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**Brief report
On
SARI/EI/IRADe Participation in the HAPUA-ASEAN- UNESCAP Workshop
on ASEAN Electricity Exchange (AEE): An International Perspective**



**17th-19th April 2017
Jakarta, Indonesia**





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Mr. V.K.Kharbanda, PD, SARI/EI/IRADe and Mr. Rajiv Ratna Panda PC, SARI/EI/IRADe participated as South Asian experts in the HAPUA-ASEAN- UNESCAP Workshop on ASEAN Electricity Exchange (AEE): An International Perspective held on 17th -19th April 2017, Jakarta, Indonesia.

The Workshop was convened to provide an opportunity for the ASEAN Power Grid Special Task Force to engage in an interactive dialogue with experts, and find out more about regional power integration models around the world, so as to consider the most appropriate approach to developing the AEE model. For best practices in addressing various challenges the key findings of the SARI/EI study on “Cross-Border Electricity Trade (CBET) in South Asia-Key Policy, Regulatory Issues, Challenges and the Way Forward” which covers various regional power integration models around the world conducted in 2015¹ was shared and discussed.

Mr. V.K.Kharbanda made a detailed presentation² titled “Energy Integration in South Asia Region: Progress, Key Achievements and Way forward “ His presentation covered on a) SARI/EI Program Structure and Framework for development of Cross Border Electricity Trade in South Asia Region b) Overview of South Asia Power Sector & current status of trade c) International Experience on Energy Integration and Key Learnings d) South Asia Experience on Energy Integration & Key Learnings e) Critical success factors for CBET and Way Forward. The detailed presentation is attached as Annexure-I.






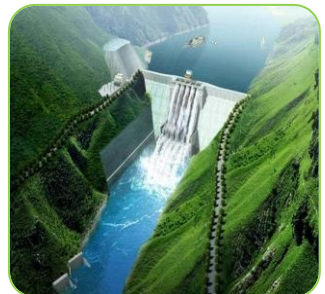
Mr. Rajiv Ratna Panda made a detailed presentation³ titled “Experiences and Learnings from Power Market Development in South Asia: Power Trading and Power Exchanges“. His presentation covered on a) South Asia: a snapshot b) Power Market Structure in South Asian Countries (SACs) c) Indian Power Sector evolution and Power Trading Development d) Indian Power Market e) Power Exchange Evolution in India- Key features f) Power Exchange Products in India g) Regulation of Power Exchange in India h) Contribution of power exchanges i) Key Lessons from Power Market and Exchange Development in India j) Development of South Asia Regional Power exchange k) Way forward. The detailed presentation is attached as Annexure-II.

Experts from region presented an overview of the benefits from regional power integration around the world, notably in the European Union (E.U.), Nordic countries (Nord Pool), the United States (U.S.), Central America (SEIPAC) and Southern Africa (SAPP).

1 <http://www.irade.org/Cross-Border%20Electricity%20Trade%20in%20South%20Asia-Key%20Policy,%20Regulatory%20Issues,Challenges%20and%20the%20Way%20Forward-Background%20Paper-%20Rajiv.pdf>

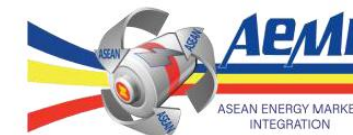
2 http://hapua.org/download/Other_Activities/4_1_SARI_Kharbanda.pdf

3 http://hapua.org/download/Other_Activities/3_2_SARI_Rajiv_v2.pdf



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

Rajiv Ratna Panda
SARI/EI/IRADe



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



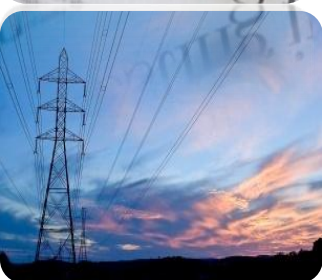
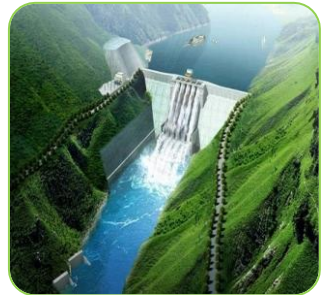


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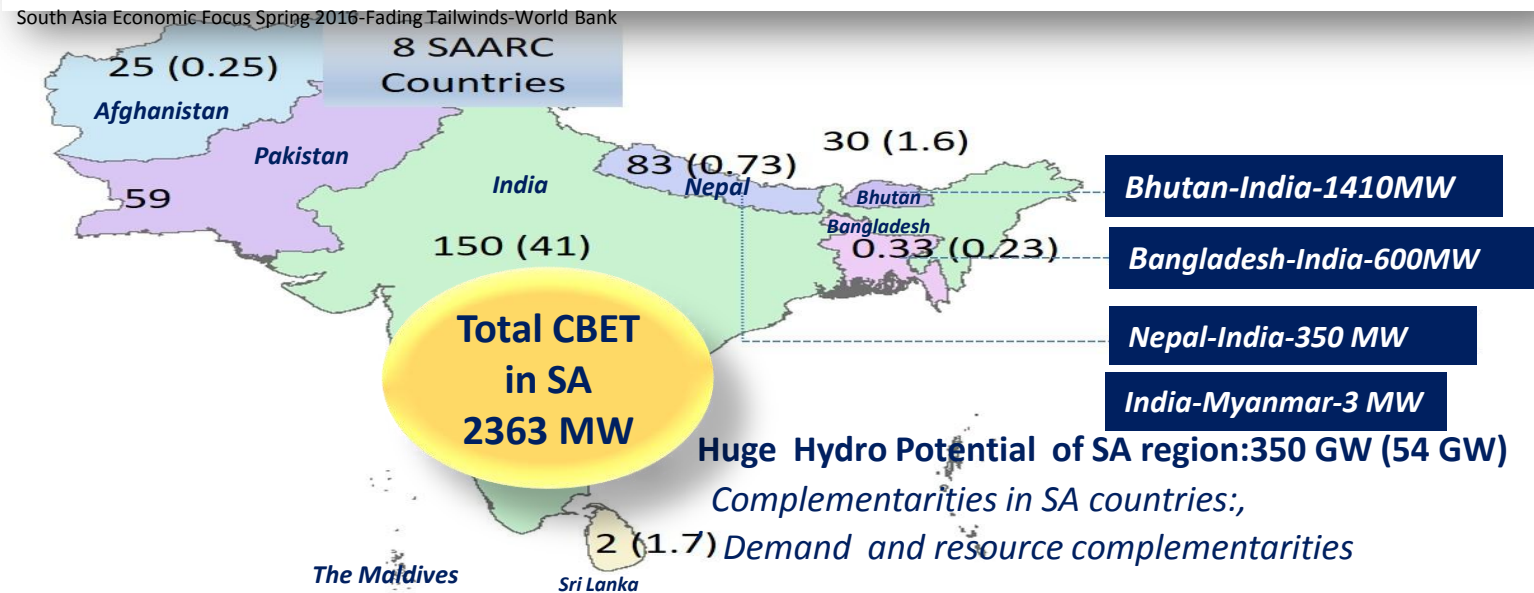
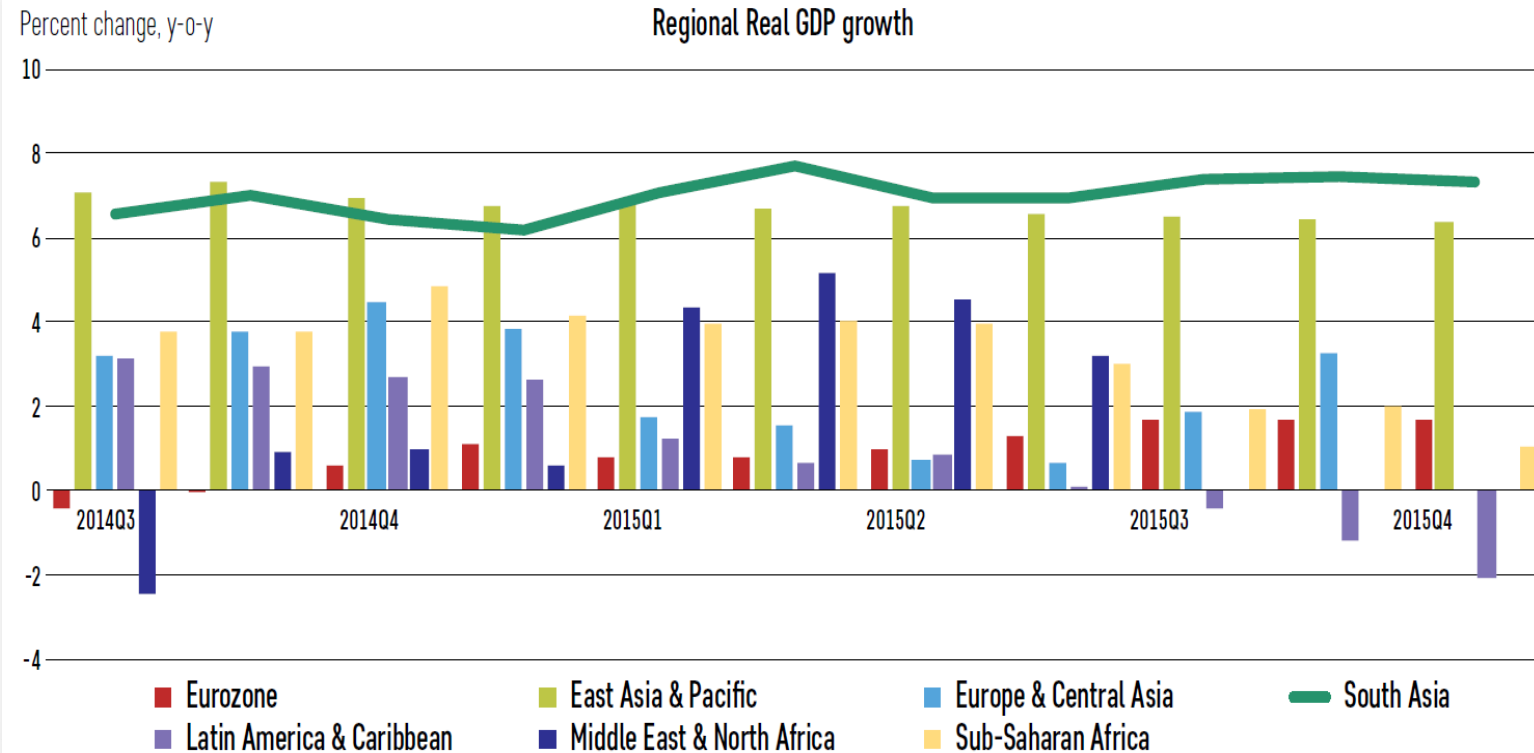
Content

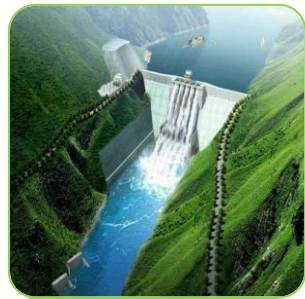
- South Asia: A Snapshot*
- Power Market Structure in South Asian Countries (SACs)*
- Indian Power Sector*
- Power Sector Evolution and Power Trading Development in India*
- Indian Power Market*
- Power Exchange Evolution in India- Key features*
- Power Exchange Products in India*
- Regulation of Power Exchange in India*
- Contribution of power exchanges*
- Key Lessons :Power Market and Exchange Development in India*
- Development of South Asia Regional Power exchange*
- Way forward*



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



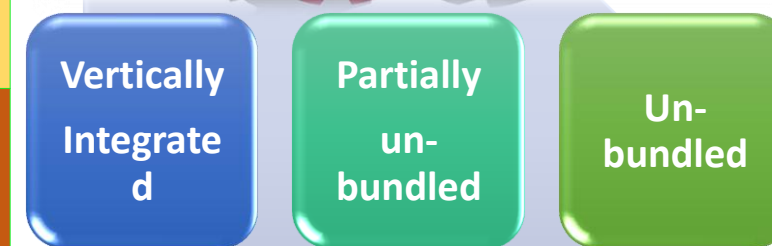


Power Market Structure in South Asian Countries



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 GoI, 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)

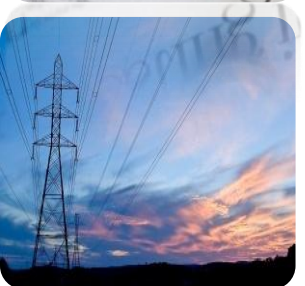
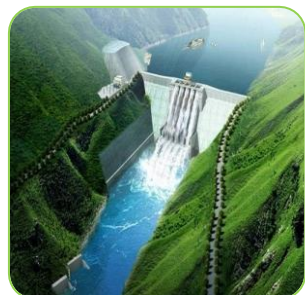


- Afghanistan (DABS)
- Bangladesh (Separate Trans.Utility)
- India (Separate G,T,D utilities)
- Maldives (FENAKA)
- Nepal (NEA)
- Bhutan (Separate Gen.utility)
- Pakistan (Separate G,T,D utilities)
- Sri Lanka (CEB)

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%

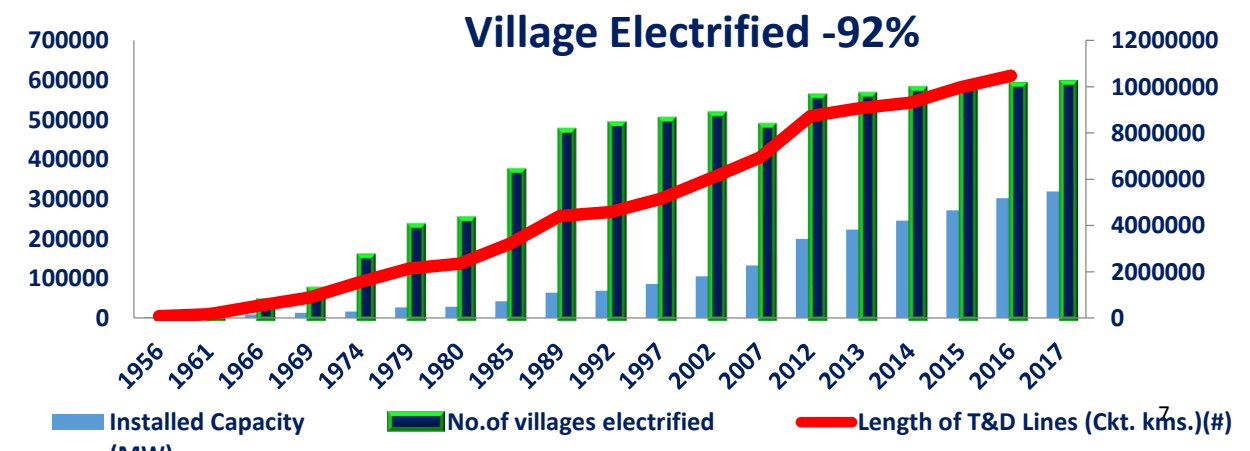
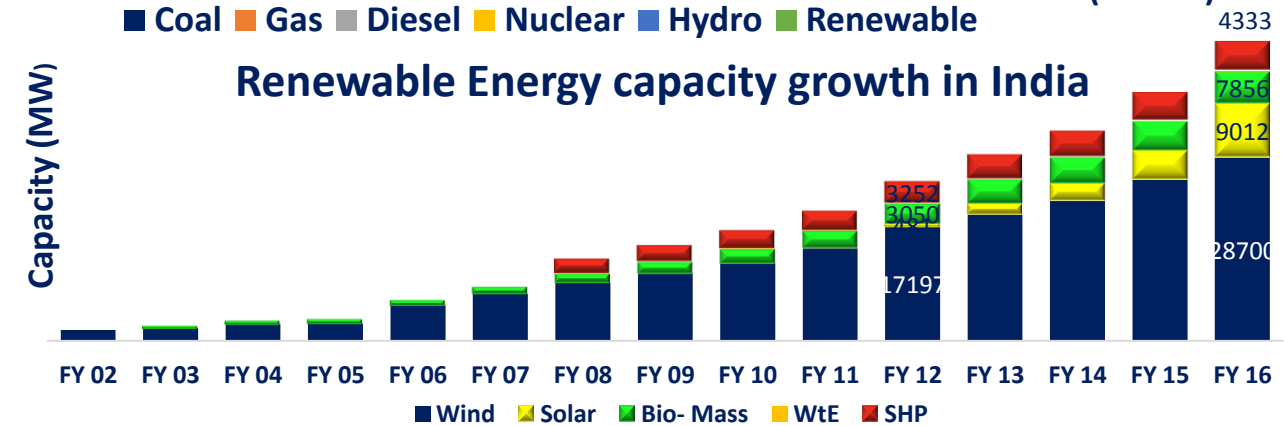
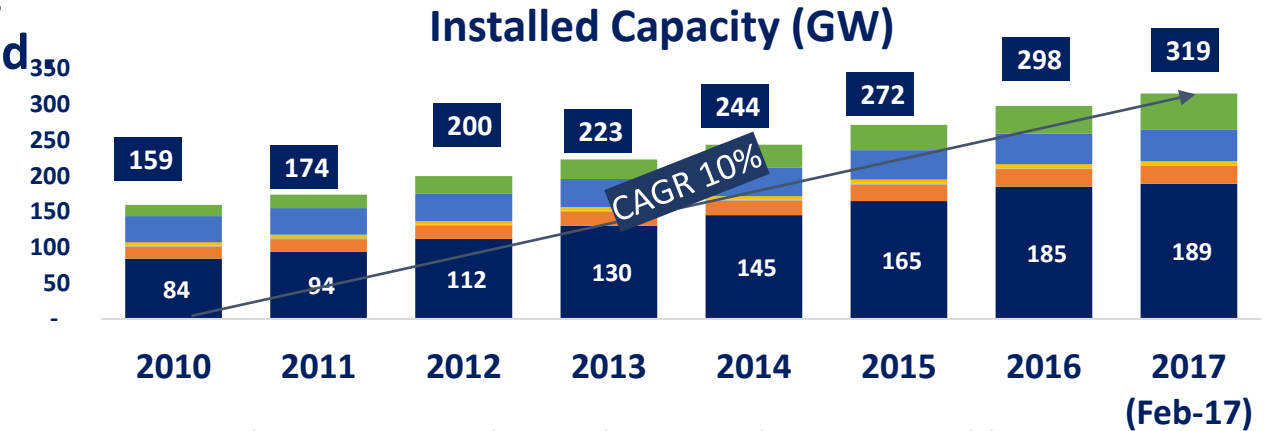
● The Per capita energy consumption-1,074 kWh (2015-16) still less than half of the world average

● 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)



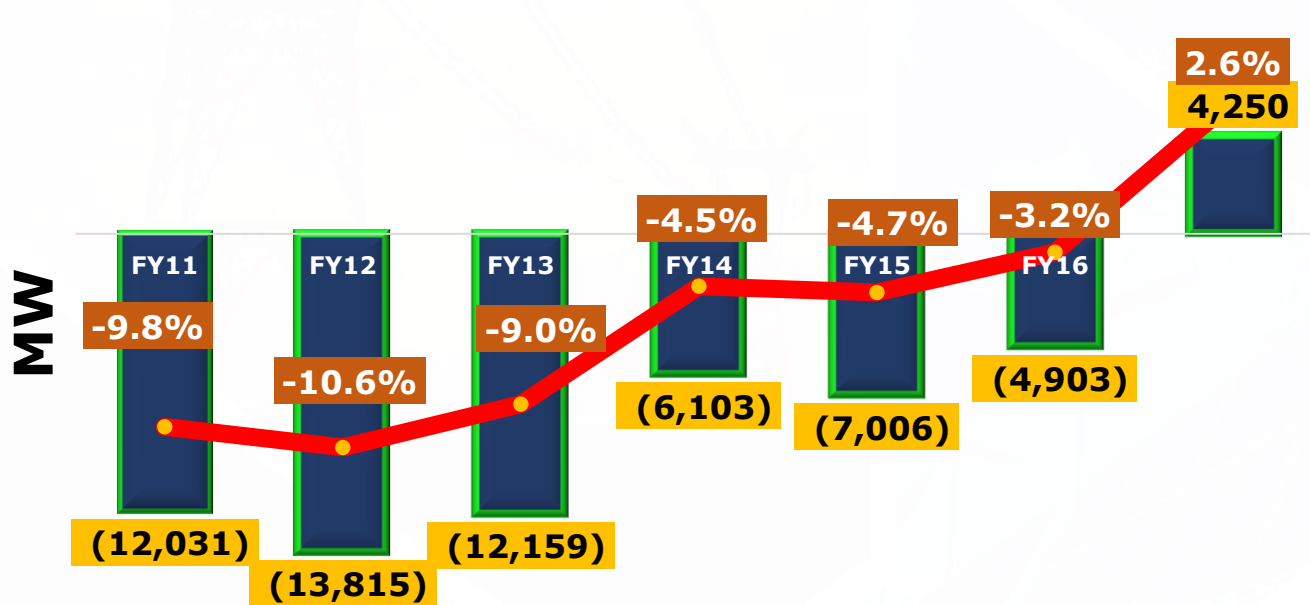
*<https://www.ibef.org/download/Power-March-2017.pdf>

Source: CEA Report Note : 92 % based on Total village in India is 640867 Confidential©2017

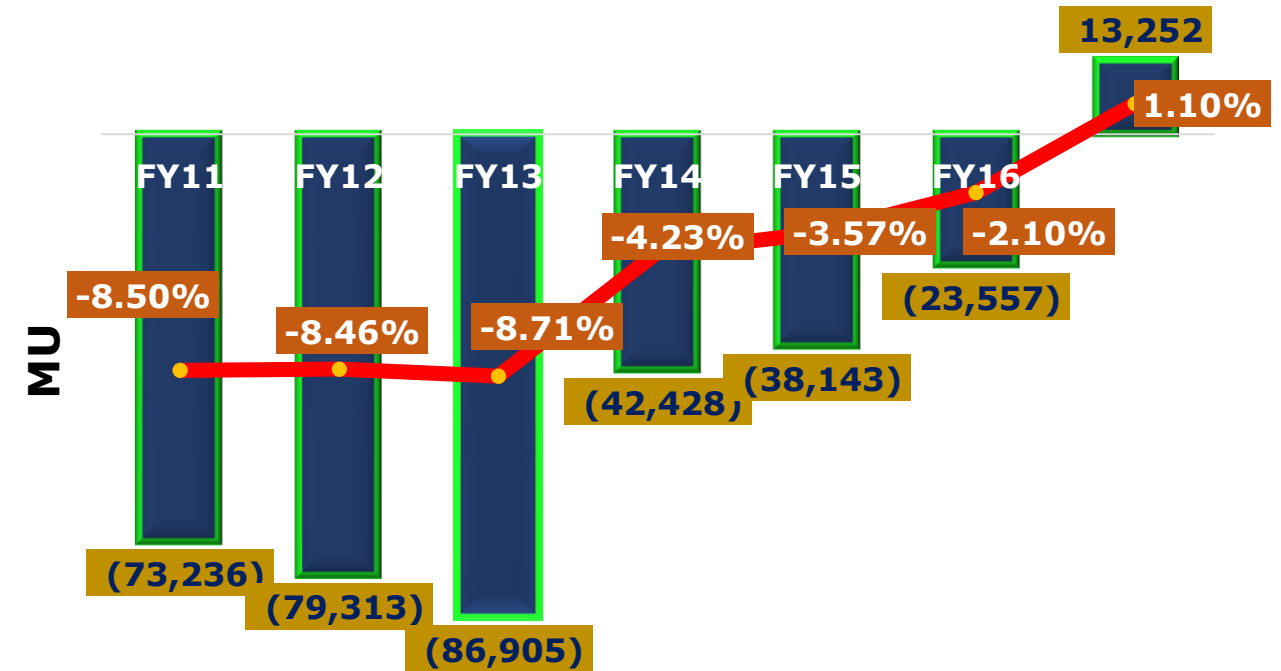
India-Demand-Supply Scenario

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)

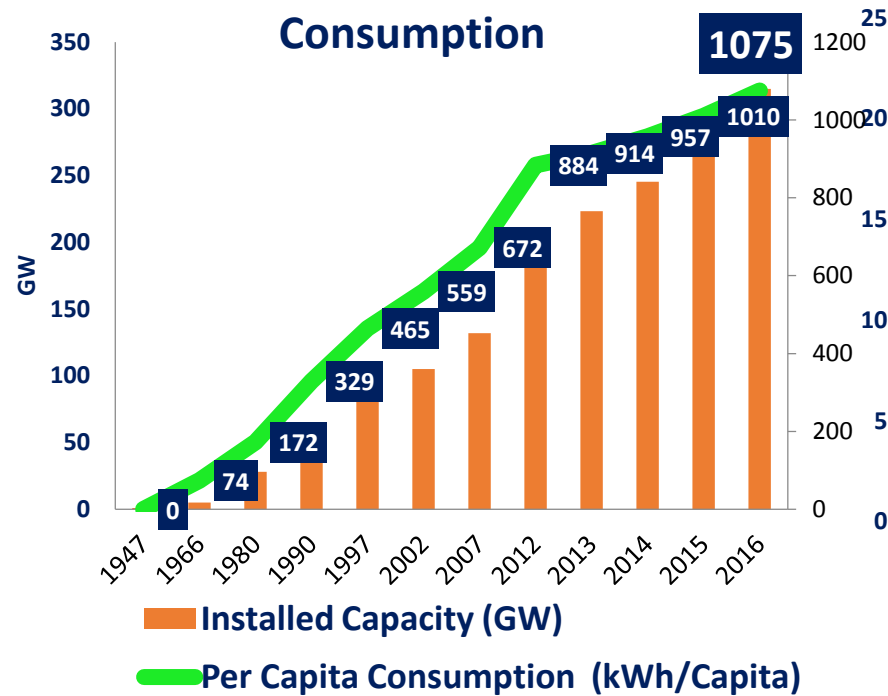


2.6%
4,250

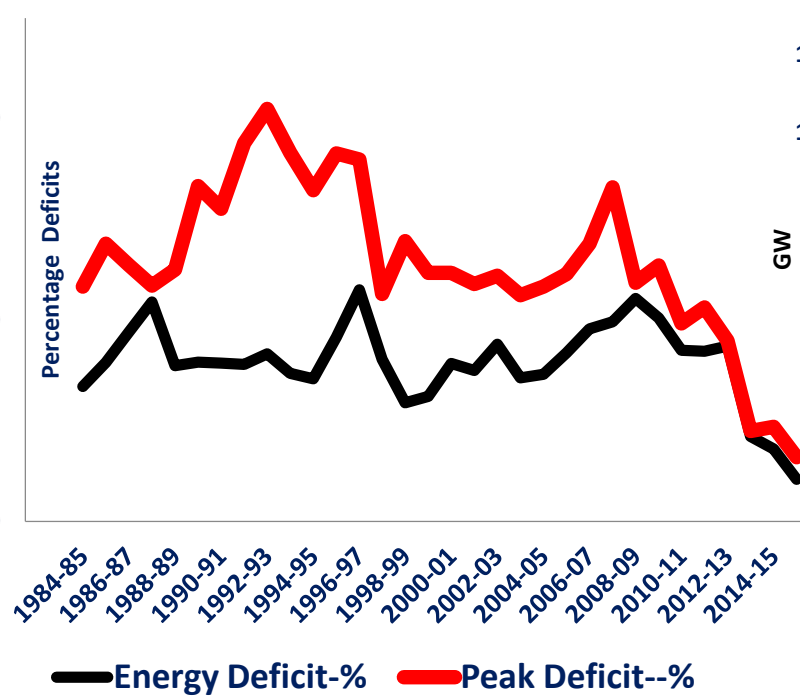
13,252
1.10%

Decades back, story was very different

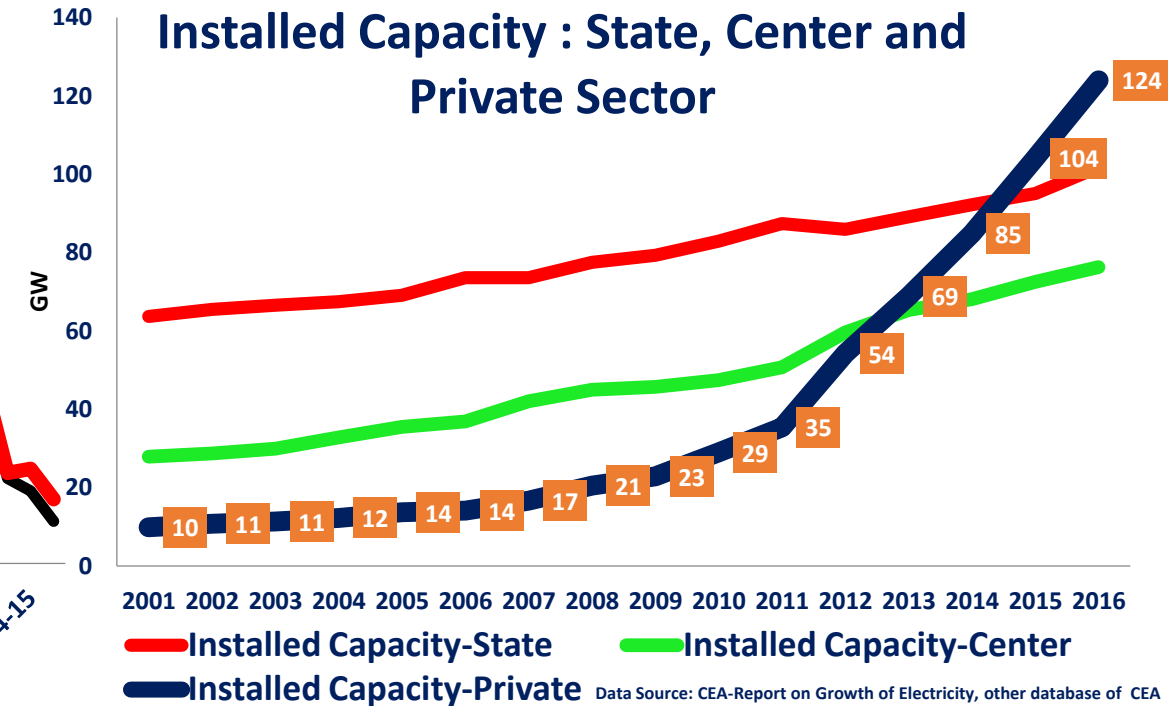
Installed Capacity and Per Capita Consumption



