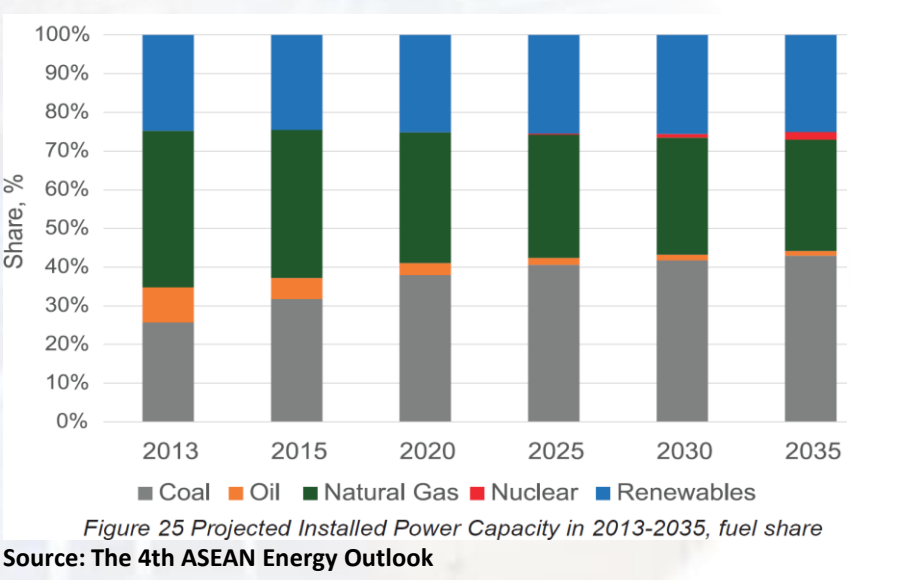
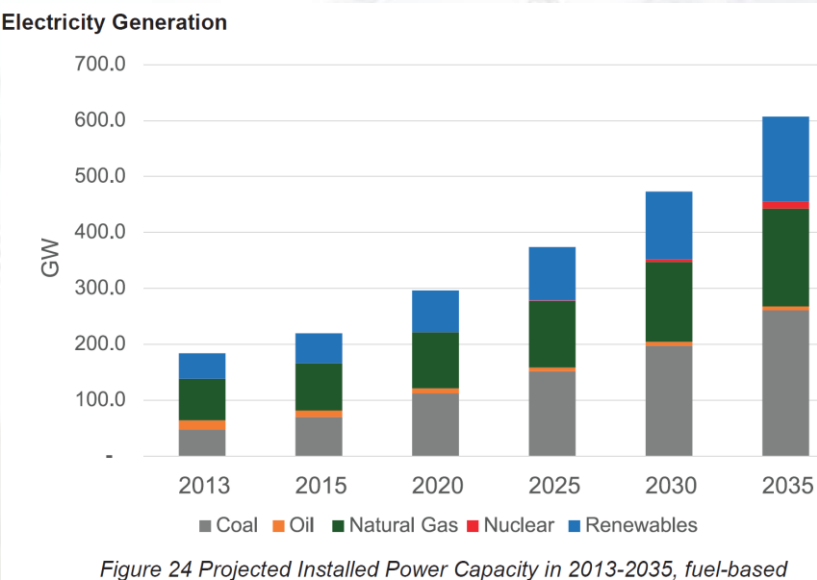
OMIE

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



	Year	Diesel	Gas Turbine	Hydro	Solar	Coal	Wind	Combin e Cycle	Biomass	Nuclear
Afghanistan	2020	19.2%	54.1%	24.6%	0.0%	0.0%	2.2%	0.0%	0.0%	0.0%
	2040	3.0%	8.5%	88.1%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%
Bangladesh	2020	14.8%	9.2%	1.5%	17.3%	19.4%	0.4%	37.5%	0.0%	0.0%
	2040	5.9%	3.7%	0.6%	6.9%	66.8%	0.1%	15.0%	0.0%	0.9%
Bhutan	2020	0.1%	0.0%	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	2040	0.1%	0.0%	99.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
India	2020	0.3%	3.1%	15.5%	3.2%	59.9%	9.7%	3.8%	1.4%	3.0%
	2040	0.1%	6.9%	12.7%	2.6%	57.7%	9.3%	4.2%	2.9%	3.7%
Nepal	2020	1.6%	0.0%	97.8%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%
	2040	0.6%	0.0%	99.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Pakistan	2020	0.8%	4.3%	29.8%	0.0%	34.3%	16.7%	10.7%	0.8%	2.6%
	2040	0.3%	1.6%	22.1%	0.0%	45.4%	20.0%	6.0%	0.3%	4.3%
Sri Lanka	2020	3.1%	10.7%	32.7%	1.5%	16.3%	17.8%	17.1%	0.8%	0.0%
	2040	0.8%	5.7%	17.6%	1.1%	37.1%	24.5%	12.3%	0.8%	0.0%
Total	2020	1.2%	3.7%	18.4%	3.6%	52.7%	9.9%	6.6%	1.2%	2.7%
	2040	0.6%	5.7%	15.9%	2.3%	54.3%	10.3%	5.1%	2.2%	3.4%