Energy and Peak Deficits -India



Installed Capacity : State, Center and Private Sector

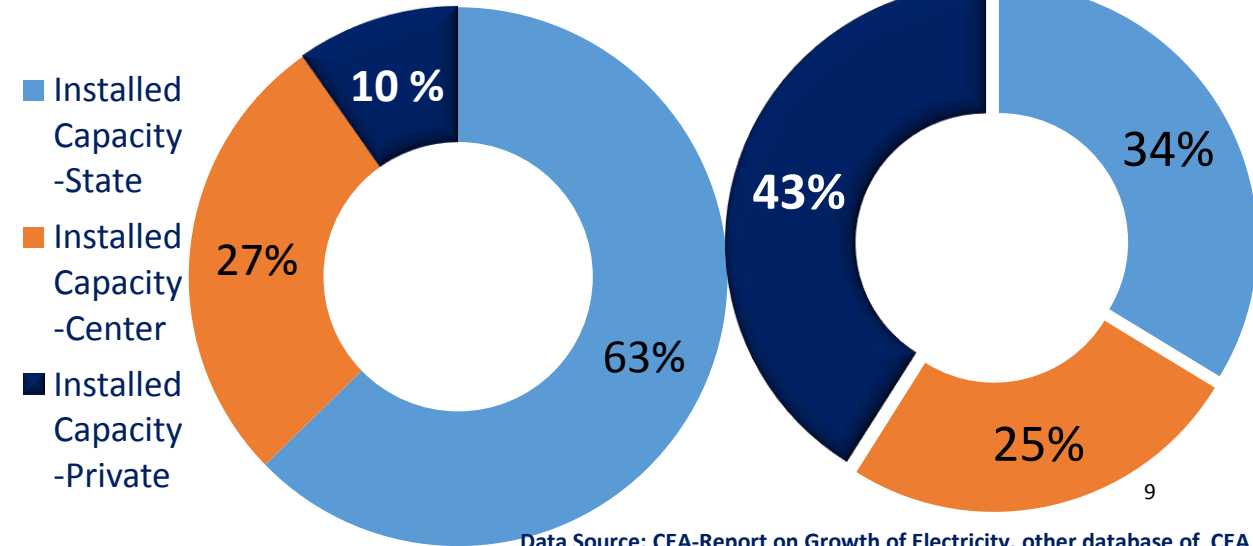


Low Per Capita: In 1990 per capita was only around 172 KWH/Capita , by 2016 -1075 KWH/Capita . IC 64 GW in 1990 to 350 GW in 2016

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

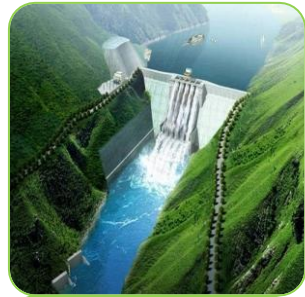
Limited Private Sector (PS) : Share of PS -10% in 2001 to 41 % 2016

Share of Private Sector -2001 Share of Private Sector -2016





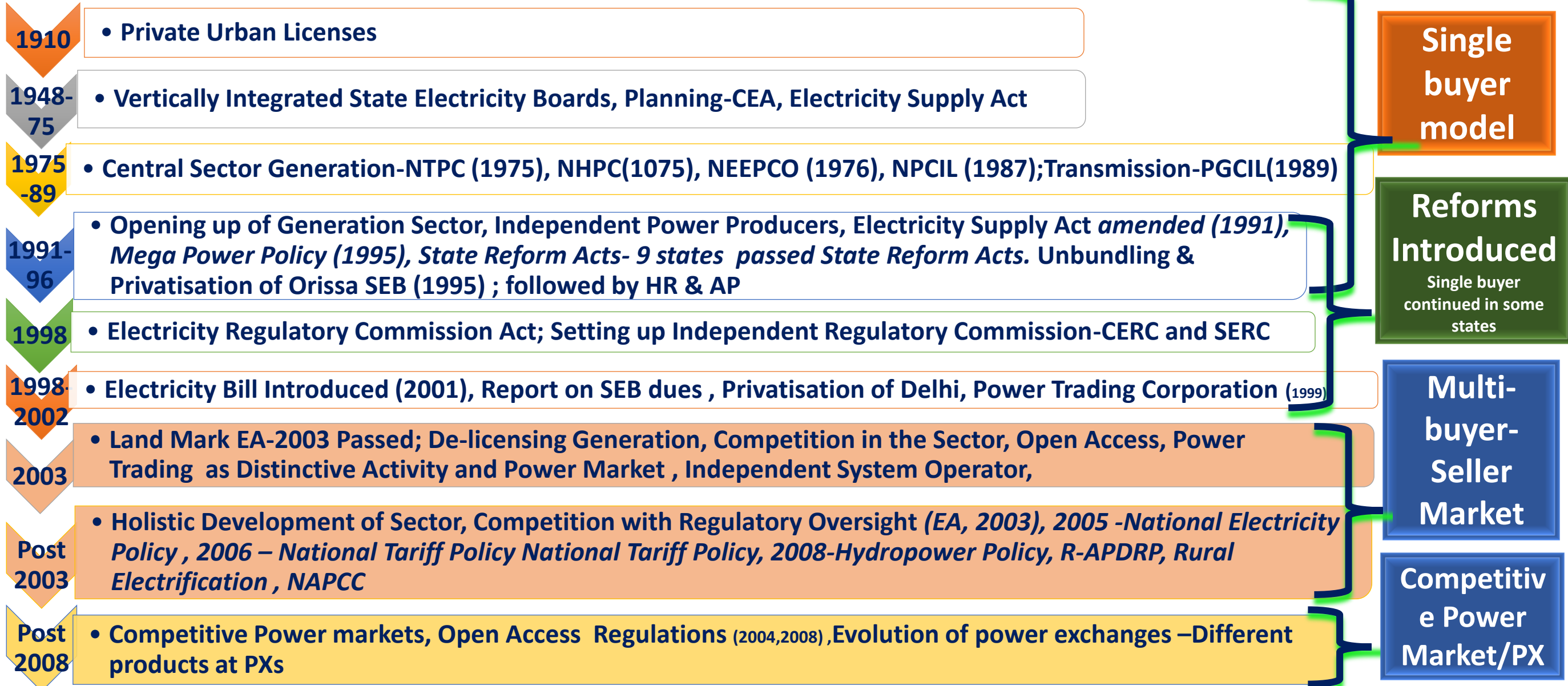
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How all this was achieved ?



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

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

Freedom to Purchase

Freedom sell Electricity

Electricity cannot be stored

Political-Economy of the Sector

Demand of electricity varies intra-day and seasonally

Electricity has demand side flaws

Electricity travels in accordance with laws of Physics

Electricity travels at the speed of light

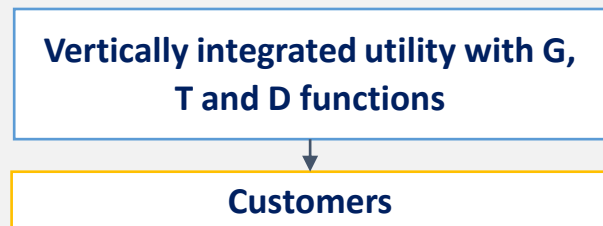


Current Power Market Structure

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

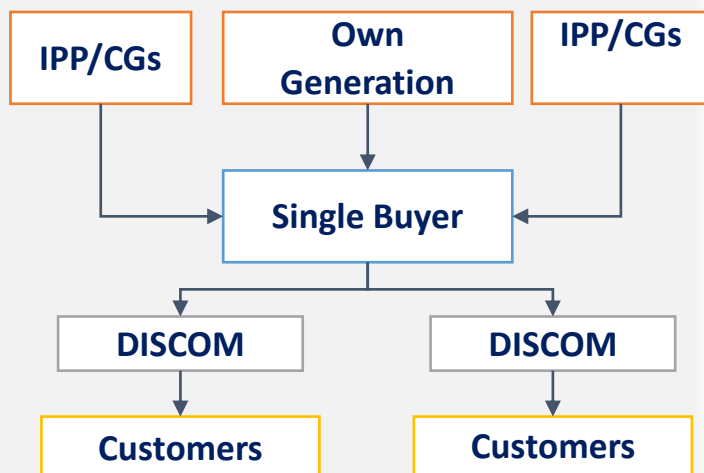
1948 - 1970s

Model I - Monopoly



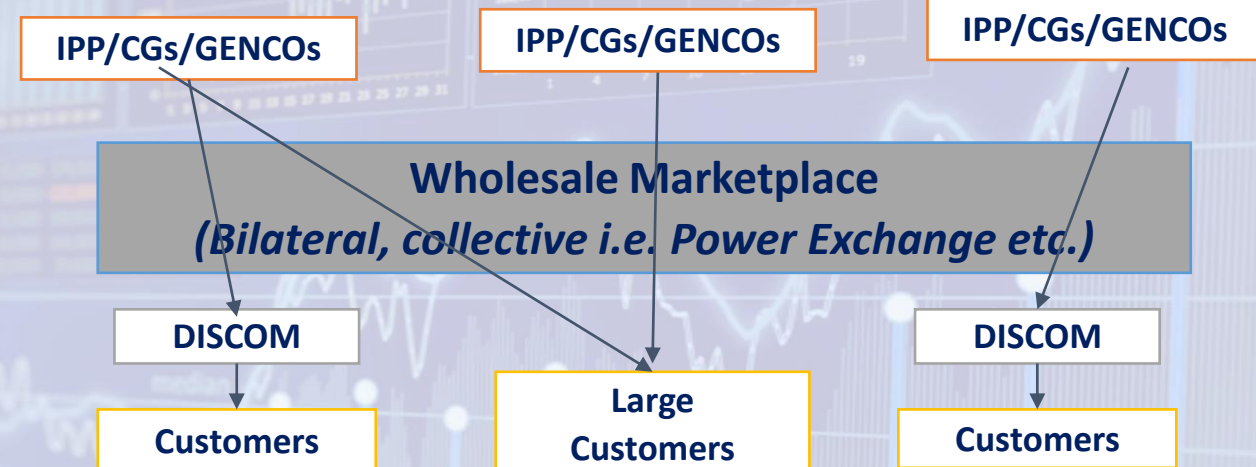
1970s-2003

Model II - Single Buyer



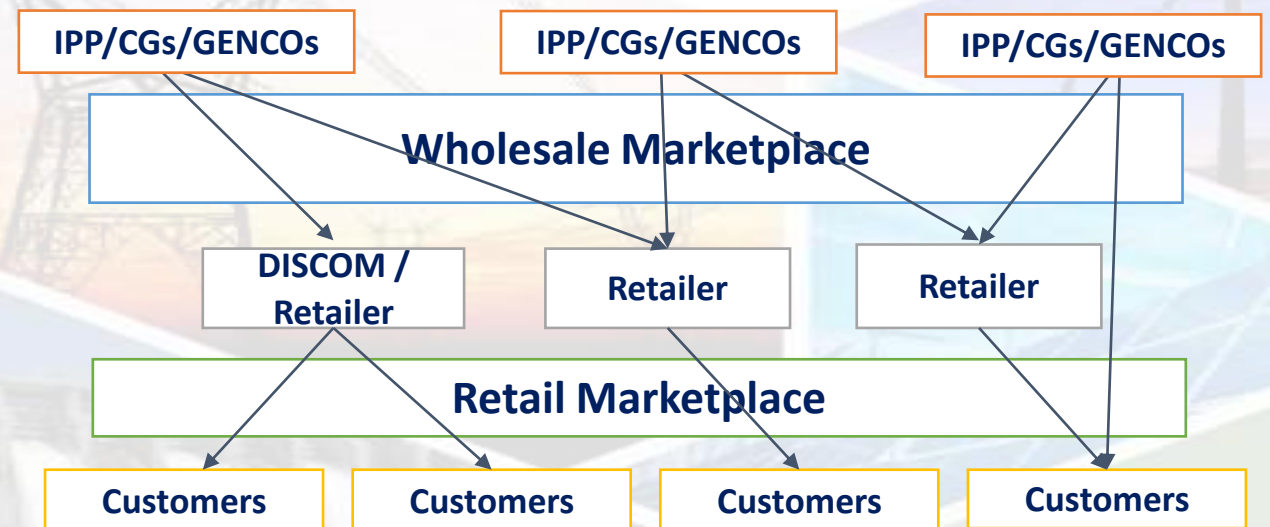
Model III - Wholesale competition

2004



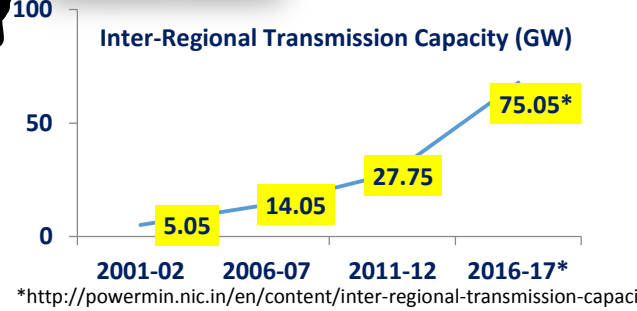
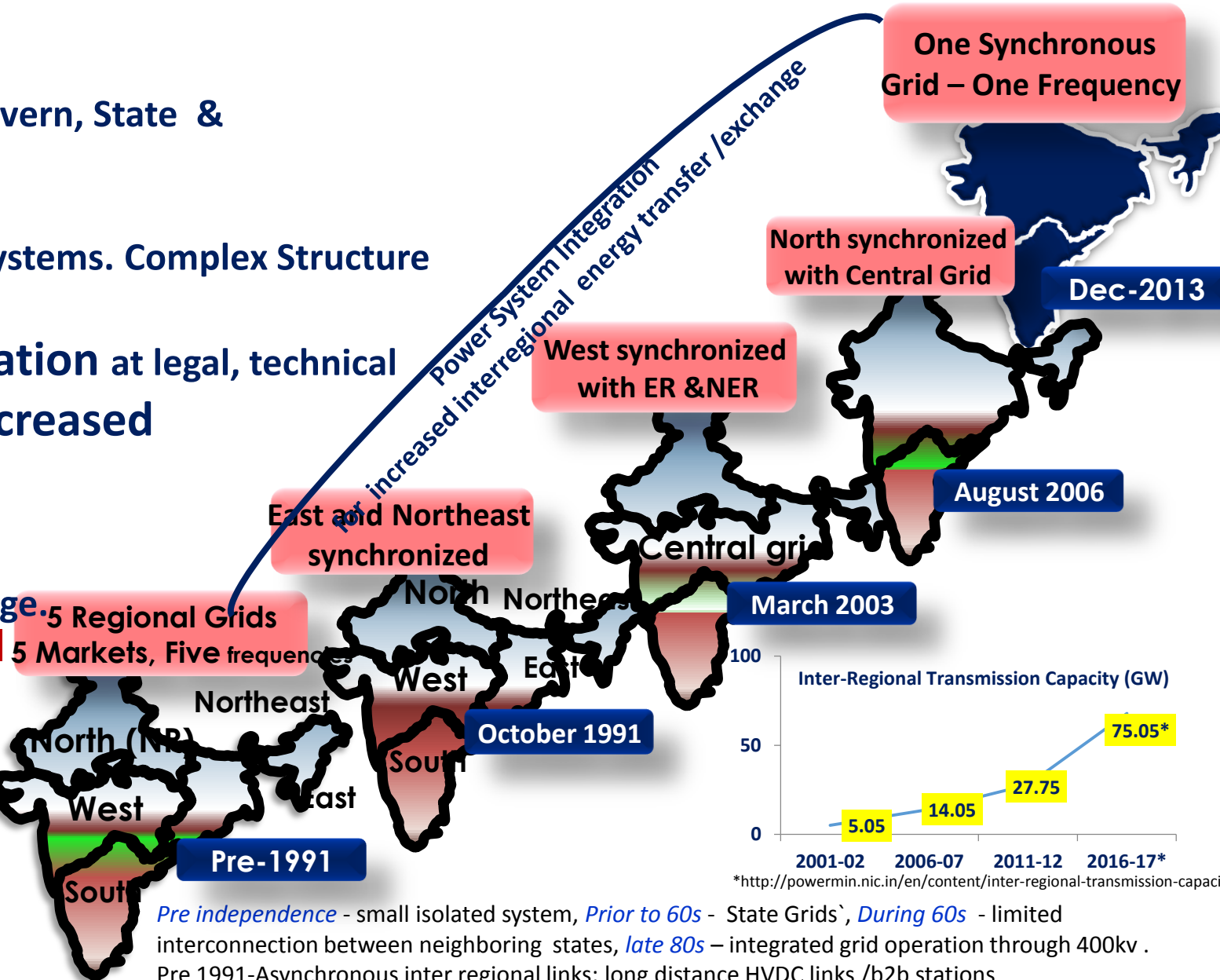
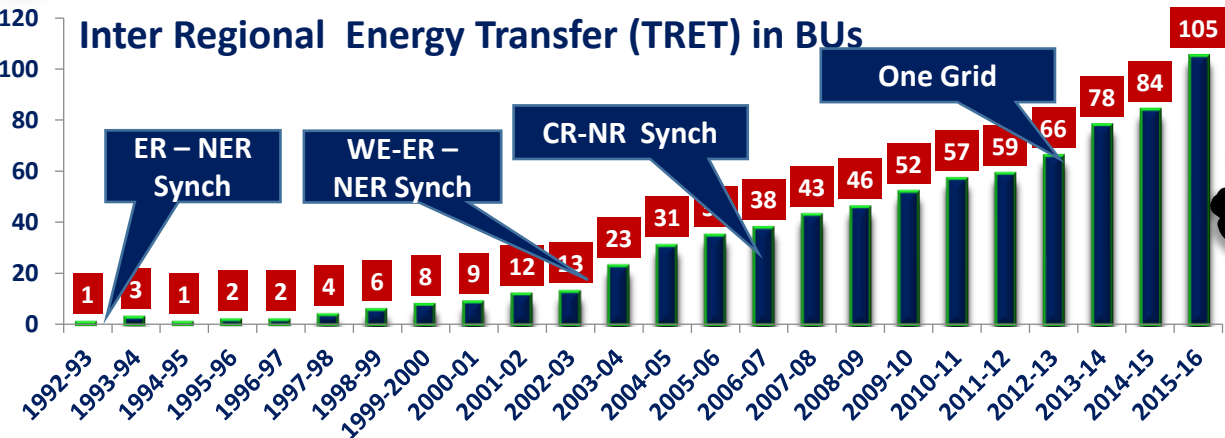
Model IV - Retail competition

??



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

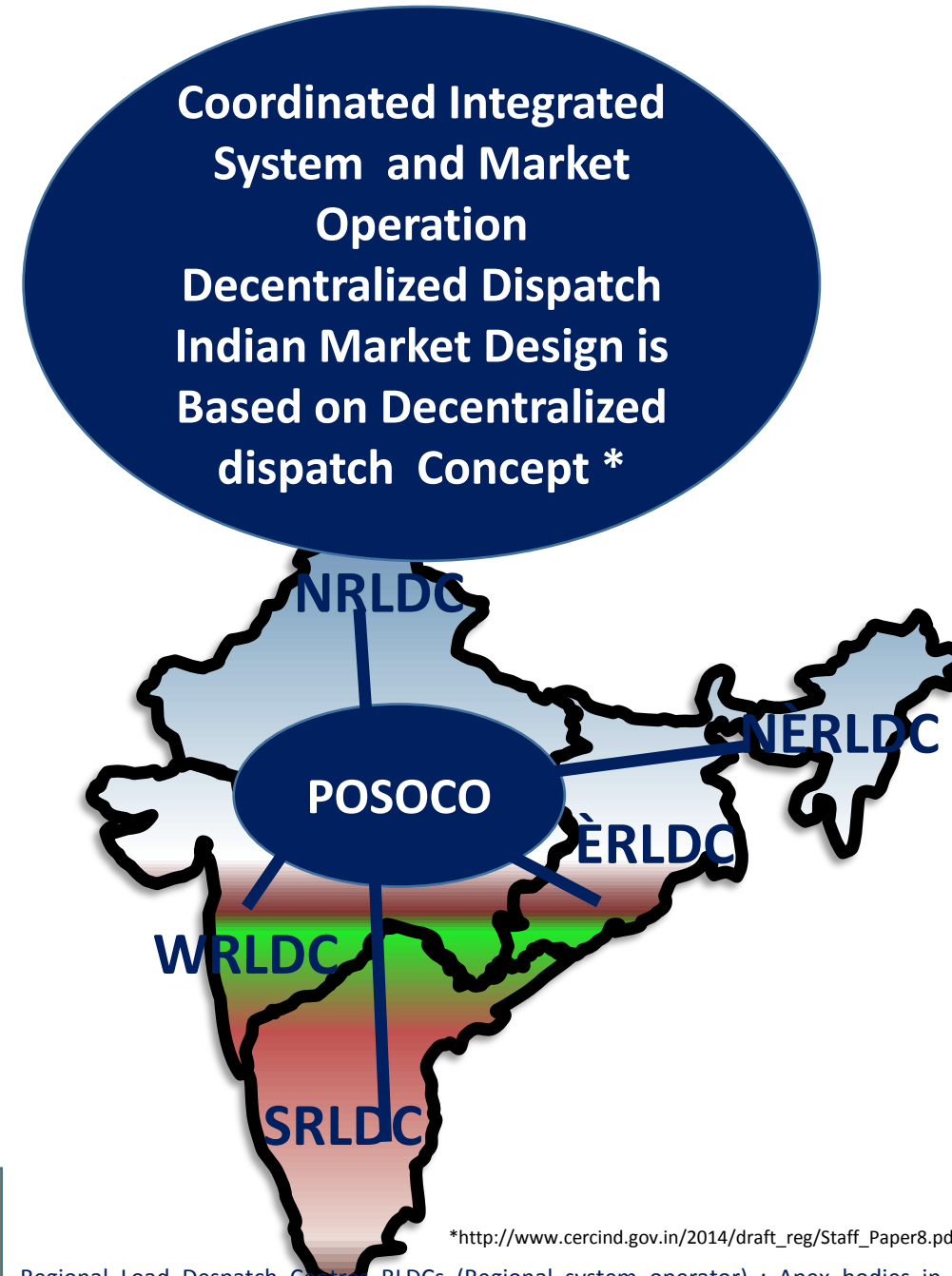


Pre independence - small isolated system, *Prior to 60s* - State Grids, *During 60s* - limited interconnection between neighboring states, *late 80s* - integrated grid operation through 400kv .
Pre 1991-Asynchronous inter regional links; long distance HVDC links /b2b stations

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

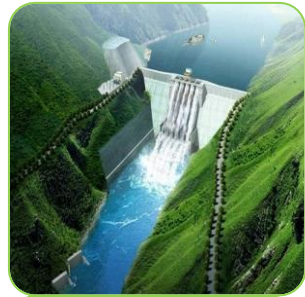


*http://www.cercind.gov.in/2014/draft_reg/Staff_Paper8.pdf

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.



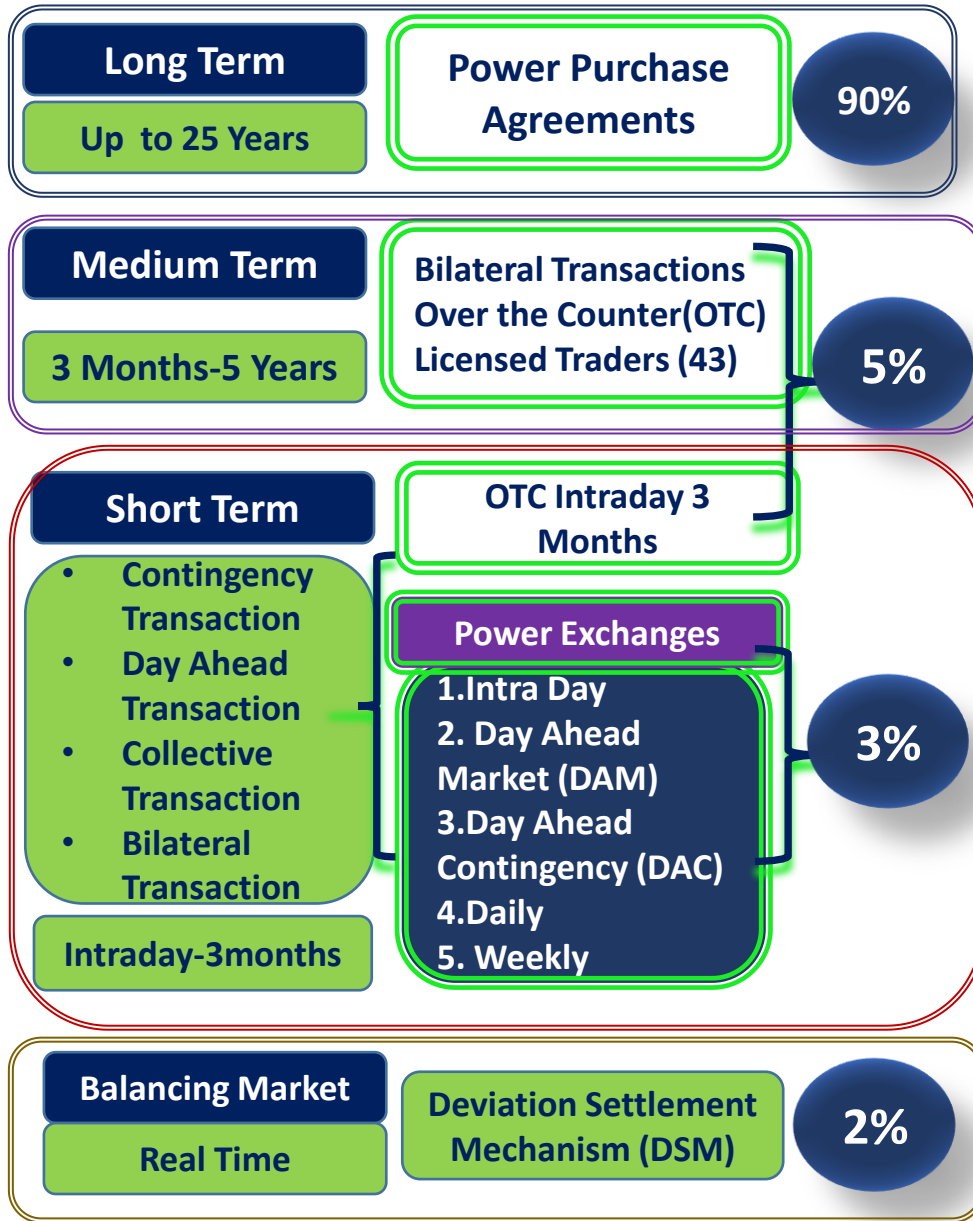
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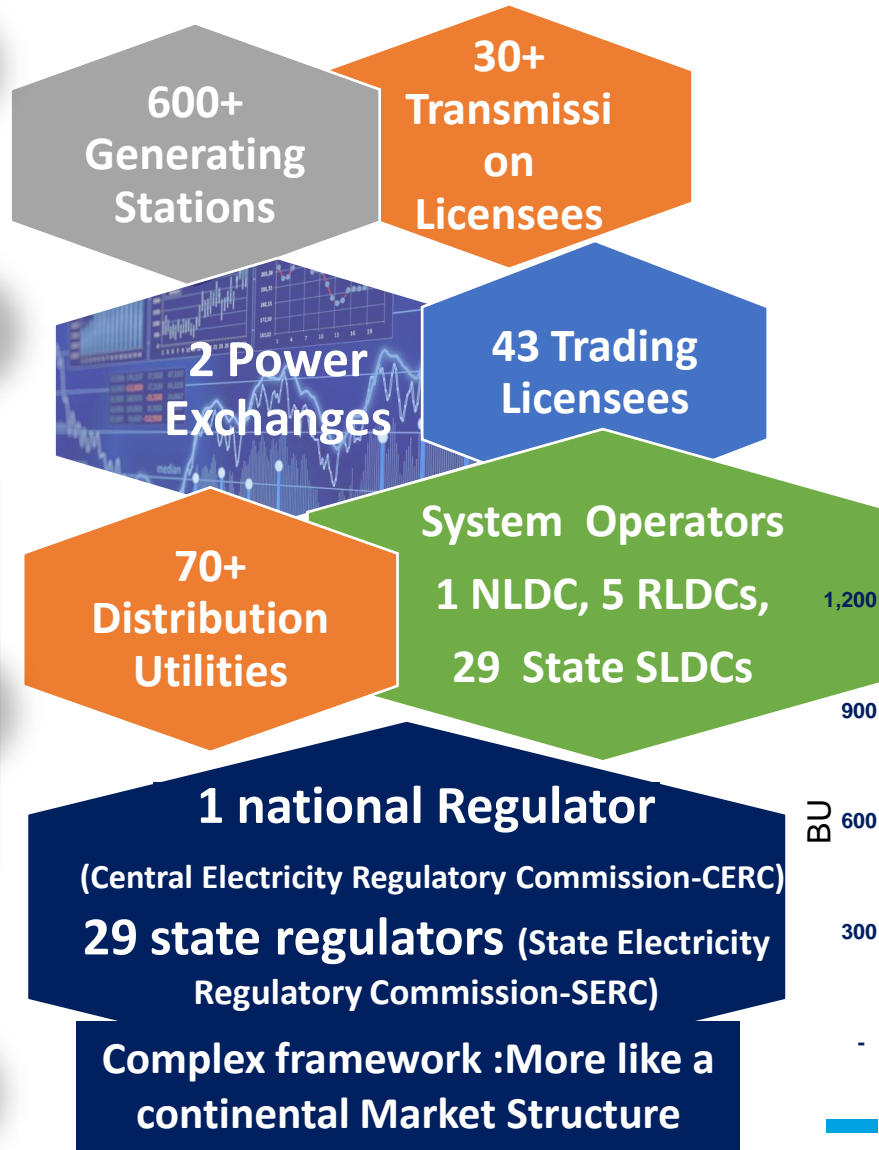
POWER MARKET IN INDIA



Power Market in India



Competitive Power Market

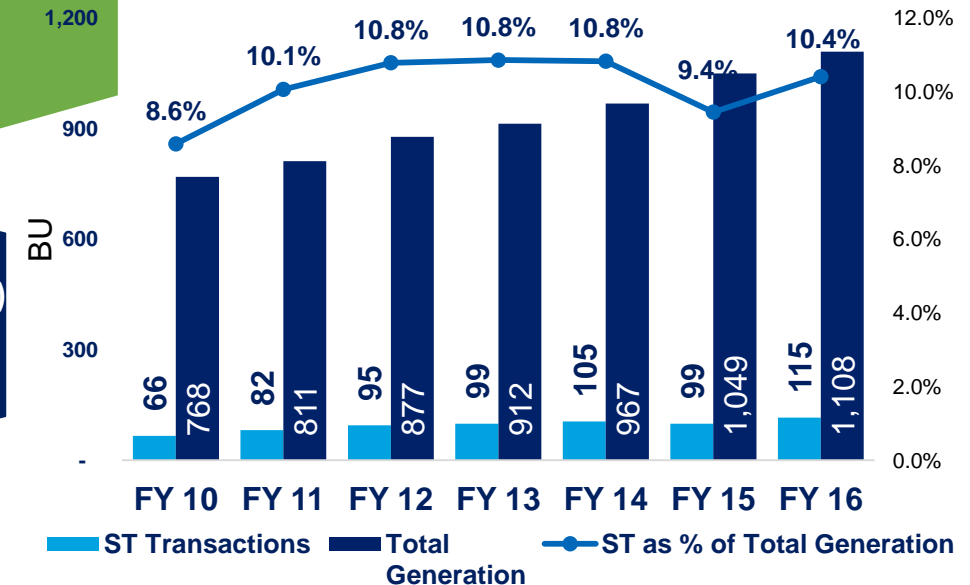


Size of Short Term Power Market
₹ 240 Billion (4.2 Billion US \$)

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



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

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 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.

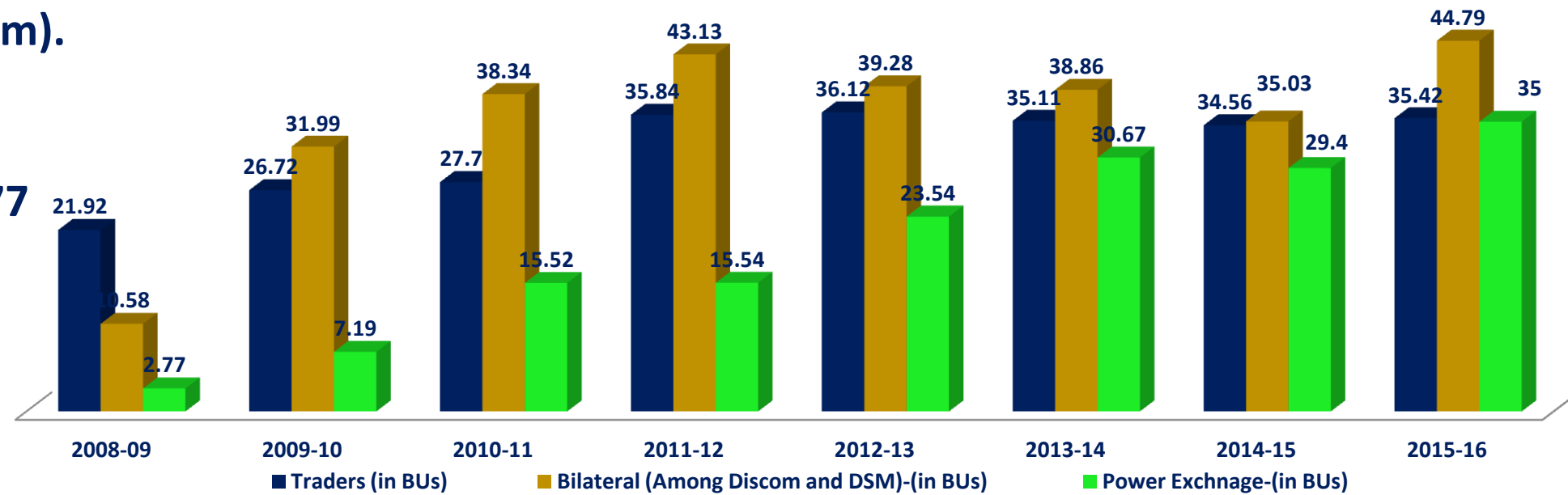
What is for the Consumer.?

Price have gone down due to competition, Choice and market

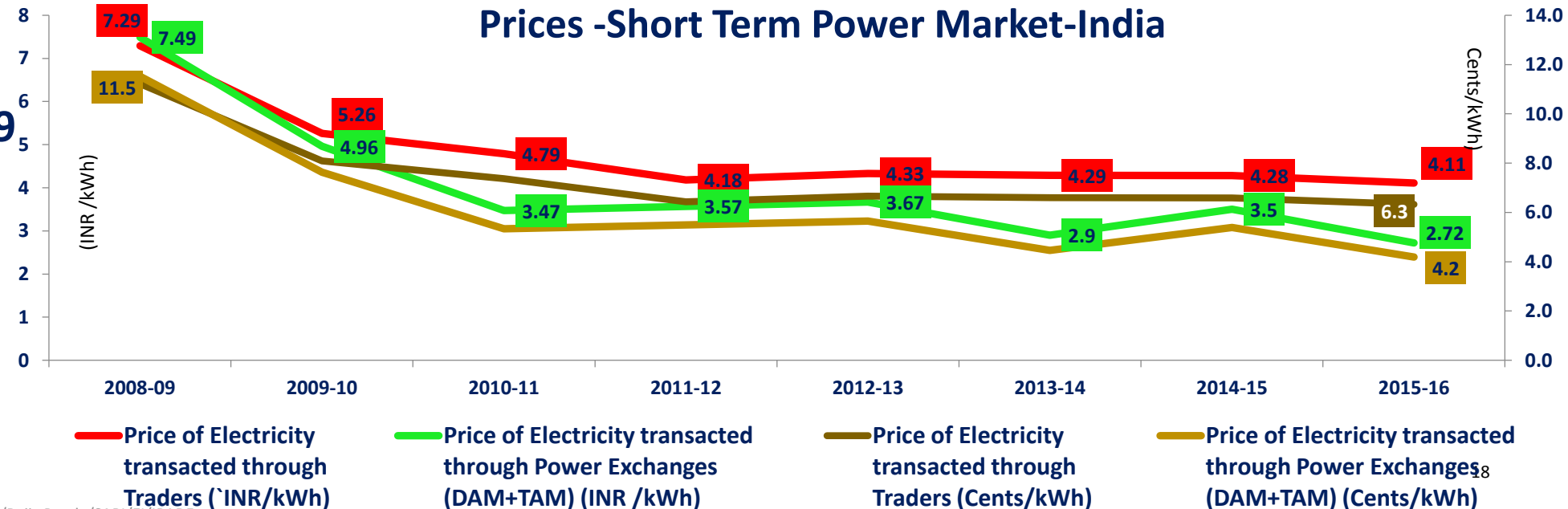
Price through Exchange : ₹ 7.49 /Kwh (11.5 Cents) in 2009 to ₹2.72/ /Kwh (4.2 cents) in 2016

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

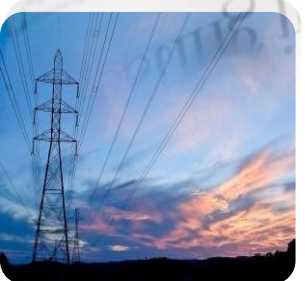
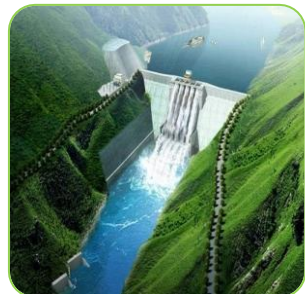


Prices -Short Term Power Market-India

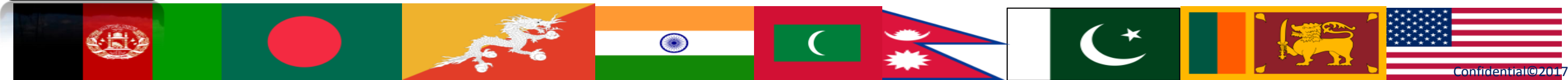




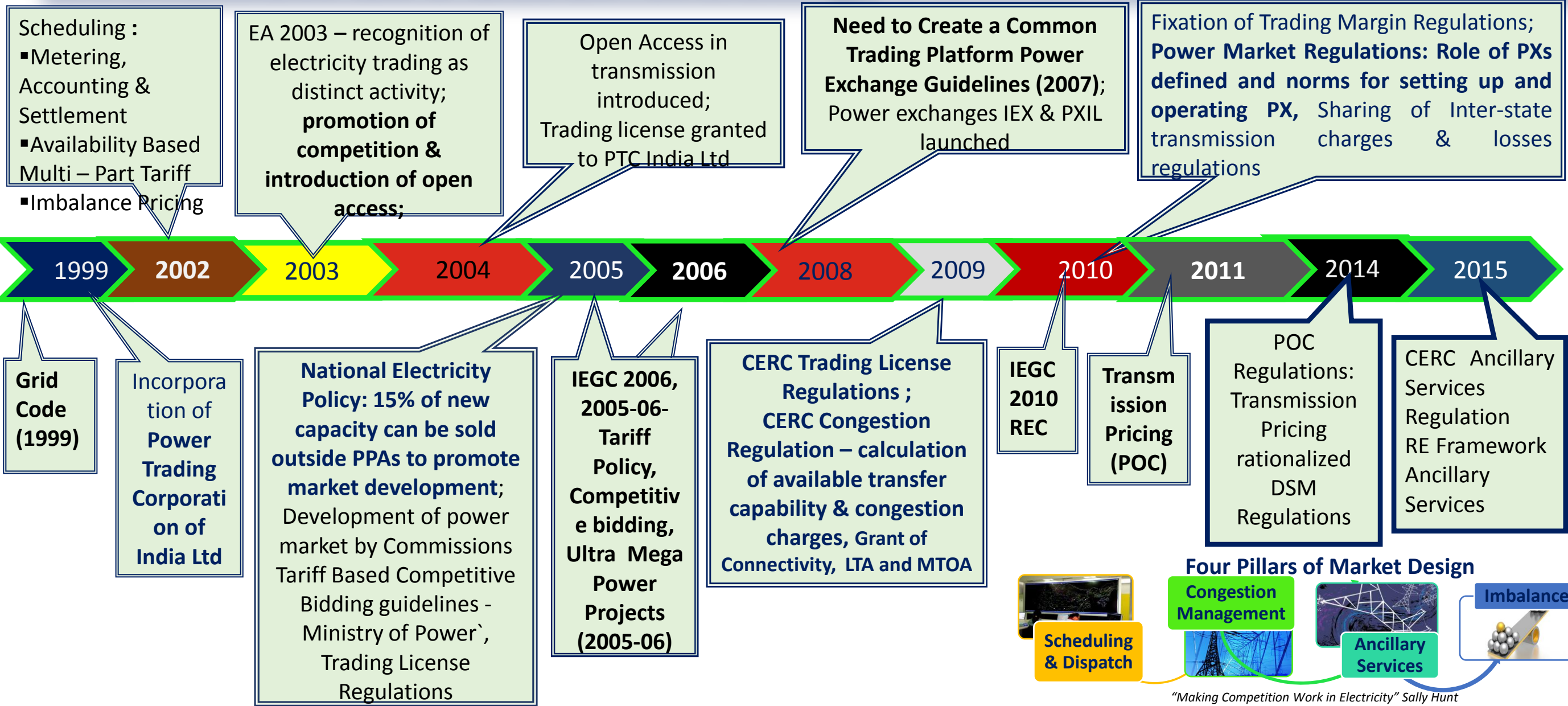
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How the power market evolved



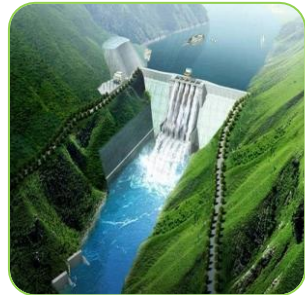
Evolution of Power Trading/Power Market in India



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



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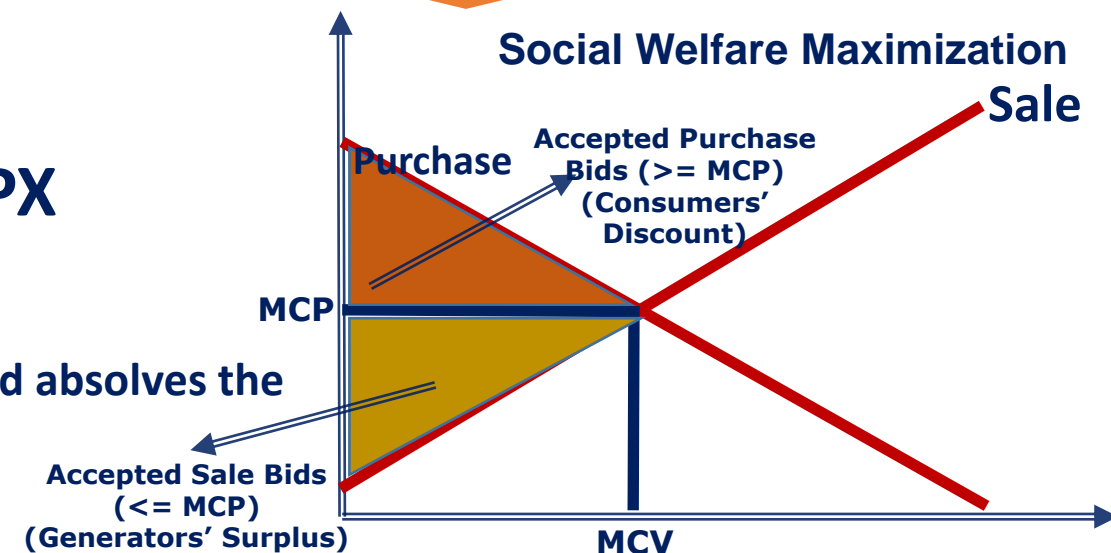
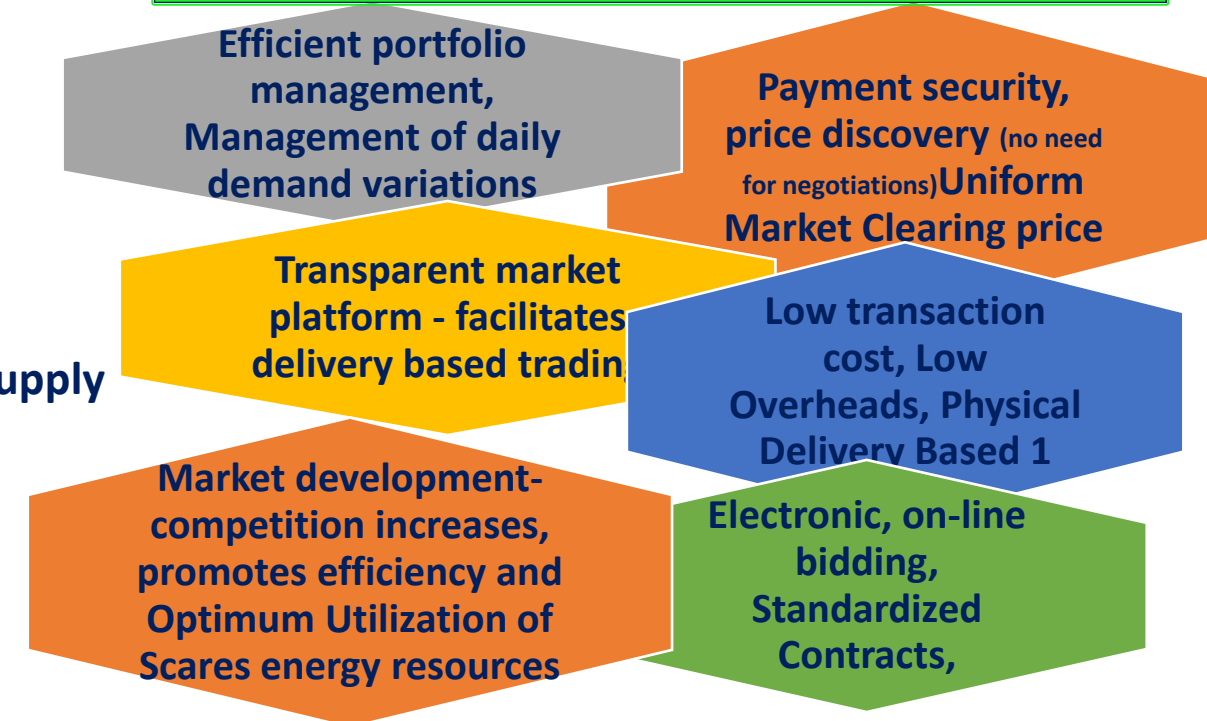
POWER Exchange in India



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



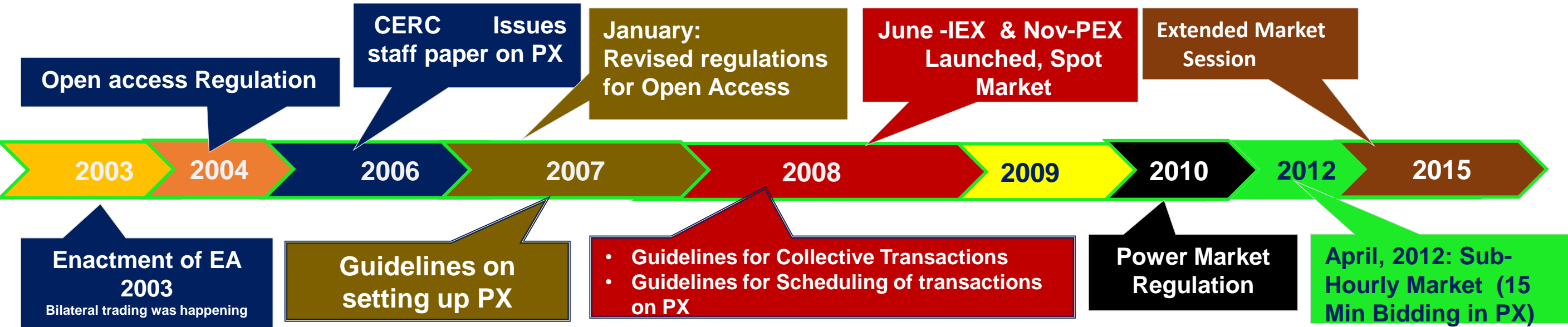
No Financial products such as Derivatives and Forward contracts **-DAM Market

* Restructuring Developments and Issues in Indian Power System, <http://searchdli.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

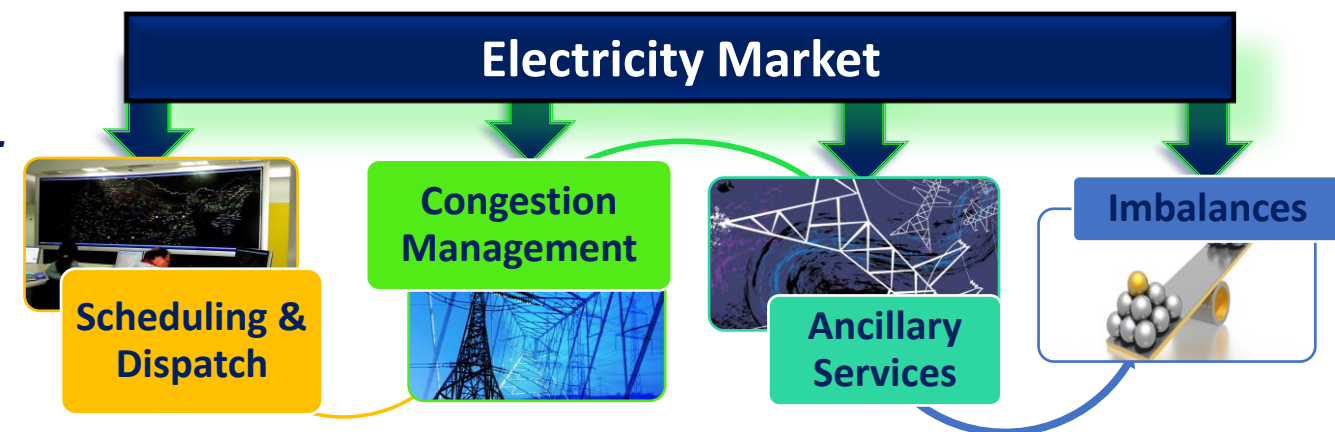
Development of Power Exchanges in India



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

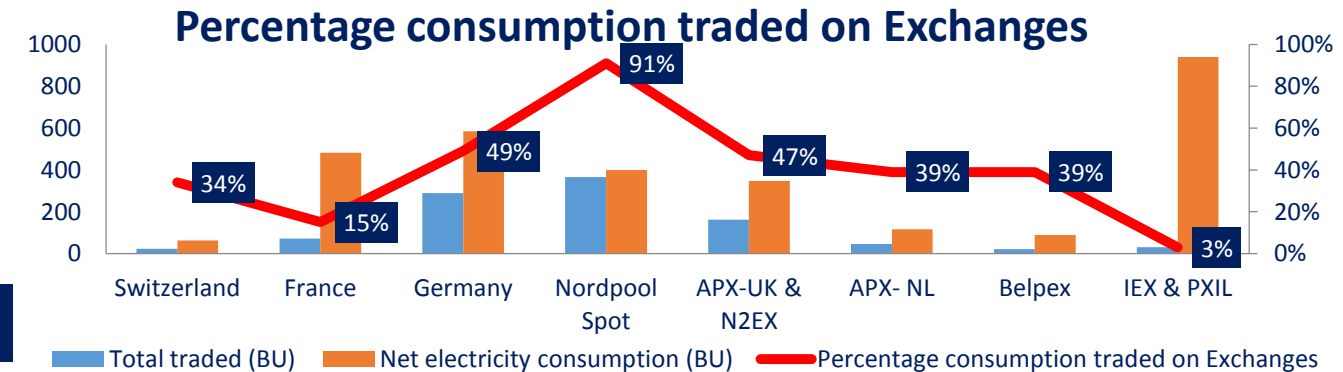
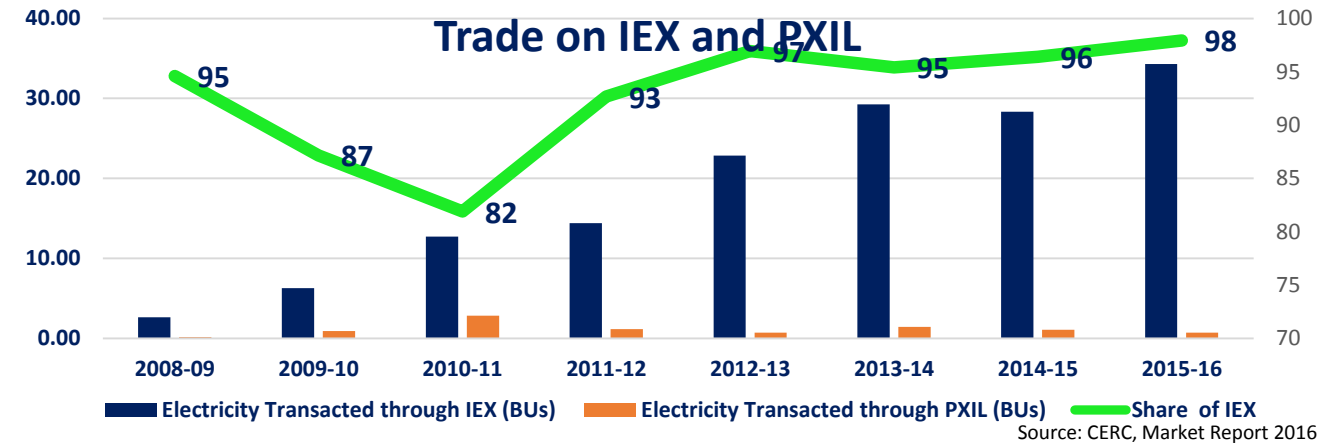
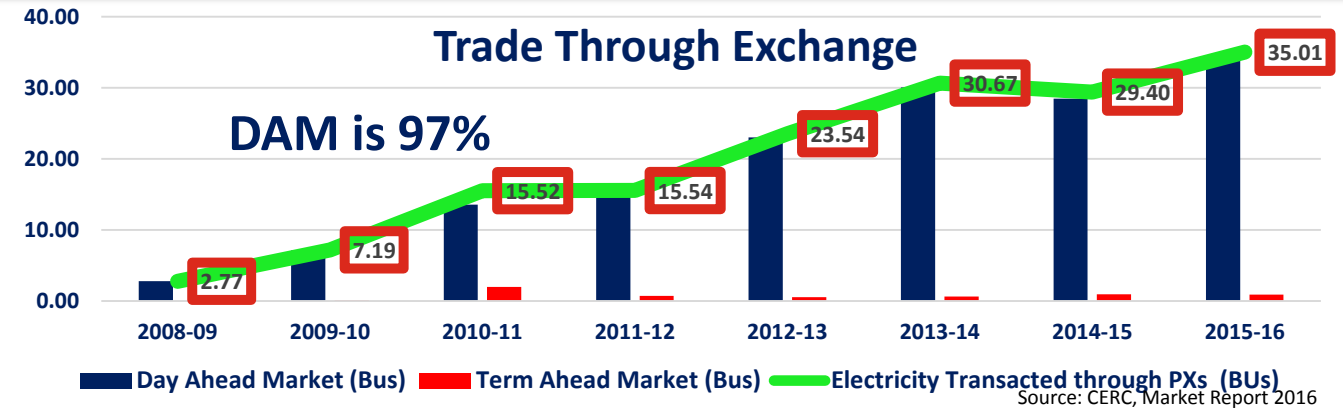
Term-Ahead Market
Since Sep 2009
Extended Markets
Since July 2015
(TAM provides a range of products allowing participants to buy/sell electricity on a term basis for a duration of up to 11 days ahead.)