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

Central Electricity Regulatory Commission (CERC)

Designated Authority (CEA)

**Transmission Planning Agency (TPA) of each
neighbouring country**

**Settlement Nodal Agency (SNA) of each
neighbouring country**

**National Load Dispatch Centre (NLDC)
Central Transmission Utility (CTU)**

CBTE Guidelines and Policy

**Regulation for facilitating cross border trade of electricity with
neighbouring countries in accordance with these guidelines.**

**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;**

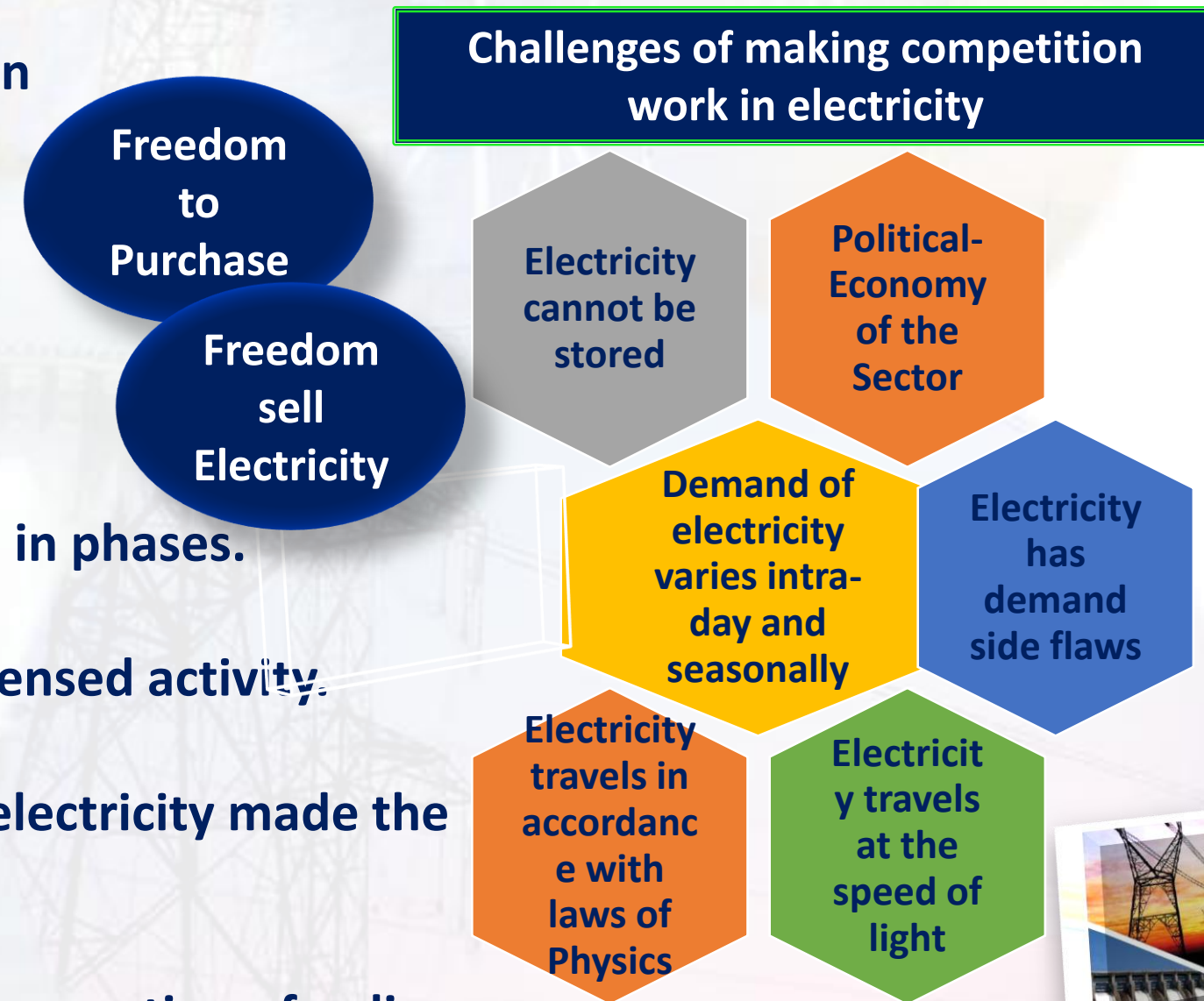
**Responsible for Transmission System planning in respective neighbouring
country for the purpose of facilitating cross border trade of electricity**

**Responsible for settling all charges pertaining to grid operations
including operating charges, charges for deviation and other charges
related to transactions**

**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.



Have we learned something from these for customized adaptation ?