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 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 24

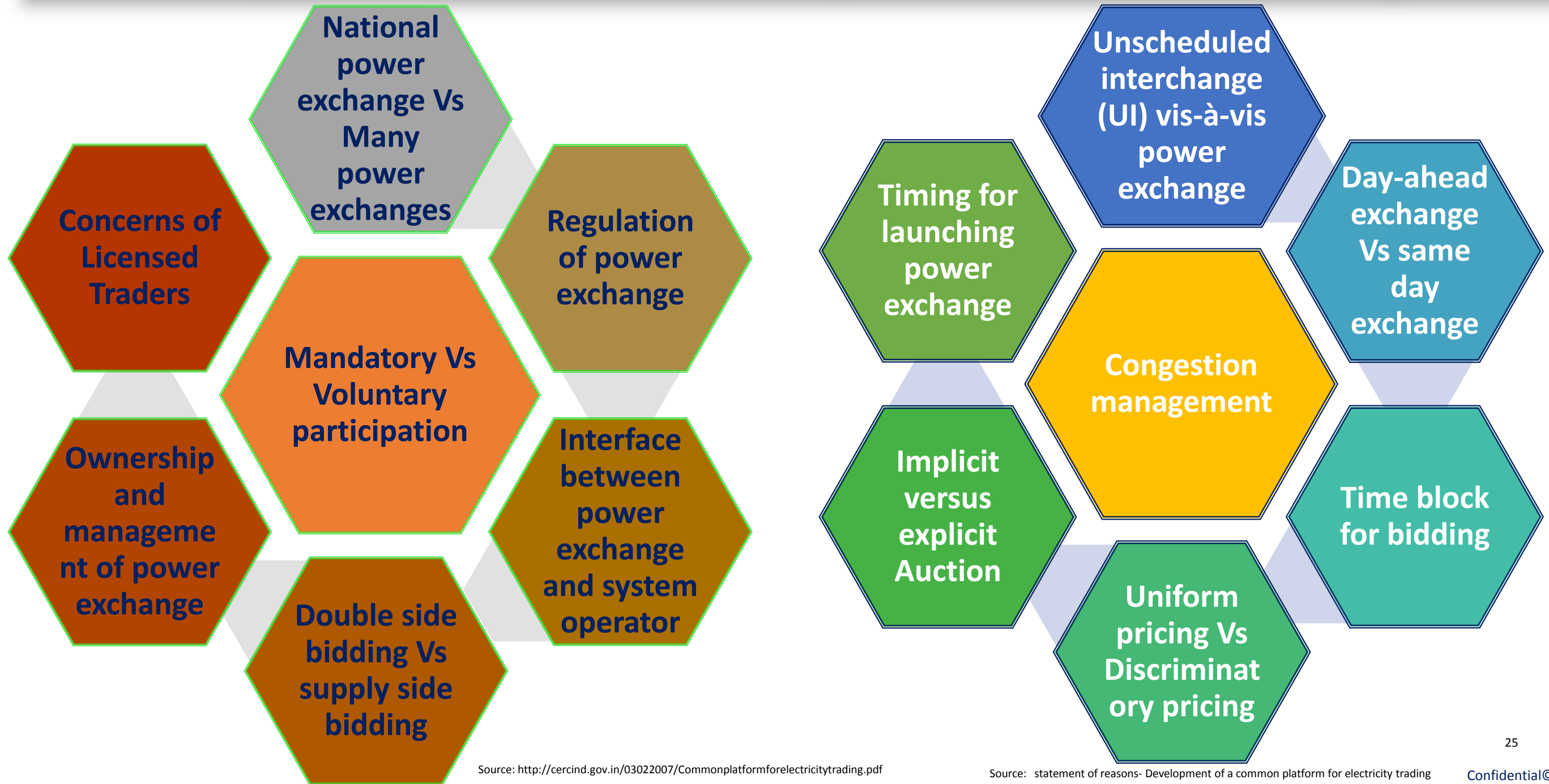


Continuous

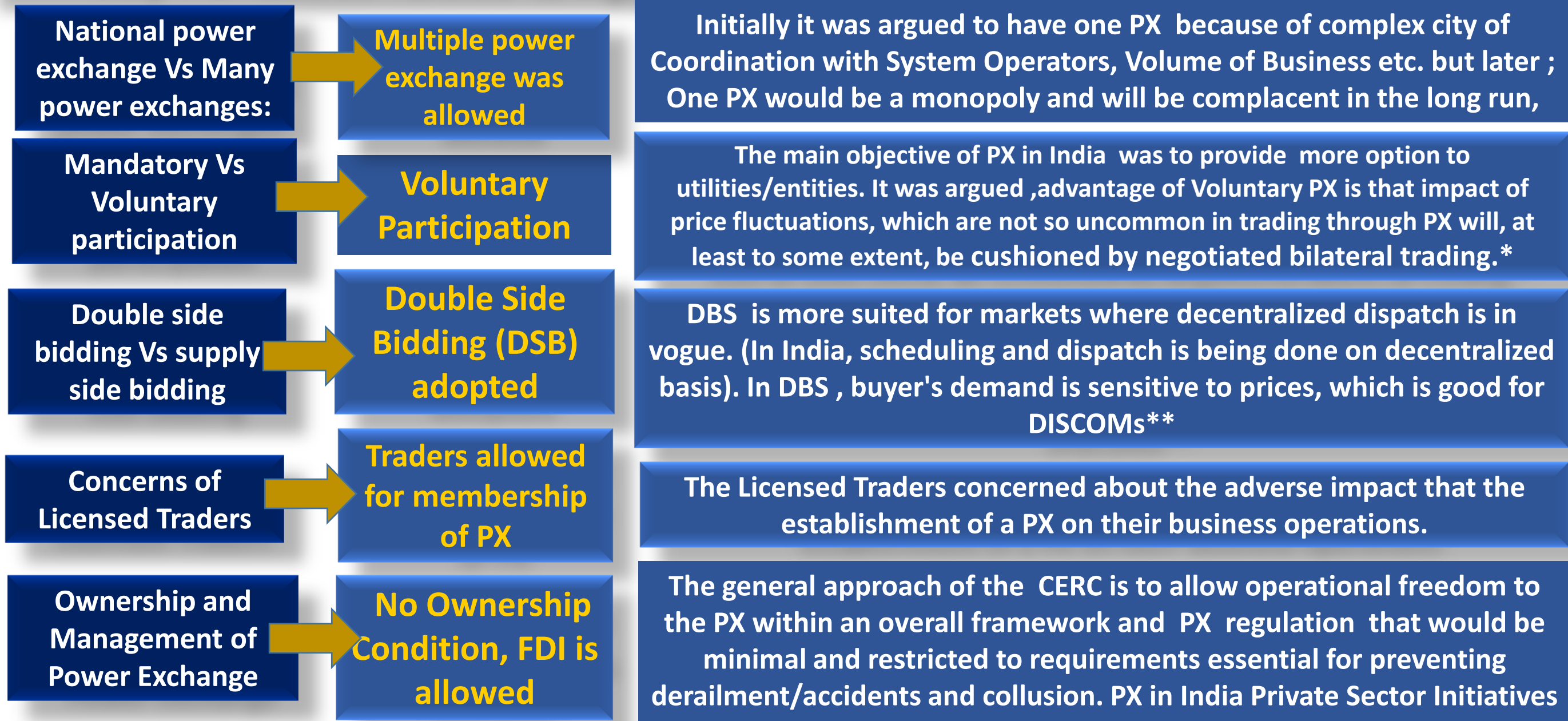
Auction

Weekly contracts are through open auction 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



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

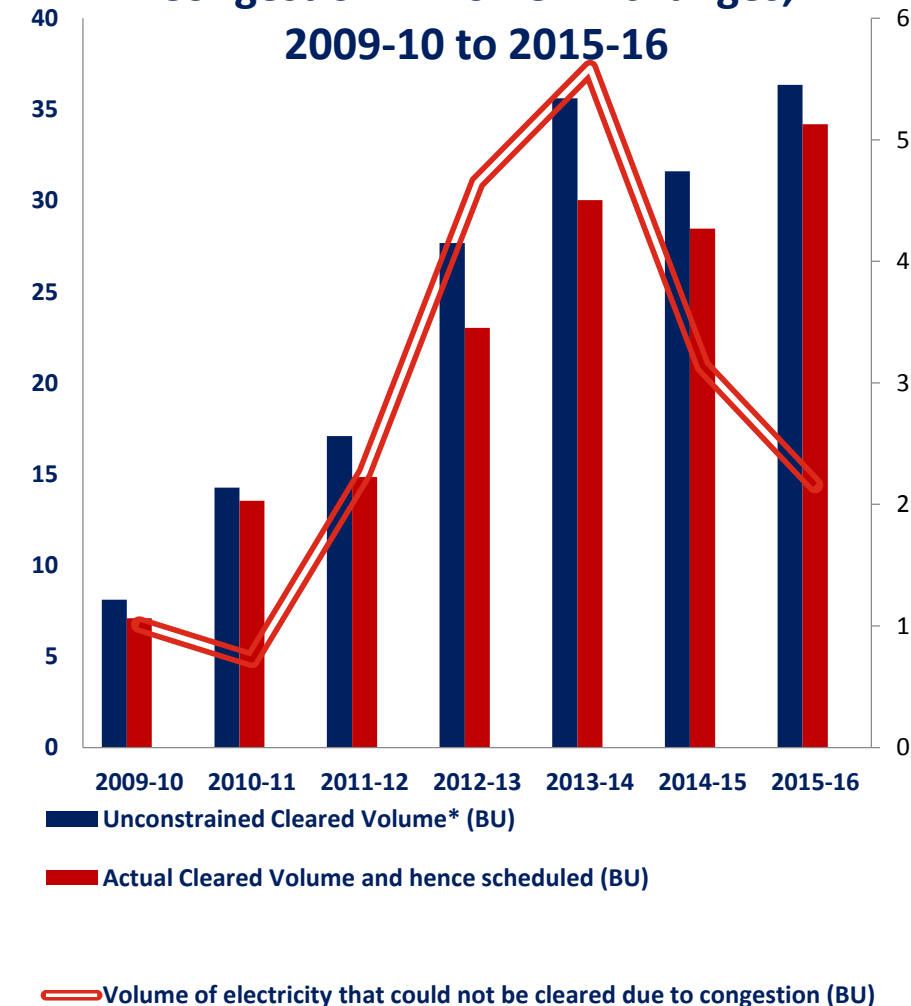
Around 3% of the total generation is being traded through power exchanges.

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.

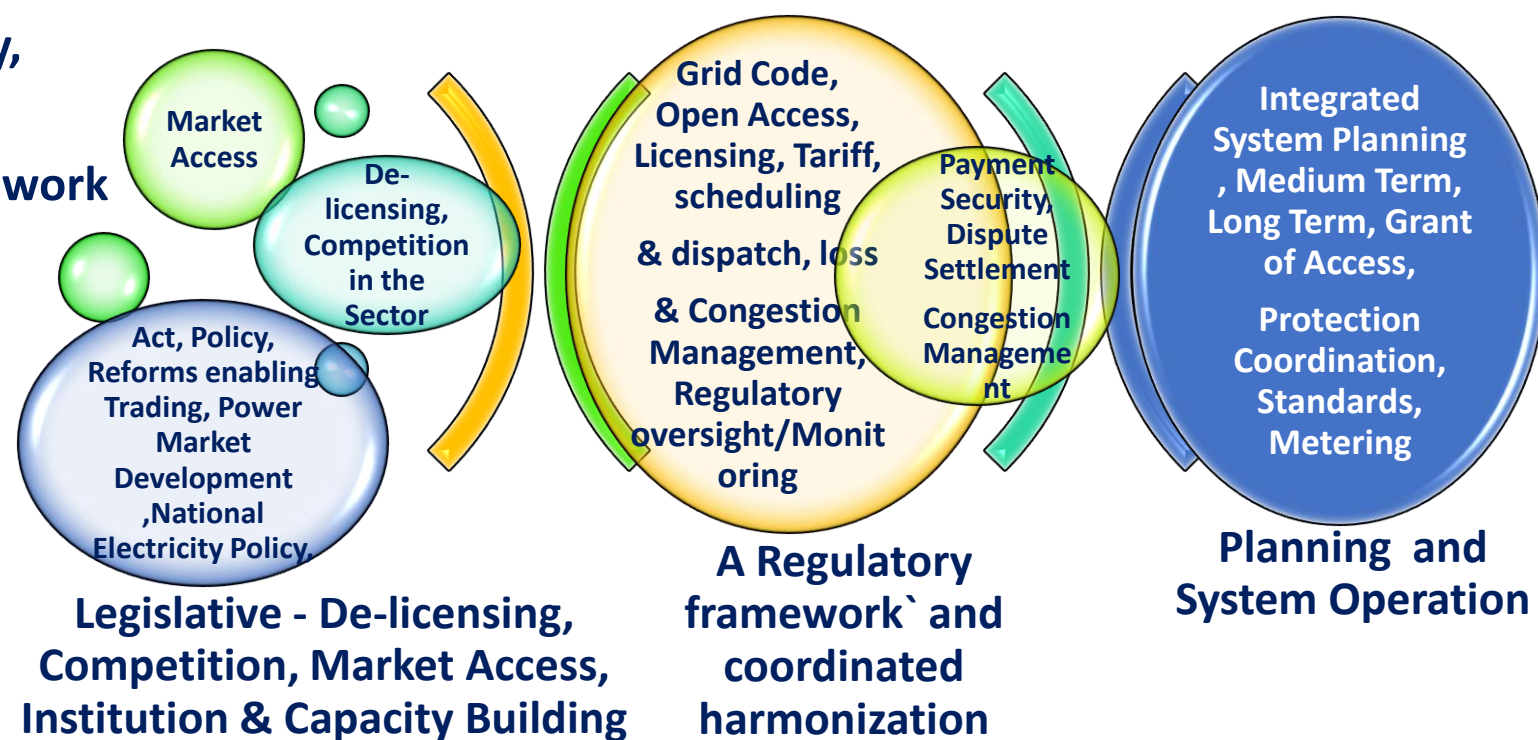
Congestion in Power Exchanges, 2009-10 to 2015-16



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



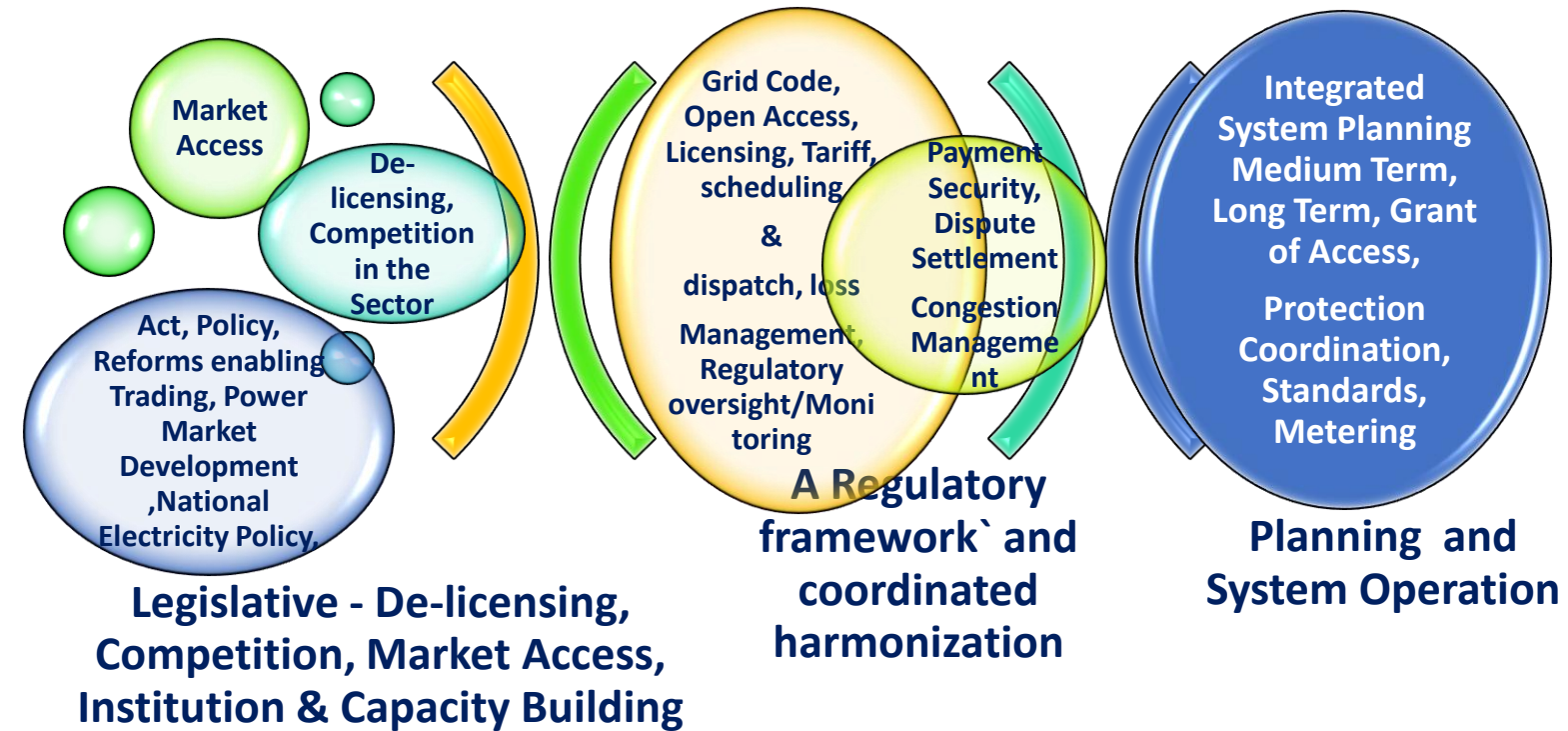
* Pre requisite

**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.

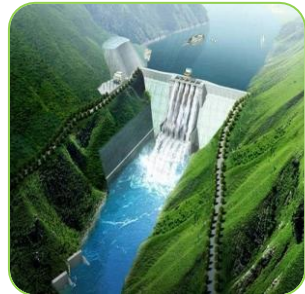
Ecosystem for Market Development



* 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 /Commercial
Bhutan (Exporter) → India	Chukka, Kurichhu Hydro Projects	Negotiated (G to G)
	Tala Hydro Project	Negotiated (G to G)
	Dagachhu Hydro Project	Market determined /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
India(Net exporter) → Nepal	100 MW India-Tripura	Negotiated (G to G)
	Bilateral contracts / Treaties to the tune of 237 MW 200 MW More	Negotiated (G to G) Market determined /Commercial



Trilateral Memorandum of Understanding between Bangladesh, Bhutan and India for Cooperation in the field of Hydroelectric Power had been worked-d 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

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

✓ Difference in policy, legal, and regulatory mechanisms.

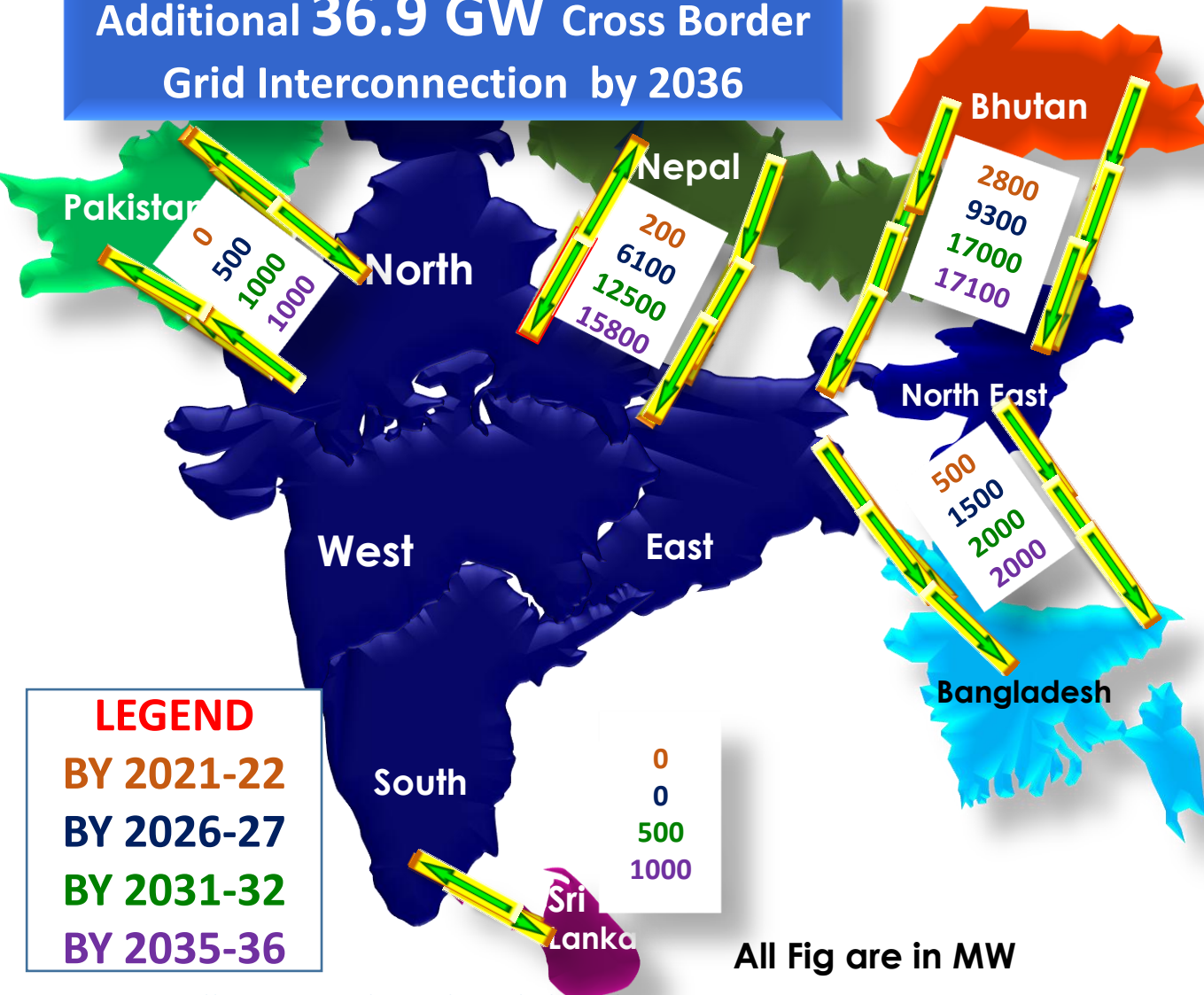
✓ Countries are Different stage of power sector evolution, depth of regulatory framework

✓ Building Strong of transmission system interconnections;

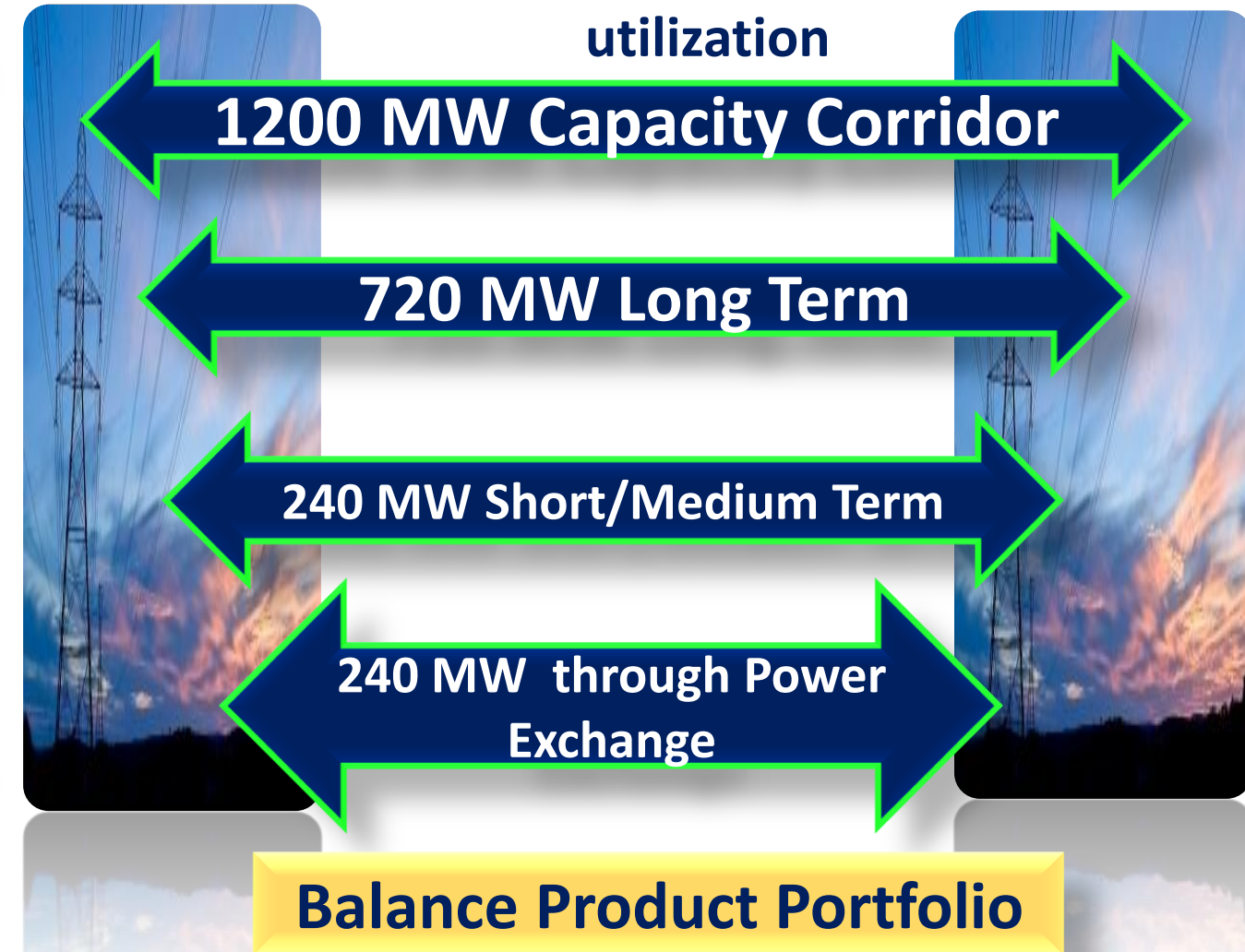
✓ Developing Regional Electricity Markets from bilateral markets

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).

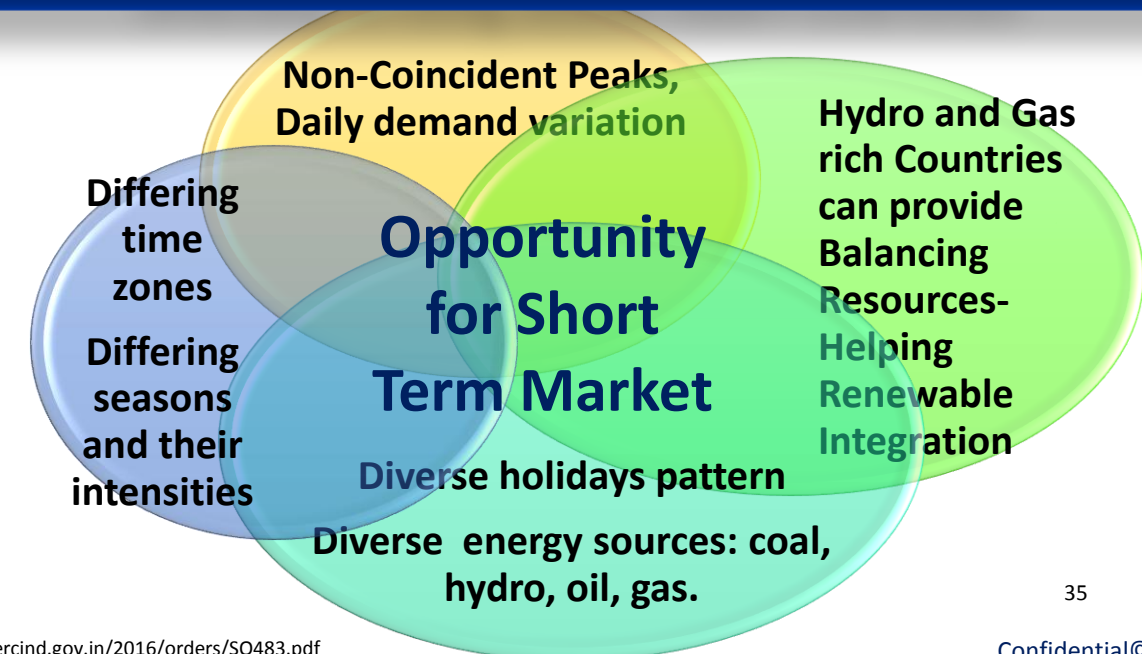
Draft Regulation by CERC has been issued , public hearing has been conducted(Feb,2017)

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



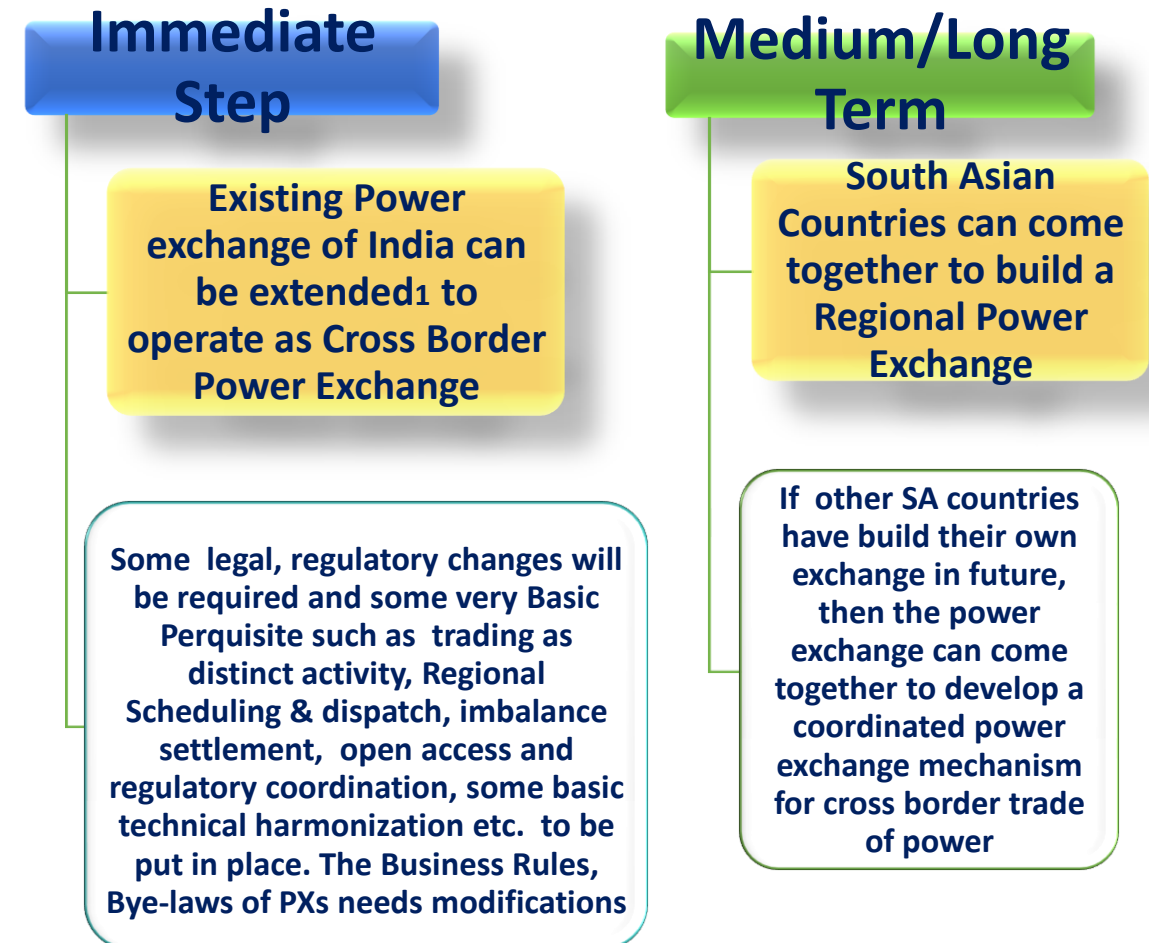
*<http://www.cercind.gov.in/2016/orders/SO483.pdf>

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 initiatives**.

Summary: one Existing Liquid Market was 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



**http://103.7.130.185/WebsiteData/Documents/PublishedPapers/Power_Exchanges_in_India_Candour_28_Sep_2010.pdf
 CTU, STU, System Operator been barred from engaging in the business of Trading in Electricity as per EA Act 2003

¹ Source: IRADe proposal for SARI/EI Cooperative Agreement

* In 1996, A joint Norwegian-Swedish power exchange is established. The exchange is renamed Nord Pool ASA Spot markets can exist as Pools or Exchanges, Exchanges use the market clearing mechanism

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

Objective of this Exercise

Ascertain the feasibility of SARPEX.

Drafting the market design and rules for the South Asian Regional Power Exchange

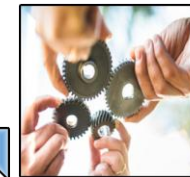
Enhance/Capacity Building of participants from South Asian countries on the function and Operation of Power Exchange.

Parties are Involved in the Execution of SARPEX



Market Advisory Committee

Key Expert of Power Market and Exchange

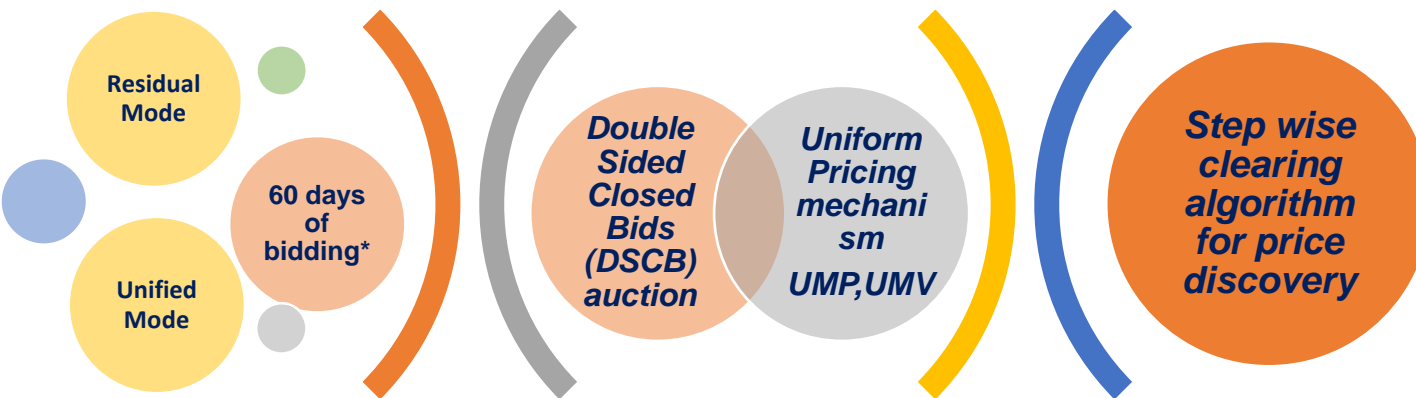


Nominated Government officials from respective country Governments for SARPEX.

Core Team



SARI/EI & Consultant Team

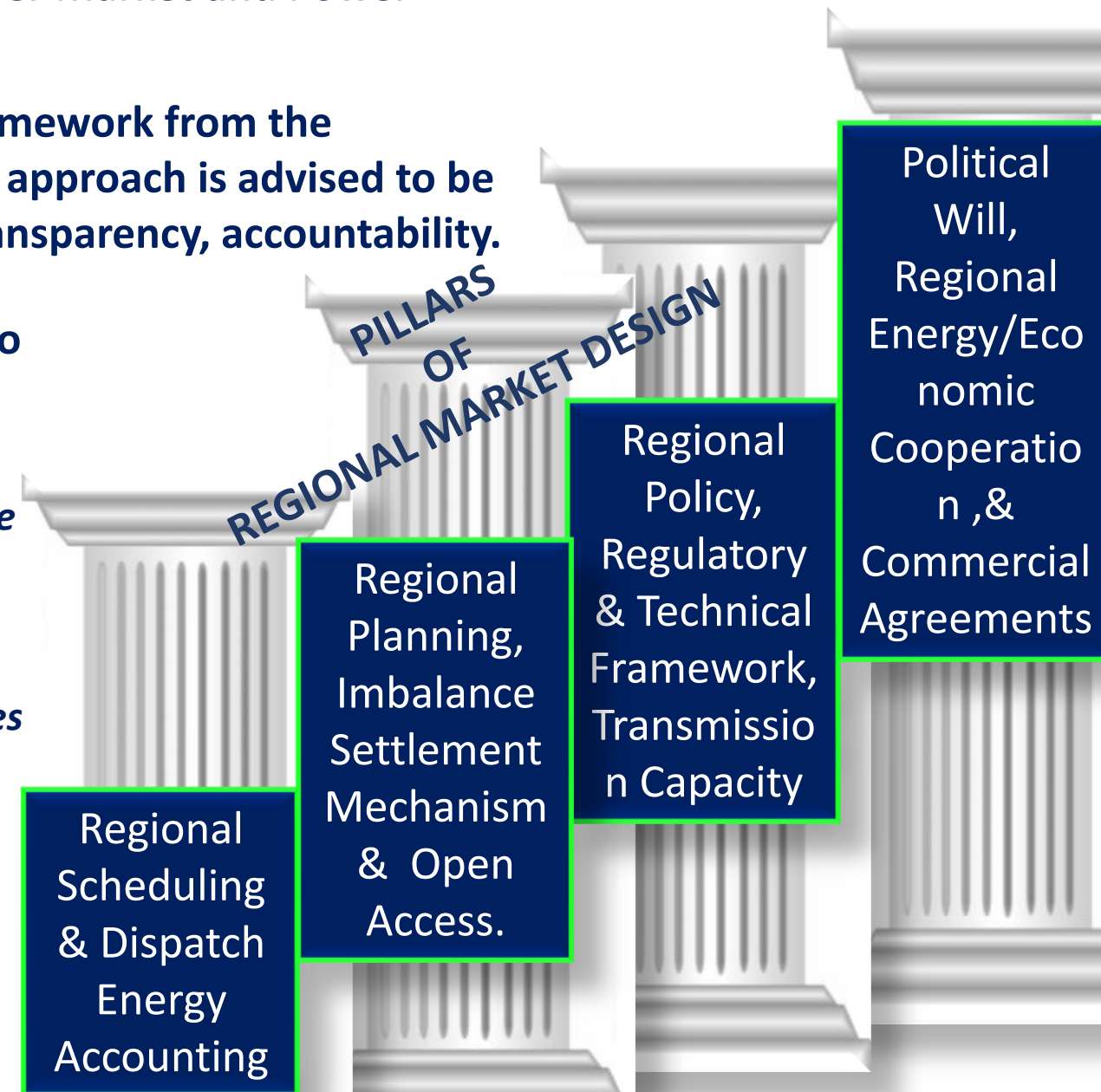


Exercise aims for Unconstrained Market Price (UMP) and Unconstrained Market Volume (UMV)

No impact of transmission constraints is considered

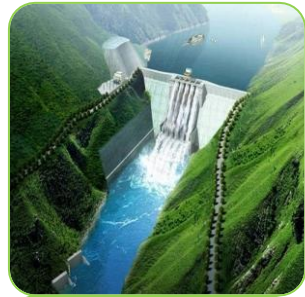
Way Forward for creation of South Asia Regional Power Exchange

- **Political Support at Regional Level is essential for Regional Power Market and Power Exchange Formation.**
- **Coordinated Harmonization of Legal , Regulatory and Policy Framework from 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.**





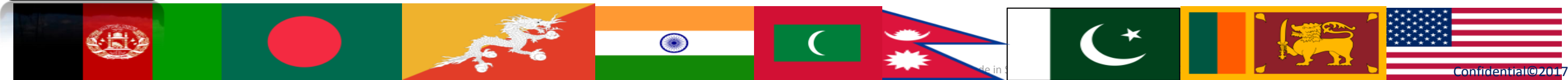
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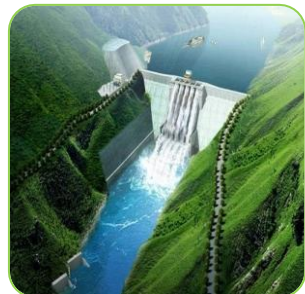


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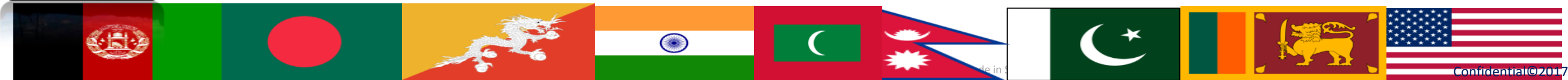
Contact

rajivratnapanda@irade.org
rajivratnapanda@gmail.com





Backup Slides



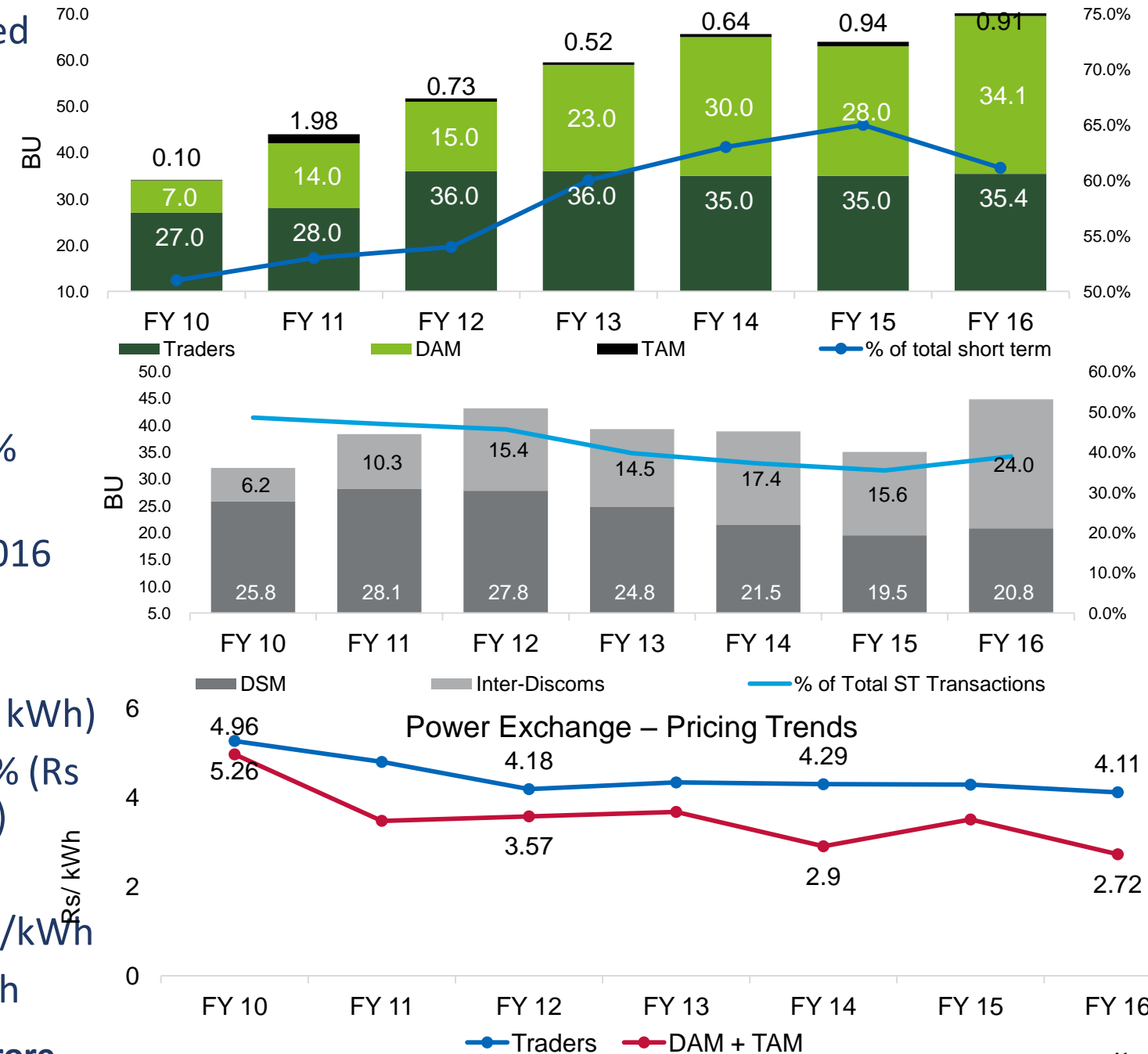
Short Term Electricity Trades

- 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

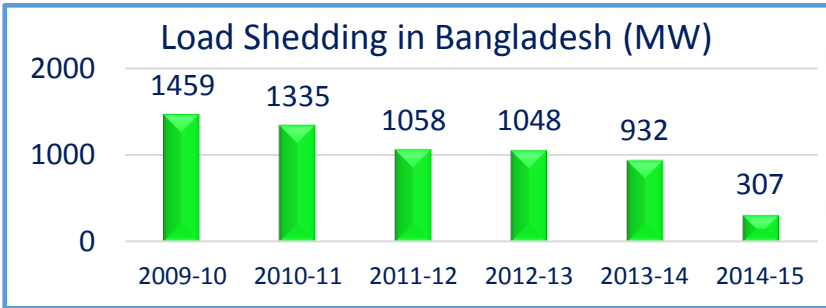
In monetary terms, short-term market size was Rs 24,096 crore, which was 4% less than in the year 2014-15,



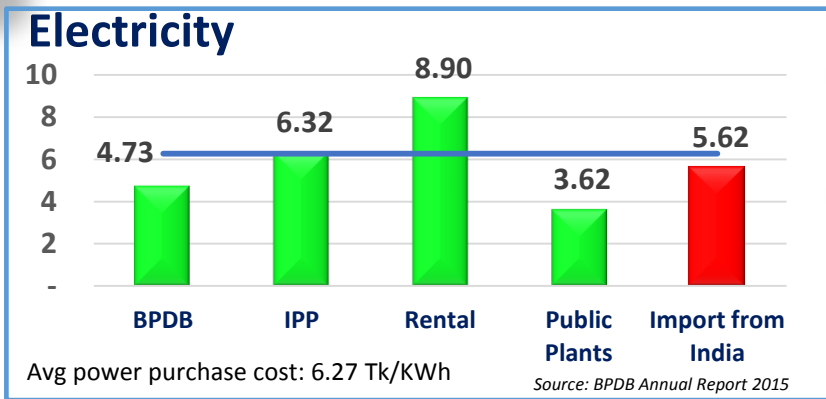
Cross Border Electricity Trade in South Asia and Key Message for ASEAN

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.

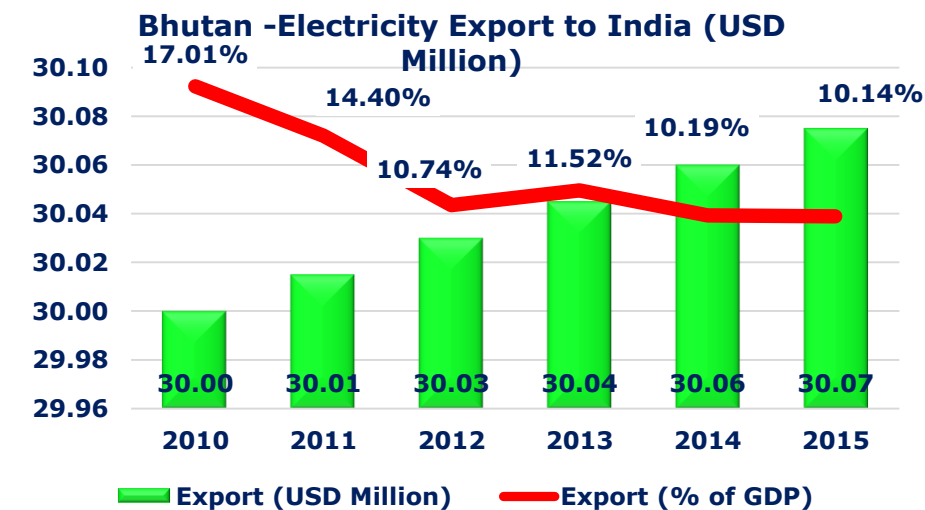
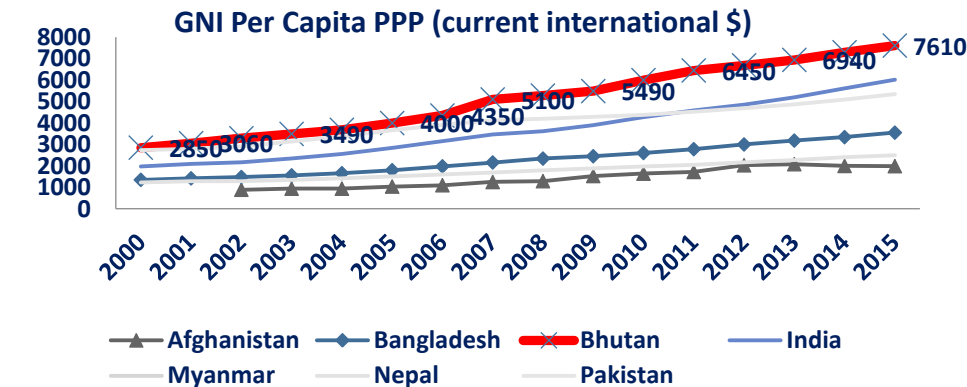
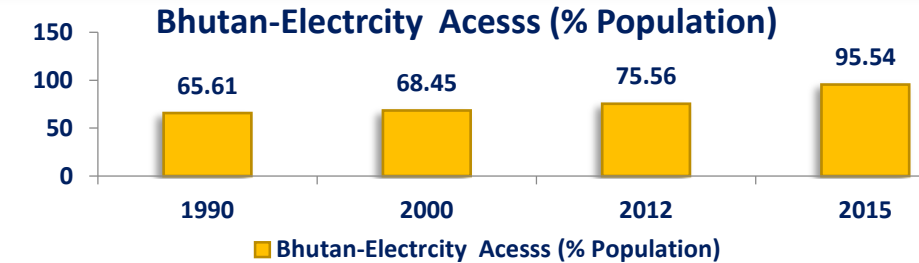
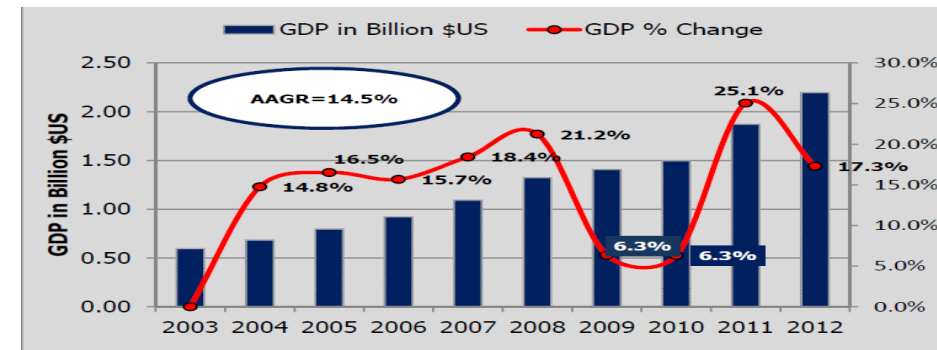
- 95% of Population Electrified.

- 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.