International Experience : Comparison

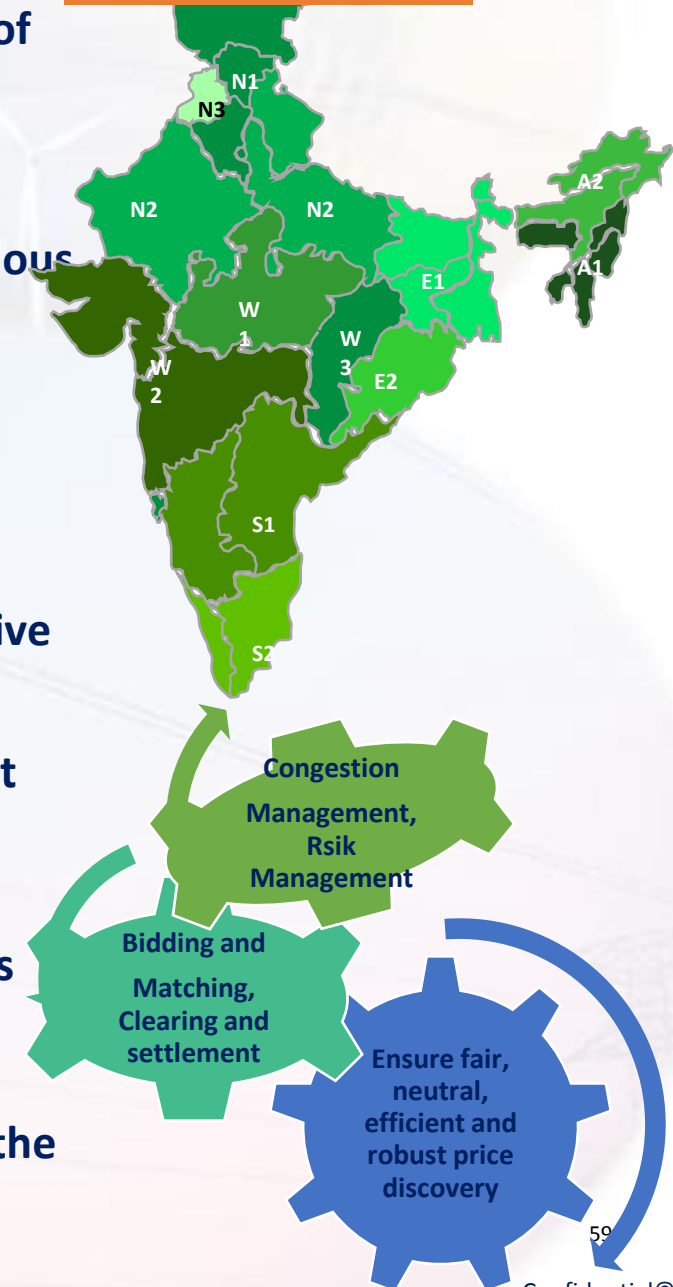
	Nord Pool	PJM	AEMO	India
Participation	Voluntary for DAM	Compulsory for Real Time	Compulsory for DAM	Voluntary
Market Offerings	DA spot, hour-ahead, forward, futures, options	DA spot, real-time balancing, capacity credit markets	DA spot, Short term forwards	DAM, TAM
Bidding Type	Double Sided	Double Sided	Double Sided	Double Sided Closed, Open Auction & Continuous
Real-time / Balancing market	Counter trade	Balancing Market	Purchase of ancillary services & reserve capacity	UI charge for deviations
Pricing Rule	Zonal Pricing	Nodal Pricing	Zonal Pricing	Zonal Pricing
Risk Management	Forwards, futures, options	FTRs, Bilateral OTC, Multisettlement, virtual bidding	Bilateral OTC, Derivatives on Sydney Exchange	Bilateral OTC
Congestion Management	Area splitting	Security constrained economic dispatch	Locational signals for transmission	Area splitting
Transmission Losses	Included in zonal price	Included in LMP	To be purchased by generators	To be purchased by participants

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

12 Bidding Areas

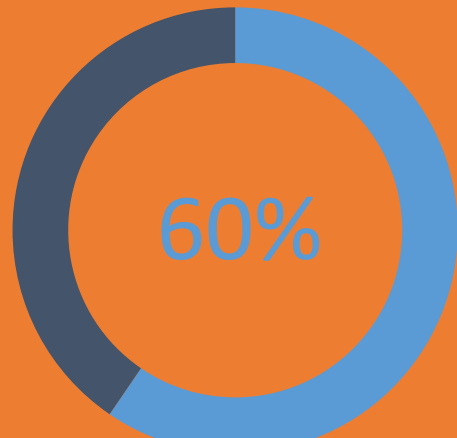


Key Lessons : Power Exchange in India

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.



Share of purchase volume of open access consumers in total exchange volume of FY 15-16

- 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.

*<http://www.cercind.gov.in/2016/orders/SO7N.pdf>