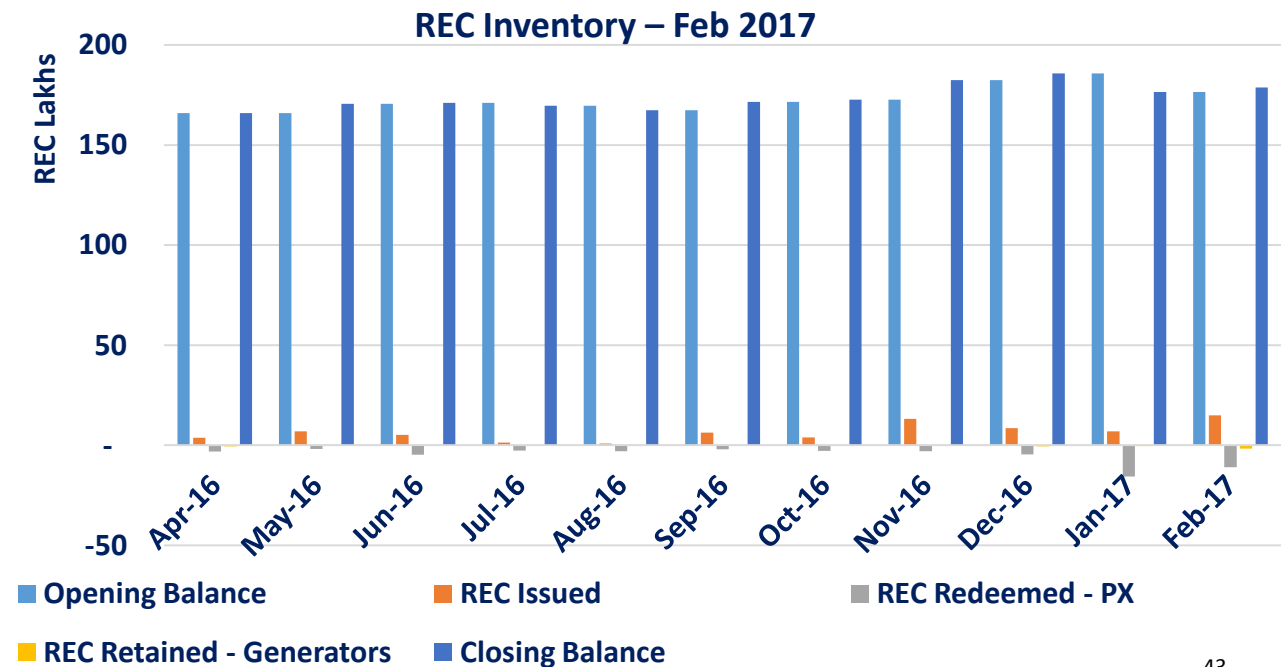
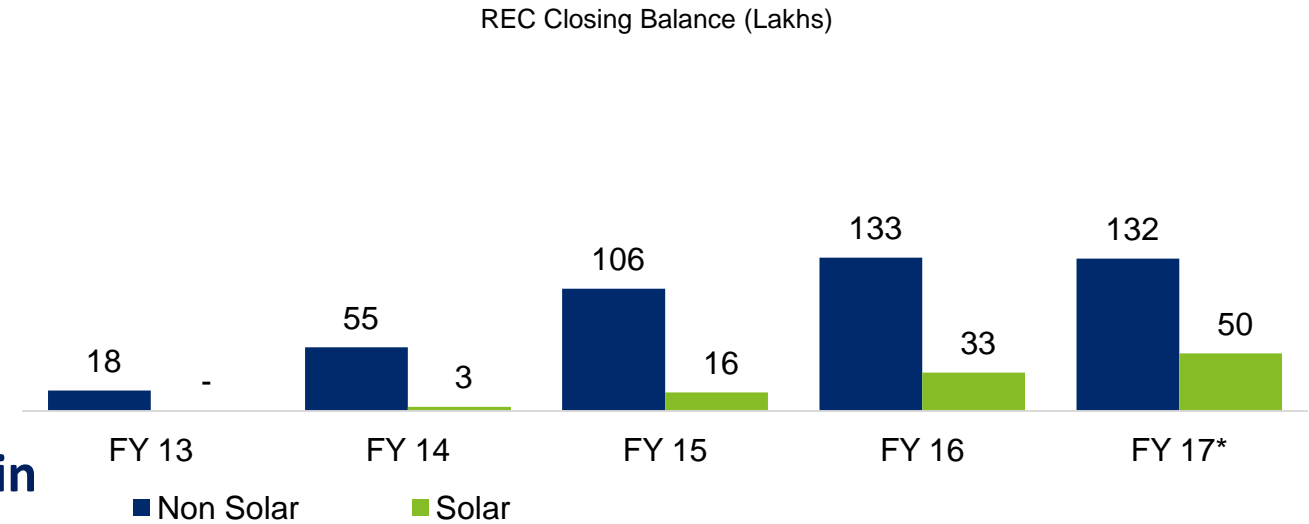
- Emergency Support -During the 2012 blackout in India**



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

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



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 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)



Afghanistan

- 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)



Pakistan



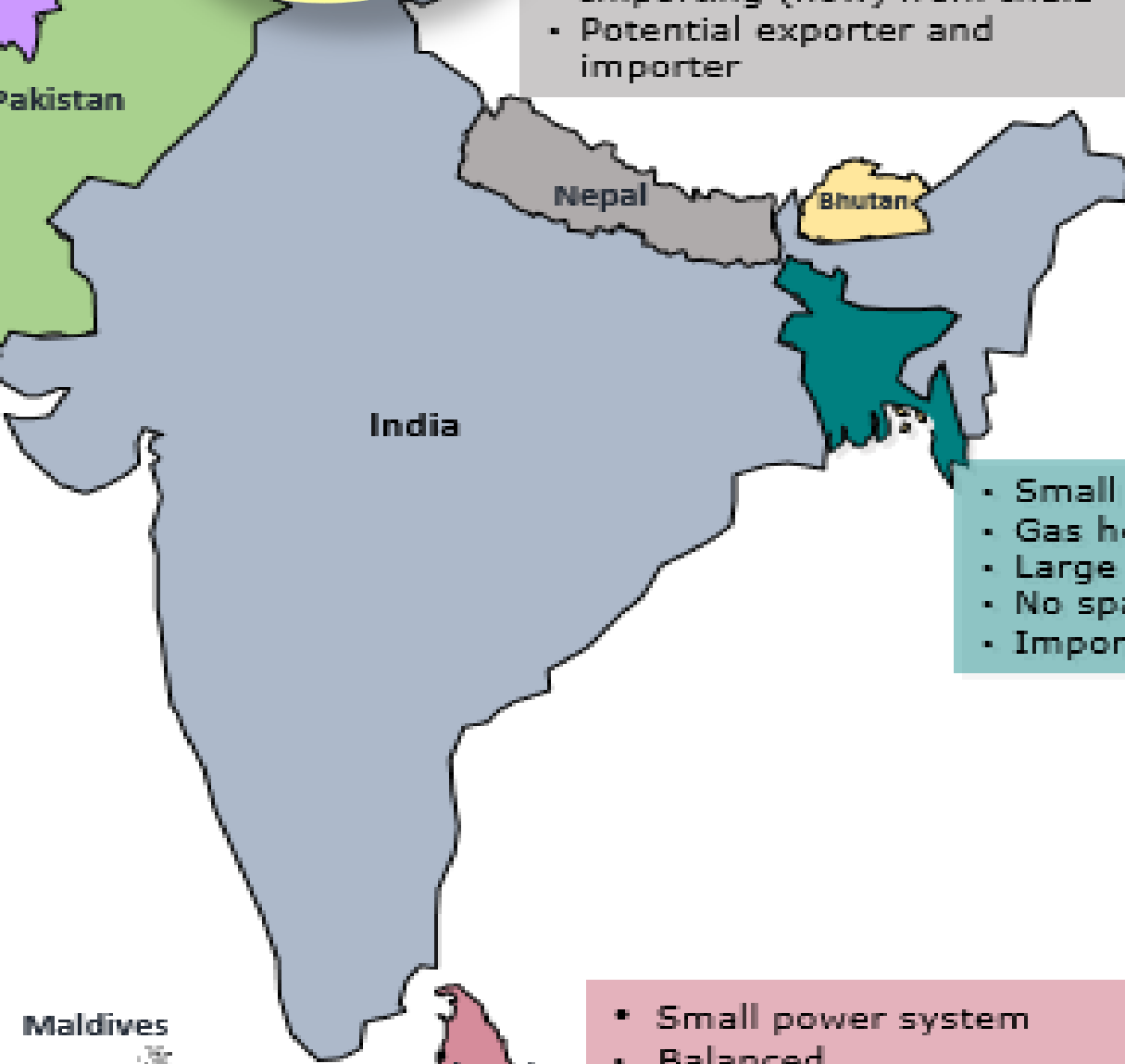
Nepal



Bhutan

- 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



India

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

Maldives



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

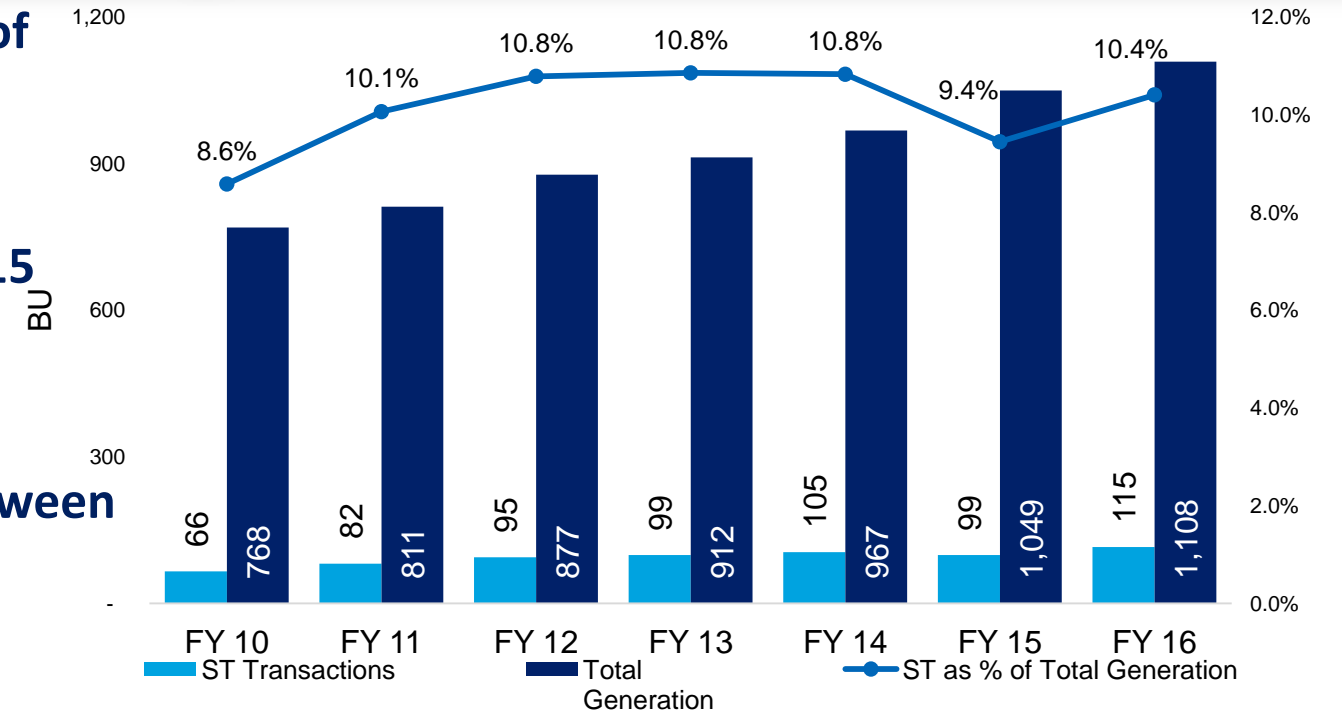
Sri Lanka



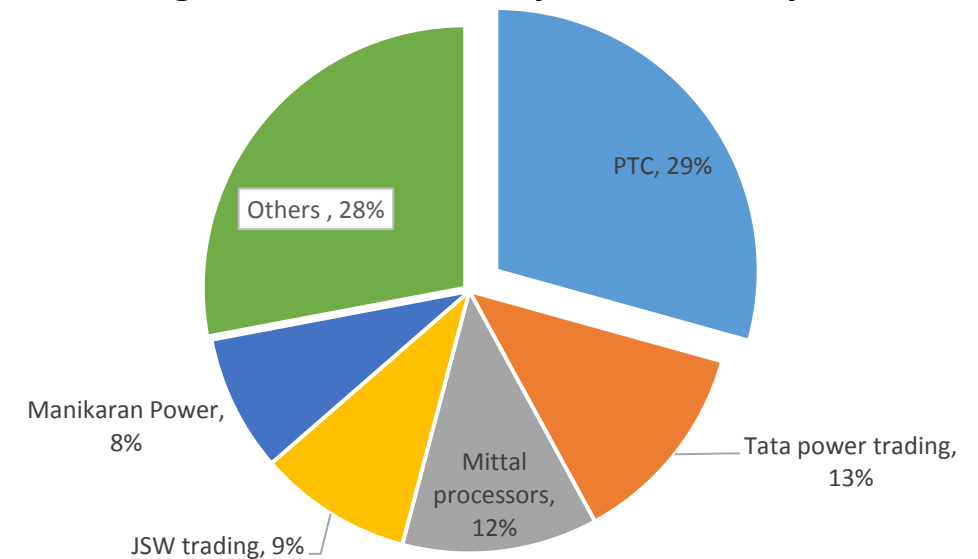
- Small power system
- Balanced
- Limited spare capacity
- No trading at present
- Potential exporter and importer

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

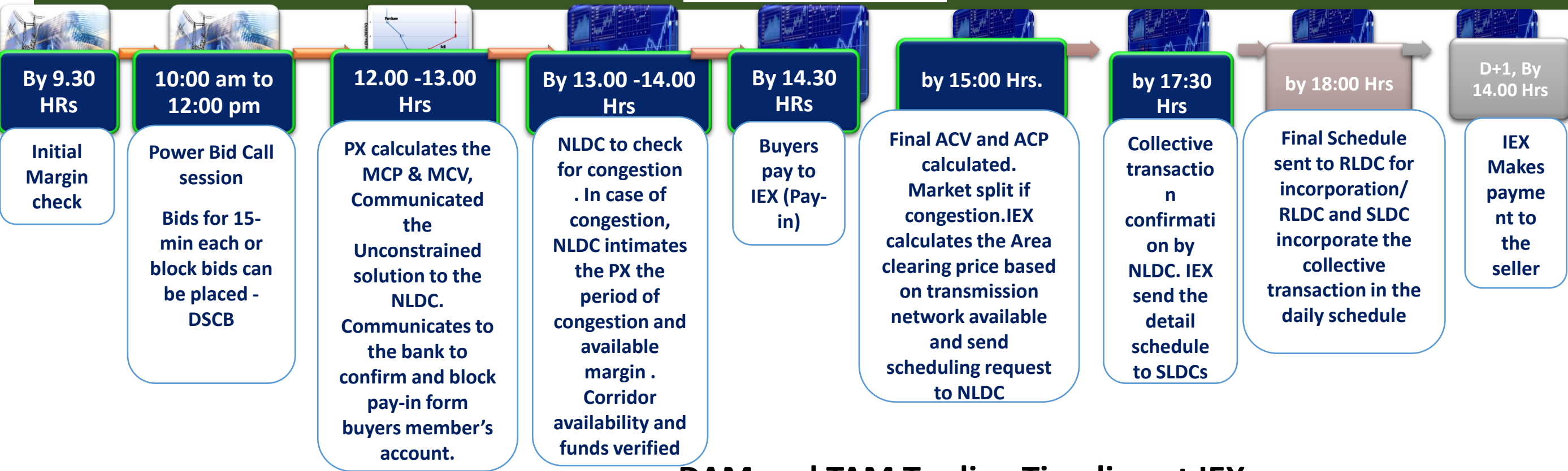


Percentage share of Electricity Transacted by Traders in 2015-16



Confidential©2017

DAM Time Line



DAM and TAM Trading Timeline at IEX



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

South Asia Regional Power Market Development for CBET

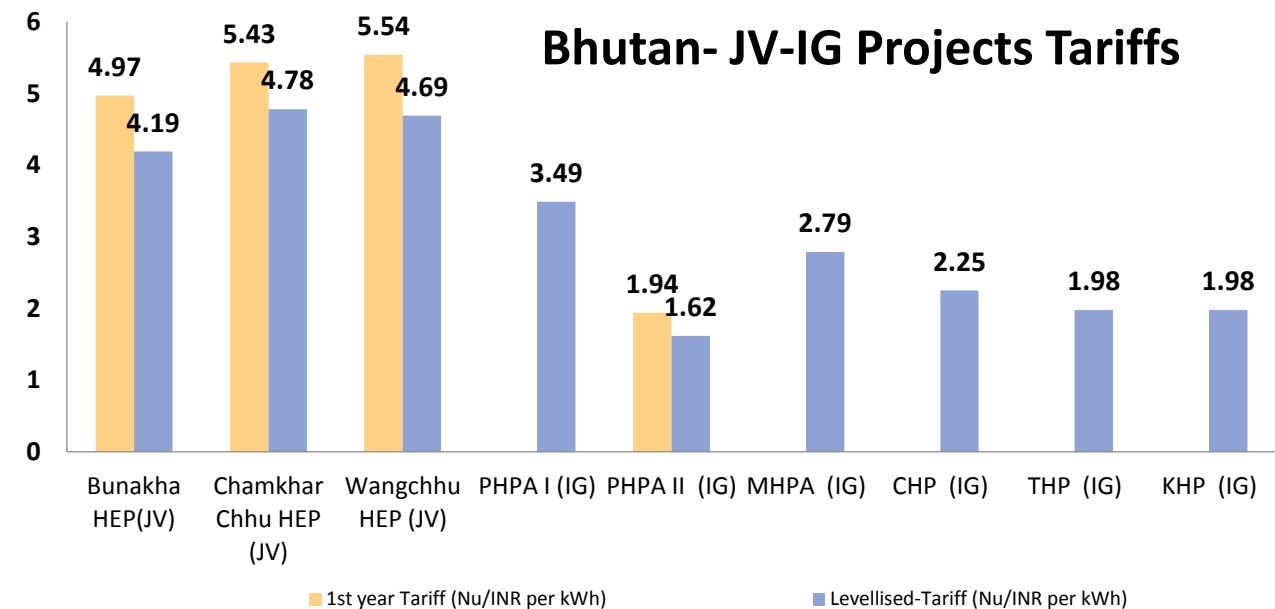
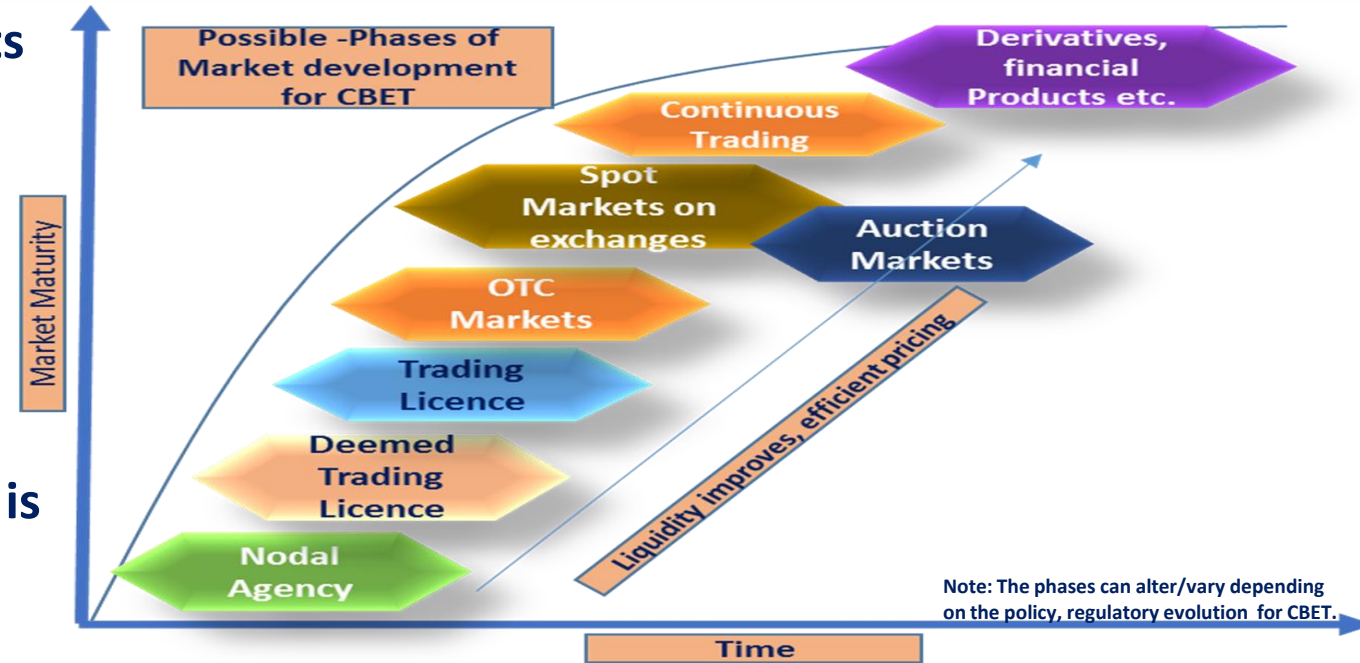
• Currently most of the Cross Border Electricity Trade projects are backed by government and rightly so as it brings confidence.

• 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.

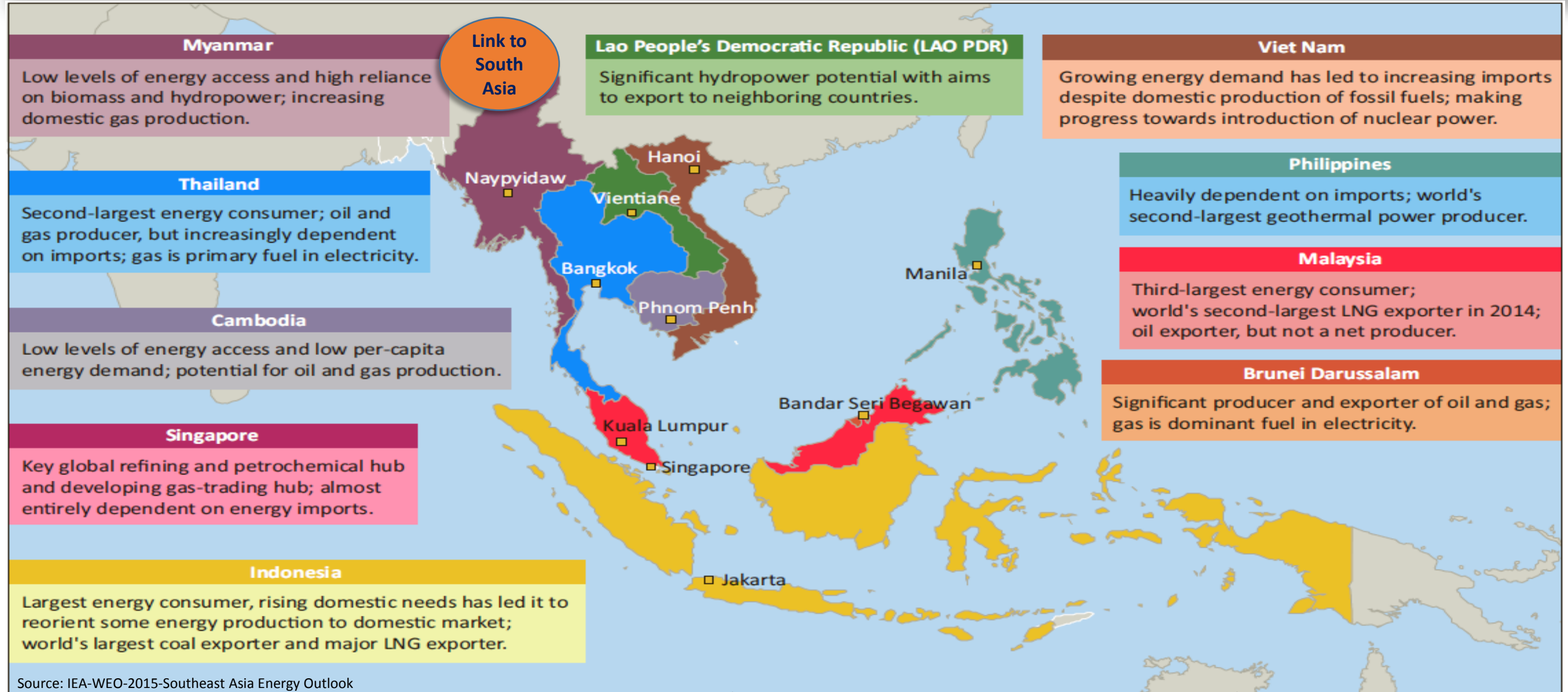
• There is a need to create a Regional Power Market to support these development.

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



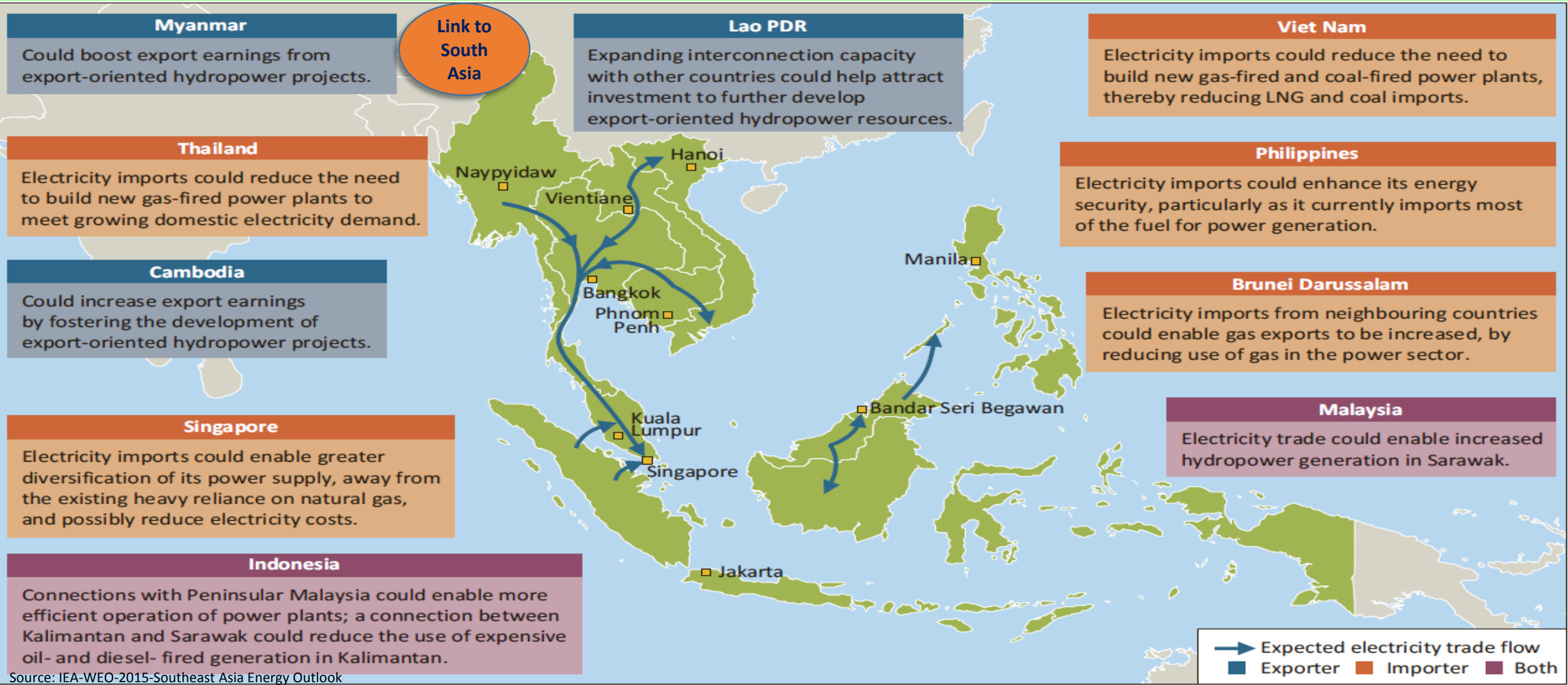
	Bhutan-India	India-Bangladesh	India-Nepal
Principle of determination	The tariff for both Tala and Dagachhu PPAs was determined on a negotiated basis	The tariff for NVVNL PPA is as per CERC regulations (agreed based on negotiation). On the other hand, tariff for PTC PPA was determined through competitive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

Energy Overview of South East Asia



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

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



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

Energy Resource in ASEAN/ South East Asia and South Asia

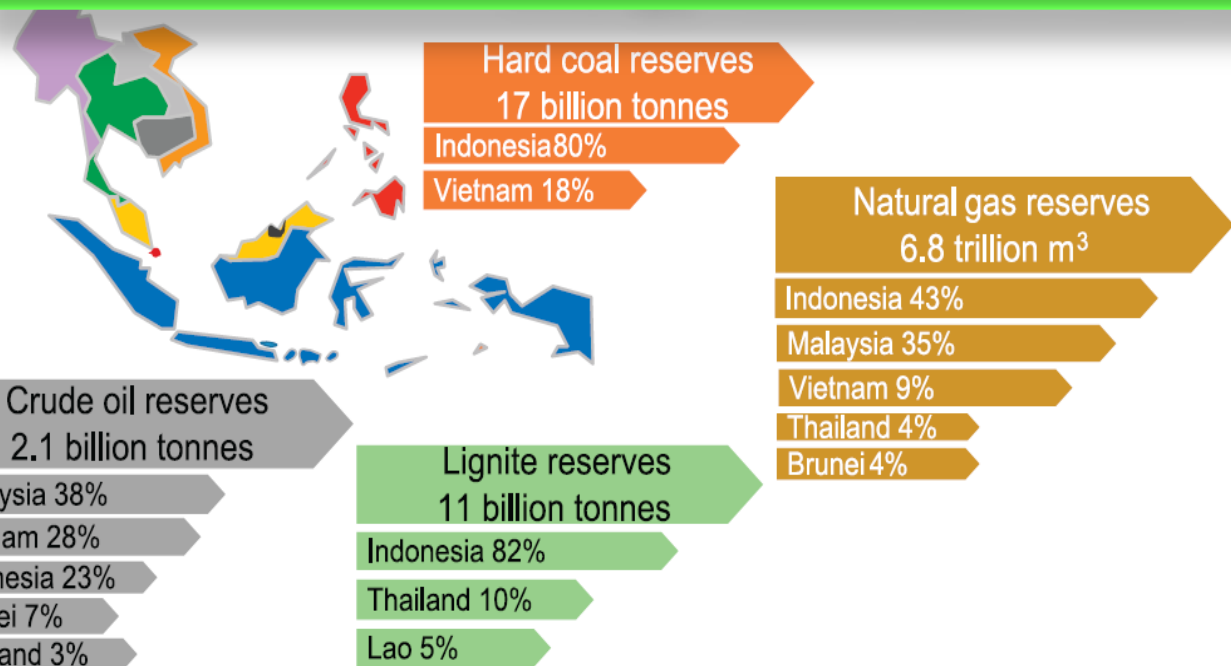
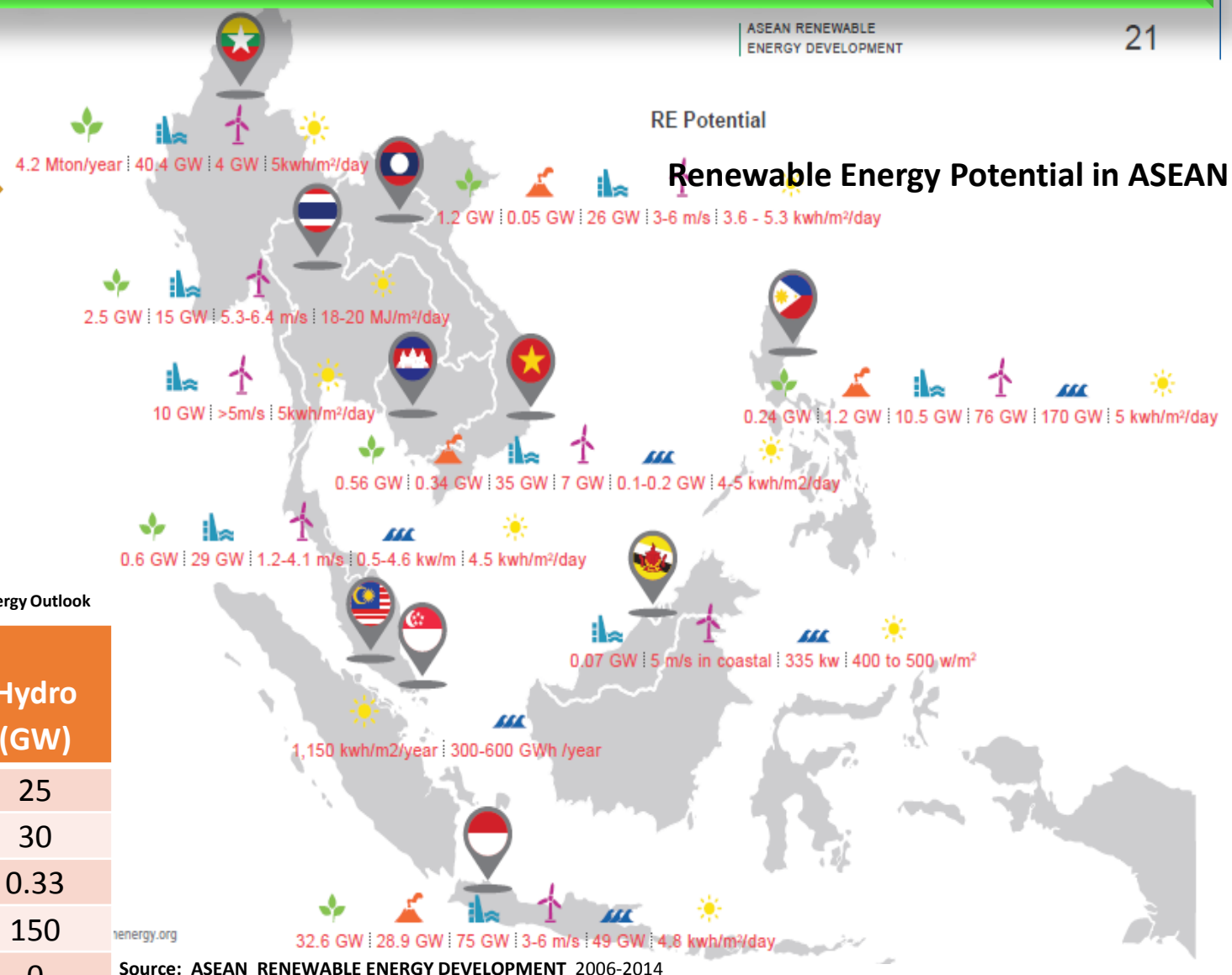


Figure 4 Fossil Fuel Reserves in ASEAN, as of 2013 Source: The 4th ASEAN Energy Outlook

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



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/USD 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 5 UTs	16 States 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

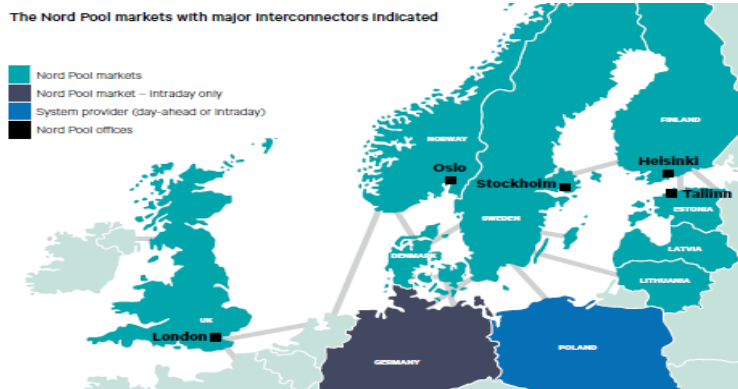
IEX: It was promoted by Financial Technologies (India) Limited and PTC India Limited. Other key shareholders include Lanco Infratech Limited, Tata Power Company Limited, Jindal Power Limited, Reliance Infrastructure Limited, Adani Enterprises Limited, Rural Electrification Corporation Limited and Infrastructure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



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 Company 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

Electricity Generation

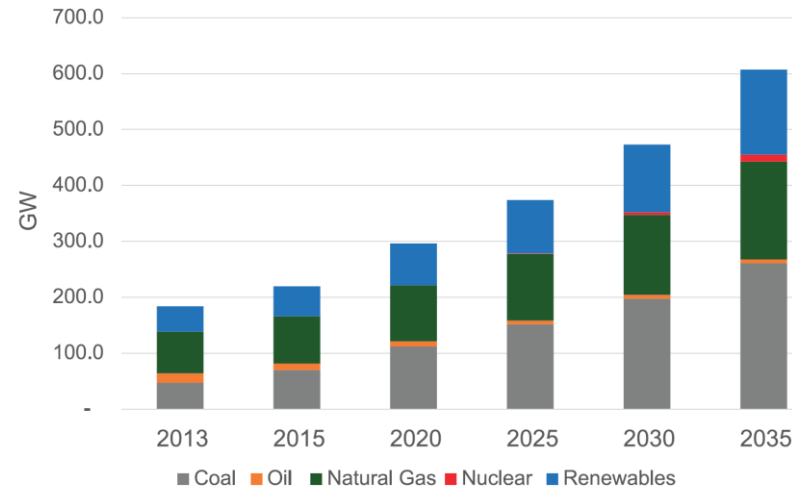


Figure 24 Projected Installed Power Capacity in 2013-2035, fuel-based

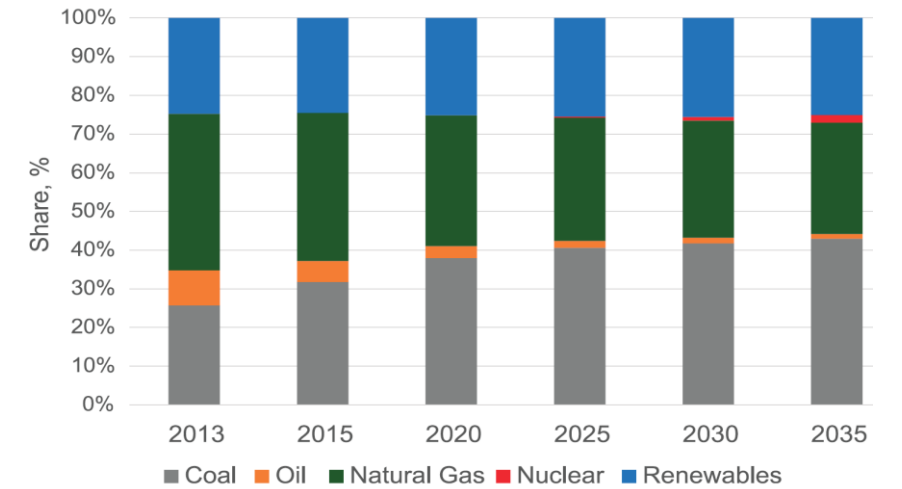
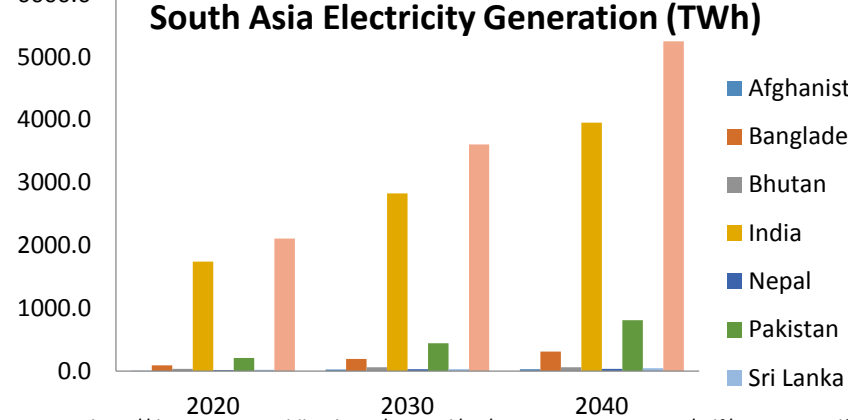


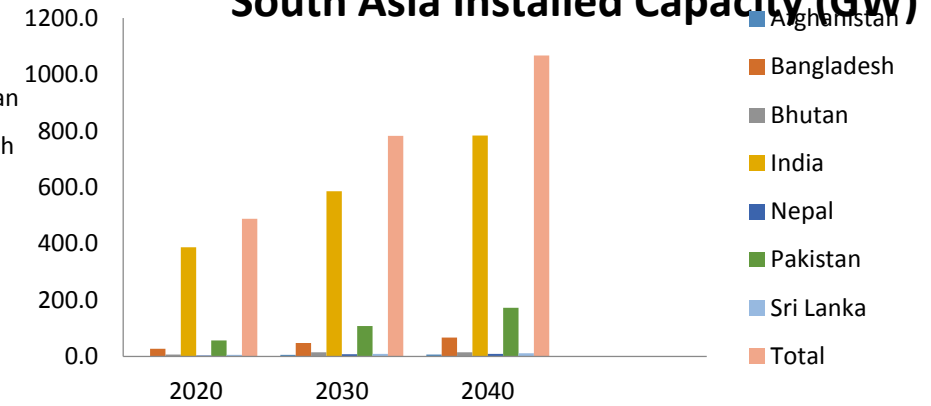
Figure 25 Projected Installed Power Capacity in 2013-2035, fuel share
Source: The 4th ASEAN Energy Outlook

South Asia Electricity Generation (TWh)



Source: <http://documents.worldbank.org/curated/en/846141468001468272/pdf/WPS7341.pdf>

South Asia Installed Capacity (GW)



Source: <http://documents.worldbank.org/curated/en/846141468001468272/pdf/WPS7341.pdf>

	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

Have we learned something from these for customized adaptation ?

International Experience : Comparison

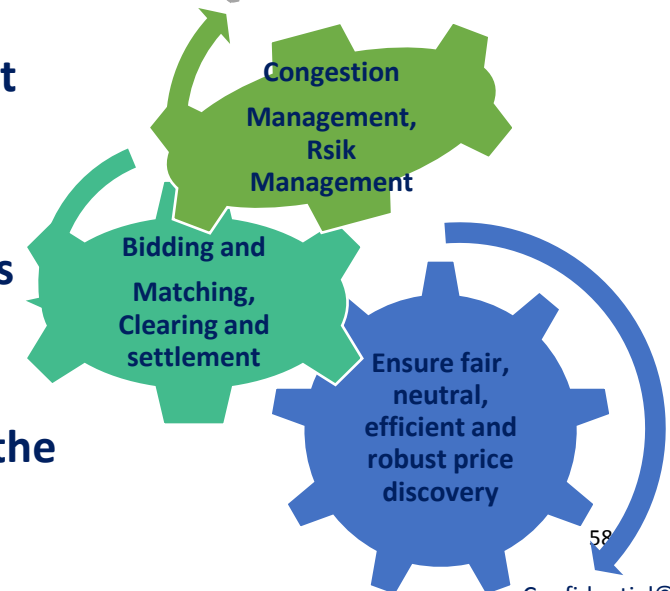
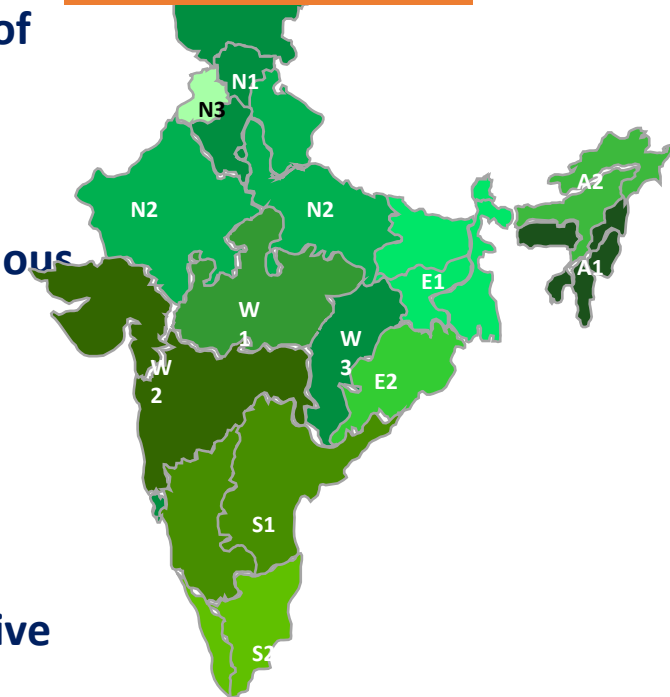
	Nord Pool	PJM	AEMO	India
Participation	● Voluntary for DAM	Compulsory for Real Time	Compulsory for DAM	● Voluntary
Market Offerings	● DA spot, hour-ahead, forward, futures, options	DA spot, real-time balancing, capacity credit markets	DA spot, Short term forwards	● DAM, TAM
Bidding Type	● Double Sided	● 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

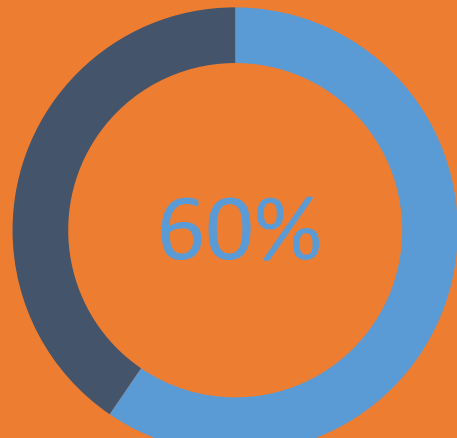


Key Lessons : Power Exchange in India

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>

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

Overview of South Asian Power Sector

Total Installed capacity of around 3,63,115 MW

Afghanistan: Small Power system (1341 MW); High Electricity Imports high, Hydro Dominated.

Bhutan: Small Power system (1614 MW); Hydro Dominated; Surplus Hydro; Exporting to India. Leading Exporter of Hydro Electricity.

Bangladesh: Gas Dominated; Resource Crunch; Imports Electricity from India; will remain as one of the Leading importer

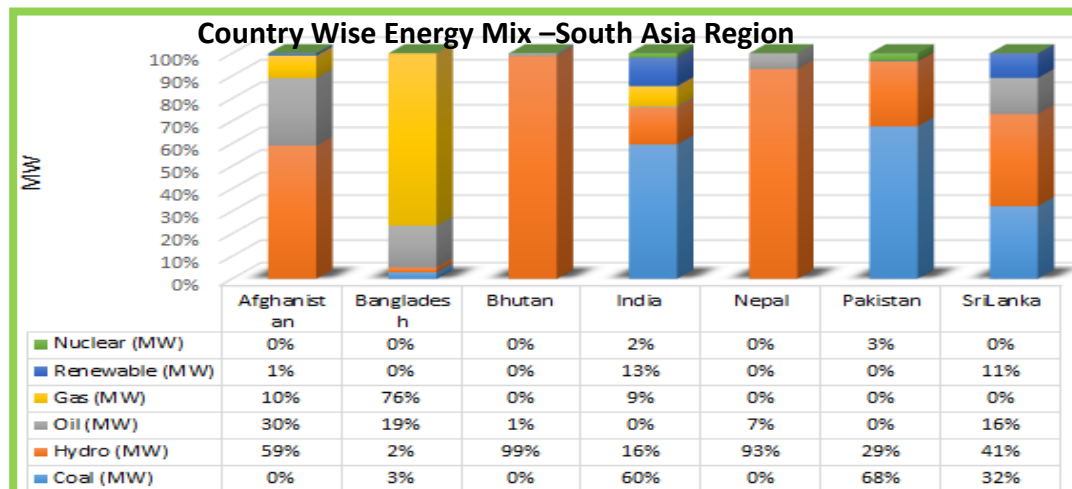
India: Large Power System; Coal dominated; reducing deficits; Long terms electricity demand are huge and potential large market. The Leading importer & exporter of electricity. 44 GW of RE.

Nepal: Very small power system (765 MW); Hydro based, very high deficits; Importing Electricity from India; Potential exporter hydro Electricity in medium term and importer of electricity in Short Term.

Sri Lanka: Hydro dominated but the flex mix is changing; High peak demand.

Country	Installed Capacity (MW)
Afghanistan	1341
Bhutan	1,614
Bangladesh	1500
India	3,15,426
Nepal	765
Sri Lanka	4050
Pakistan	24,829
Maldives	90
Total	3,63,115

Source : Compiled form various sources PGCB, DGPC,CEA,Annual Report NEA, Status of Industry Report NEPRA, Task Force 1 Report IRADe Report on CBET south Asia: Challenges and investment



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)

Energy Saving Certificates (ESC)

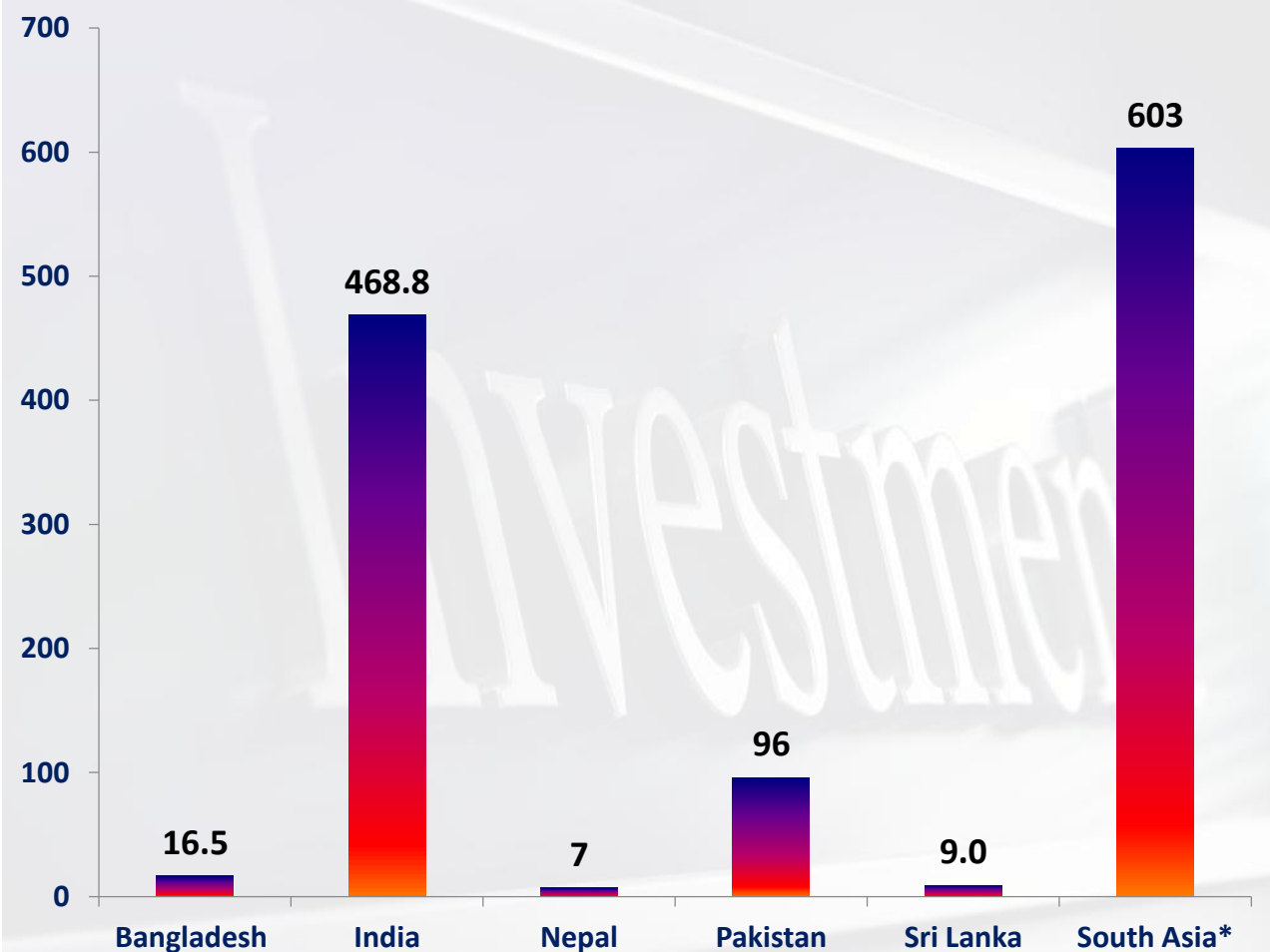
- Perform, Achieve & Trade Scheme (PAT) is a market-based mechanism to incentivize energy efficiency in large energy-intensive industries
- Initiative under National Mission on Enhanced Energy Efficiency (NMEEE) and covers 478 Designated Consumers(DCs) from eight energy-intensive sectors—thermal power, aluminium, cement, fertilizer, iron & steel, pulp and paper, textiles and chlor-alkali
- It facilitates the DCs to achieve their legal obligations under Energy Conservation Act, 2001, but also provides market-based incentives to over-achieve the targets set for them

Compliance	Mandatory
Target Entities	Designated Consumers
Buyers	Industries not achieving target
Sellers	Industries achieving beyond target
Mechanism	Cap and Trade
Phase Cycle	3 Years
ESCCerts	1 ESCert = 1 MTOE (Metric Tonne of Oil Equivalent)
Trading Platform	Power Exchange only
Penalty	As per Energy Conservation Act, 2001(Link with market value of oil equivalent)
Banking	Allowed for two consecutive cycles
Compliance Period	3 Years for DCs

Investment Requirement in Electricity Sector in South Asia 2020

- South Asia is now the fastest growing regions in the world.
- As per world bank estimates at present economic growth rate, SA countries needs to invest in the range of **USD 1.7 trillion to USD 2.5 trillion(2011-2020)** to bring its power grids, roads, water supplies up to the standard needed to serve the population.
- Total investment of **USD 603 billion** is required for SAARC countries for **Electricity Infrastructure development**.
- Bangladesh, India, Nepal, Pakistan & Sri Lanka need to invest around **US\$ 16.5 Billion, US\$ 468.8 Billion, US\$ 7billion, US\$ 96 Billion & US\$ 9 Billion** respectiv. by 2020.

*Investment Requirements 2011–2020 in total-
in billions of dollars 2010*



Source : World Bank- Reducing Poverty by Closing South Asia's Infrastructure Gap Luis Andrés, Dan Biller, and Matías Herrera Dappe December 2013

* Including Bhutan, Afghanistan, Maldives

Cost of Cross border Transmission Interconnections

<i>Countries</i>	<i>Interconnection Description</i>	<i>Capacity (MW)</i>	<i>Cost</i>
Bhutan -India-	Grid reinforcement to evacuate power from Punatsangchhu I & II	Reinforcement of 2,100 MW	140-160 USD Million (2010 Estimate)
Nepal -India	Dhalkebar-Muzaffarpur 400 kV line	1,000 MW	186 USD Million (2010 Estimate)
Nepal -India	Bardaghat- Gorakhpur(400 KV)	2500 MW evacuation capacity	32 USD Million
Nepal -India	Duhabi- Jogbani (400 KV)	1800 MW evacuation capacity	16 USD Million
Sri Lanka- India-	400kV, 127 km HVDC line with submarine cable	500 MW in the short-term	600 Million USD
Bangladesh-India	400kV HVDC back-to-back asynchronous link	500 MW	190-250 USD Million(2011 Estimate)
Bangladesh-India	Capacity Up gradation(500MW) of Existing Bheramara HVDC Station Project	500 MW	184.37 USD Million Bangladesh side only)
Bangladesh-India	(Eastern Interconnection Project) Tripura (India)- Comilla (Bangladesh) Grid Interconnection project(400 kV)	100 MW	24.04 USD Million (Bangladesh side) and 2.73 USD Million (Indian side)
India-Pakistan	220 kV in the short-term (could be upgraded to 400 kV later)	250-500 MW	50-150 USD Million (2012 Estimates)
CASA	500 KV AC line from Datka (Kyrgyzstan) to Khudjand (Tajikistan) 500 KV HVDC line :Tajikistan-Afghanistan-Pakistan	1300 MW	1.17 billion(2011 Estimates)



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SARI/EI



Annexure-I

Energy Integration in South Asia Region

Progress, Key Achievements and Way forward

V K Kharbanda
SARI/EI/IRADe

HAPUA- UNESCAP Workshop
17-19th April'2017, Jakarta, Indonesia



Contents

- **USAID's SARI/EI Program Structure and Framework for development of Cross Border Electricity Trade in South Asia Region**
- **Overview of South Asia Power Sector & current Status of Trade**
- **International Experience on Energy Integration and Key Learnings**
- **South Asia Experience on Energy Integration and Key Learnings**
- **Critical success factors for CBET and Way Forward**

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

- SARI/E is a long standing program of USAID started in the year 2000.

- Program has consistently strived to address energy security in South Asia by focusing

- 1) Cross Border Energy Trade
- 2) Energy Market Formation and
- 3) Regional Clean Energy Development.

- SARI/EI–Phase IV (2012-2017): Key Outcomes.

Three Key Development Outcomes:

1. *Coordinate policy, legal and regulatory issues.*
2. *Advance transmission interconnections.*
3. *Establish South Asia Regional Electricity Markets.*

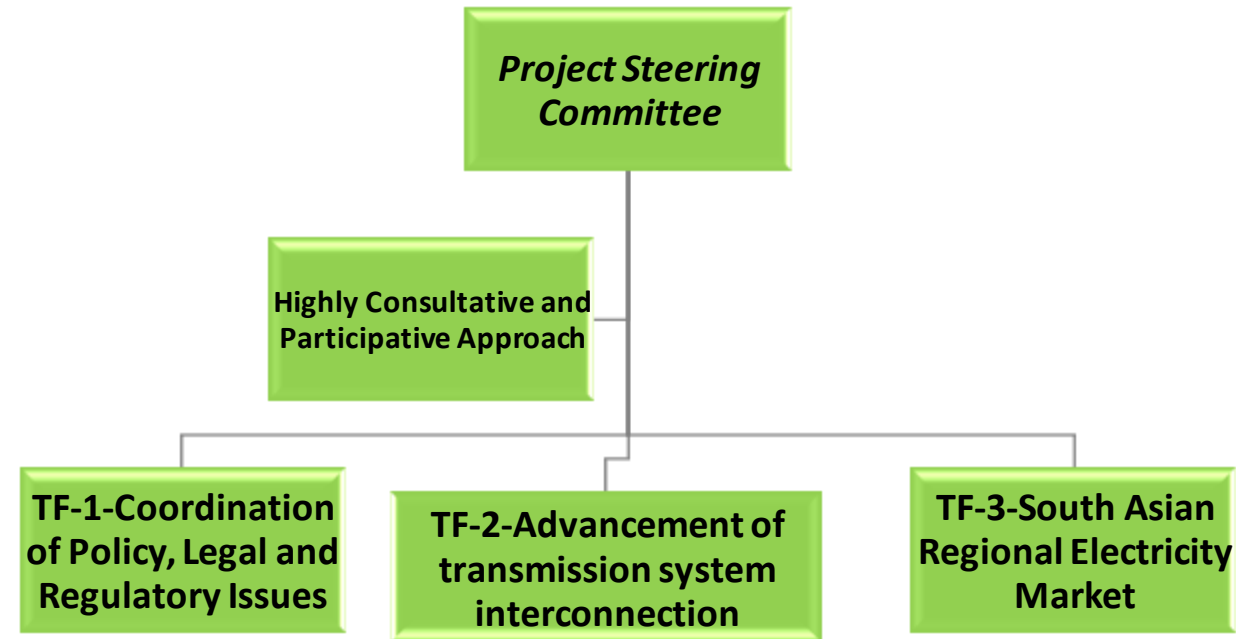
- Demand Driven ‘Bottom Up’ Approach

- IRADe, a regional organization, is implementing partner



SARI/EI Framework

- **Project Steering Committee (PSC)** is the apex body of the program and provides overall strategic directions.
- PSC members consist of **Senior level officials from the country governments, SAARC, ADB, Independent Energy Experts/Diplomats.**
- Task Forces are **represented by Government Nominated members of level of Directors/Chief Engineers/Members etc. from Utilities, Regulators, planners, Power Exchanges of SA countries.**



➤ **TF1: Coordination of Policy, Legal and Regulatory issues**



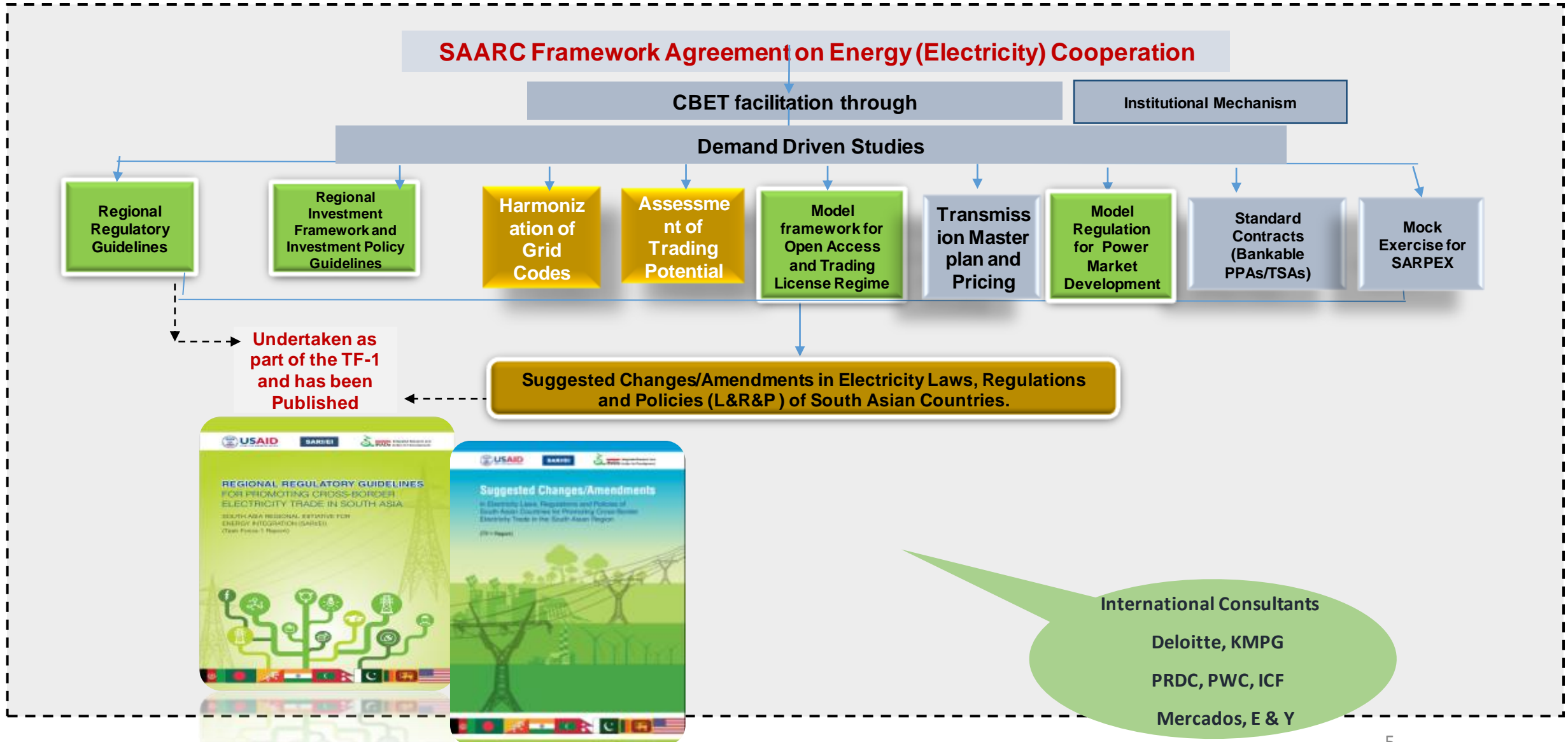
➤ **TF-2: Advancement of transmission system interconnection**



➤ **TF 3: South Asian Regional Electricity Market**

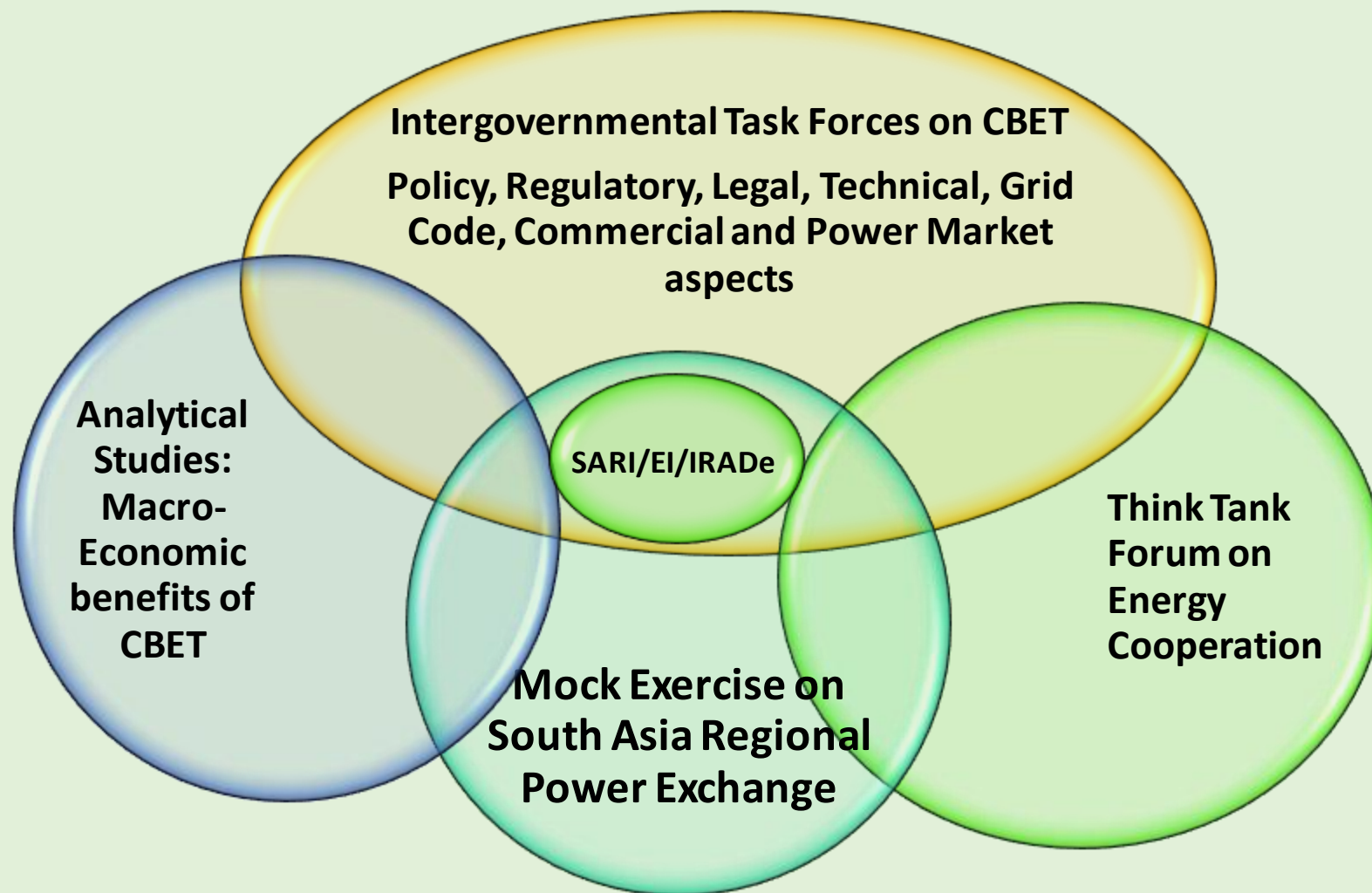


SARI/EI Overall Framework for development of CBET in SA





SARI/EI: Various Streams of Work





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 Integrated Research and
IRADE Action for Development

Overview of South Asia Power Sector

Overview of South Asia Power Sector

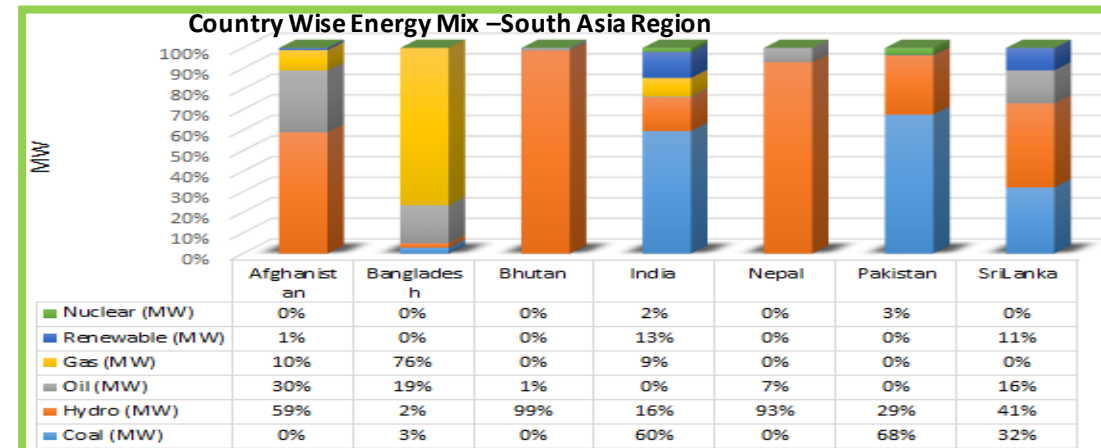
South Asian Power Sector. Total Installed capacity of around 3,60,603 MW

- ✓ **Afghanistan**: Small Power system(1341 MW), Electricity Imports high, Hydro Dominated.
- ✓ **Bhutan**: Small Power system (1614 mw) Hydro dominated, Surplus Hydro , Exporting to India
- ✓ **Bangladesh** : Gas Dominated, Resource Constraints , Imports Electricity from India and in future will remain as a Importing Country.
- ✓ **India**: Very Large Power System, Coal Dominated, reducing deficits, long terms electricity demand are huge and potential large market, Electricity importing and exporting nation.
- ✓ **Nepal** : very Small Power system (765 MW), Hydro based, very high deficits, Importing Electricity from India , Potential exporter and importer of electricity.
- ✓ **Sri Lanka**: hydro dominated but the fuel mix is changing, no trading at present, High peak demand.

Overall SA region is a power hungry region and per capita consumption is very low. Large part of population remains without access to electricity.

Country	Installed Capacity (MW)
Afghanistan	1341
Bhutan	1,614
Bangladesh	12,578
India	315426
Nepal	765
Sri Lanka	4050
Pakistan	24,829
Total	360603

Source : Compiled form various sources PGCB, DGPC,CEA,Annual Report NEA, Status of Industry Report NEPRA, Task Force 1 Report IRADe Report on CBET in South Asia: Challenges and investment oppoutinities, etc.



Resource Potential: Hydro Potential :350 GW !

- ✓ Vast potential of hydro power:350 GW
- ✓ Bhutan, Nepal, Pakistan, India: 30,83, 59, 150 GW respectively.
- ✓ Nepal and Bhutan can build export oriented hydro power plants
- ✓ Significant Coal deposits in India and Pakistan.
- ✓ Coal deposits in Bangladesh yet to be exploited.
- ✓ In addition to the conventional energy resources, there is huge renewable energy resources like solar and wind.

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

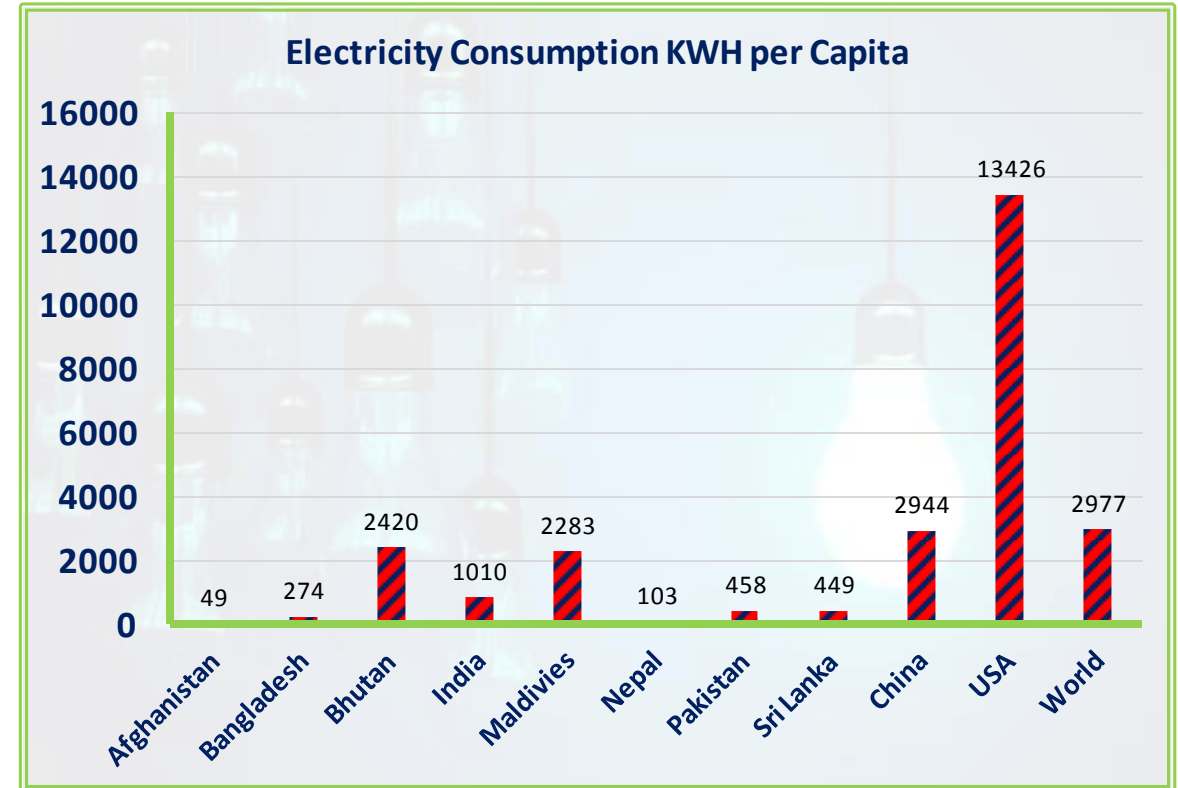
Renewables	Bangladesh	India	Nepal	Bhutan	Pakistan	Sri Lanka
Solar Power (Kwh/sq. m per day)	3.8 - 6.5	4 - 7	3.6 - 6.2	2.5 - 5	5.3	NA
Wind (MW)	Very limited potential	151,918	3,000	4,825	24,000	25,000MW



Per Capita Electricity Consumption

Country/ Region	Electricity Use kWh/capita/yr
SAARC	517
USA	12,914
EU	6,592
BRAZIL	2,206
MALAYASIA	3,614
CHINA	2,631
WORLD	2,803

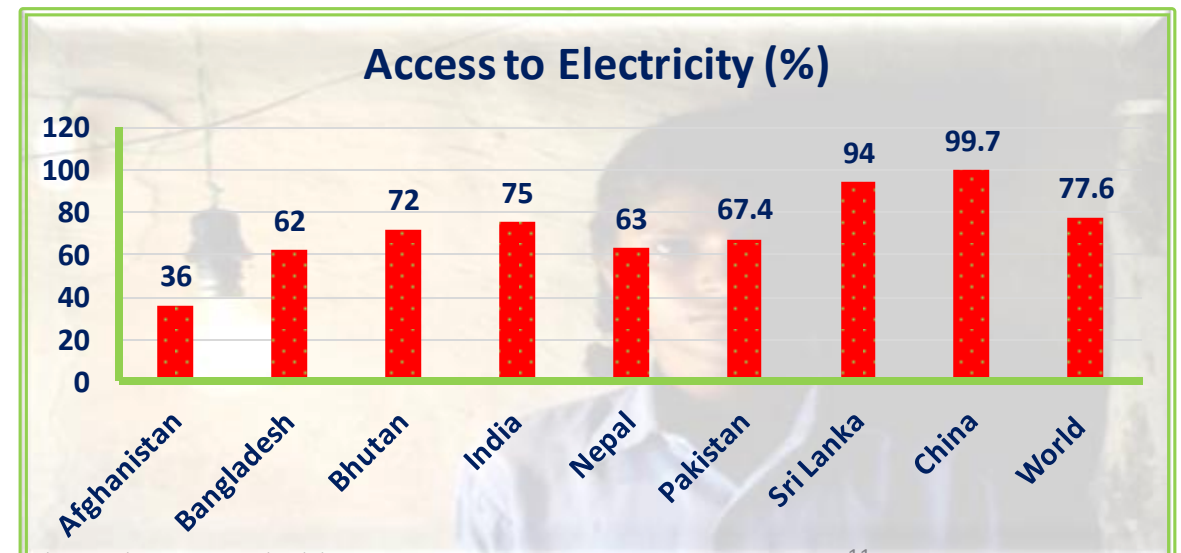
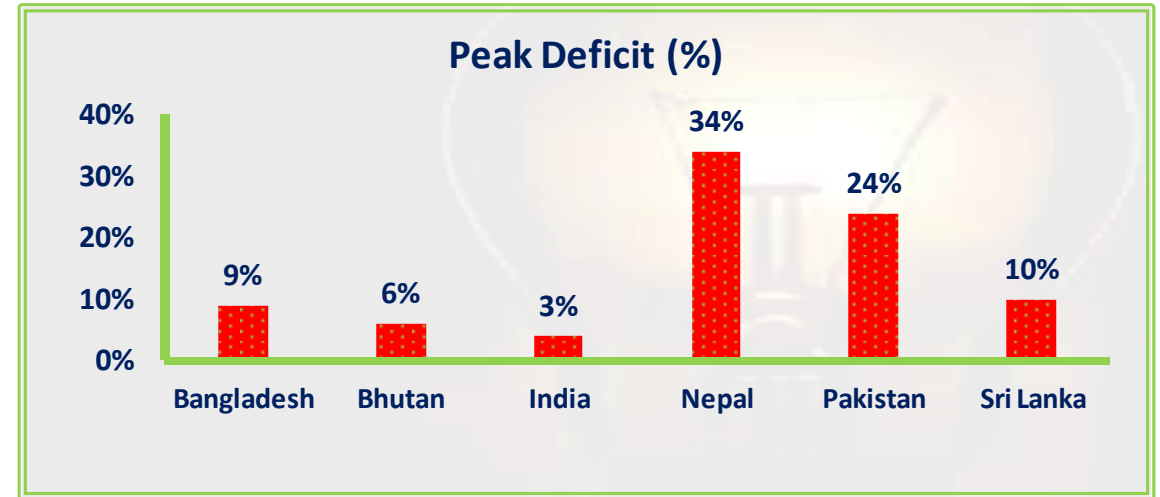
Source: SAARC Energy Centre



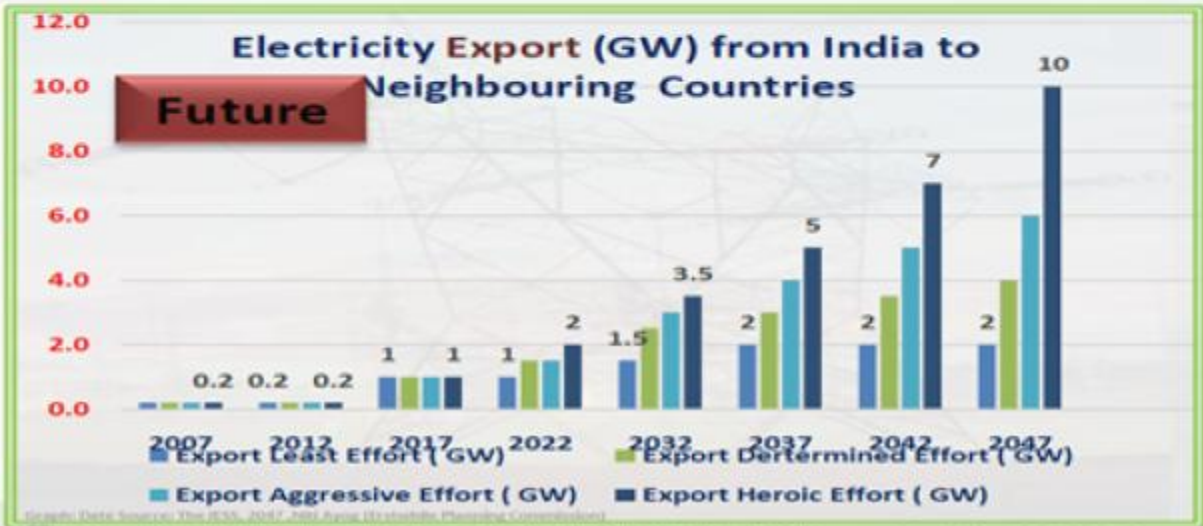
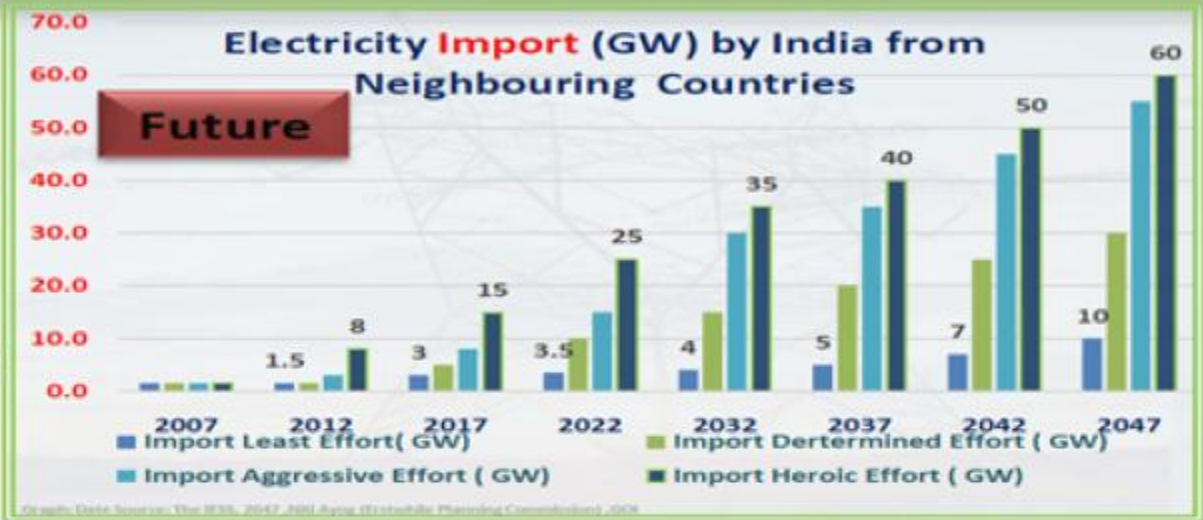
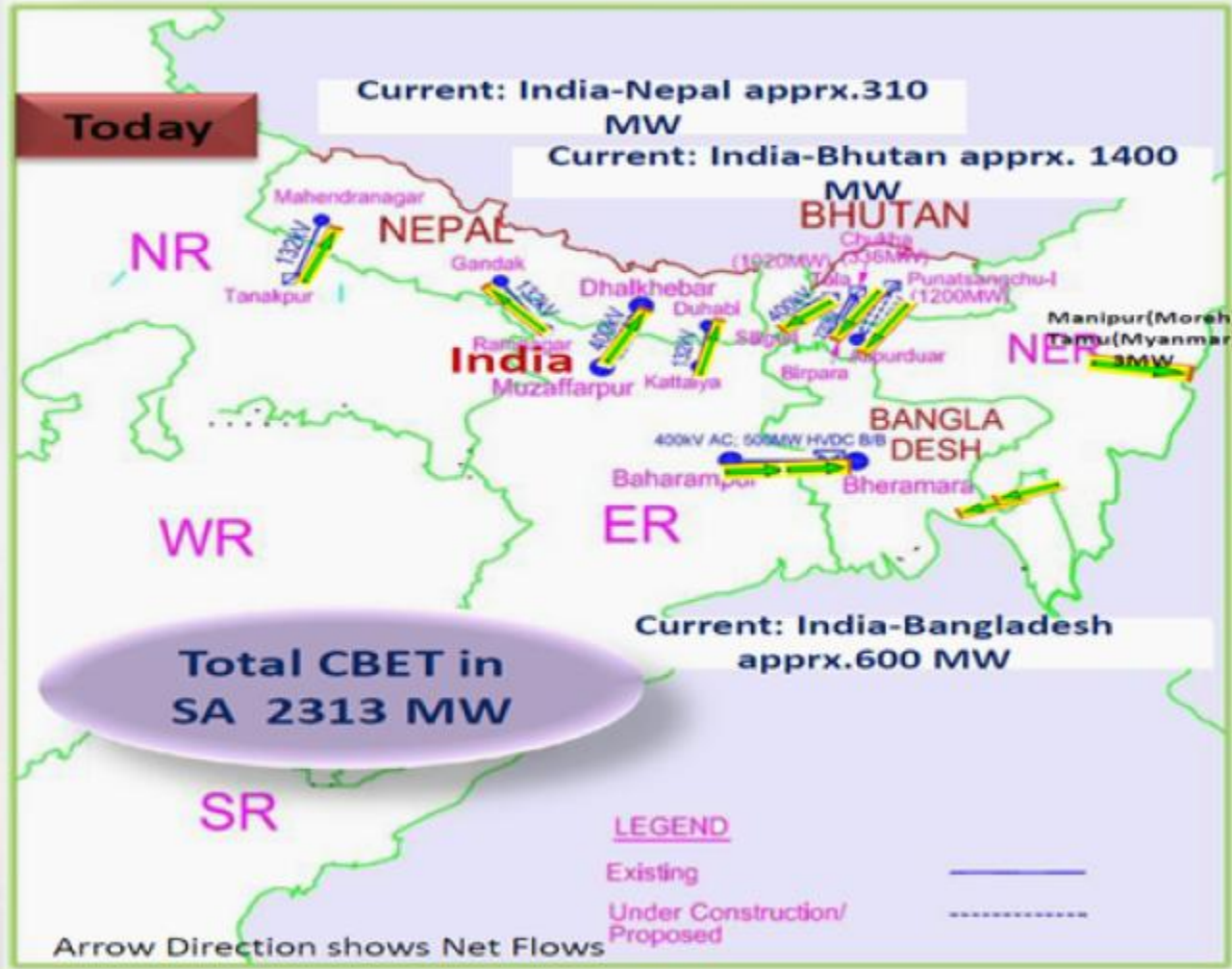
- ✓ Low per capita electricity consumptions.
- ✓ Maldives and Bhutan have high per capita electricity consumption among SA countries.
- ✓ Developed countries are at much higher level of consumption.
- ✓ Need to increase the level of consumption for a decent standard of living.

Key Drivers for CBET

- ✓ Energy and Peak Shortages.
- ✓ Low per Capita electricity consumptions
- ✓ Poor access to electricity.
- ✓ Resource Crunch (In Bangladesh)
- ✓ Optimal utilization of energy resources.
- ✓ Availability of Prices on Market Based.
- ✓ Enhancing Liquidity
- ✓ Economic benefits.



Current Status of CBET and Future Trading



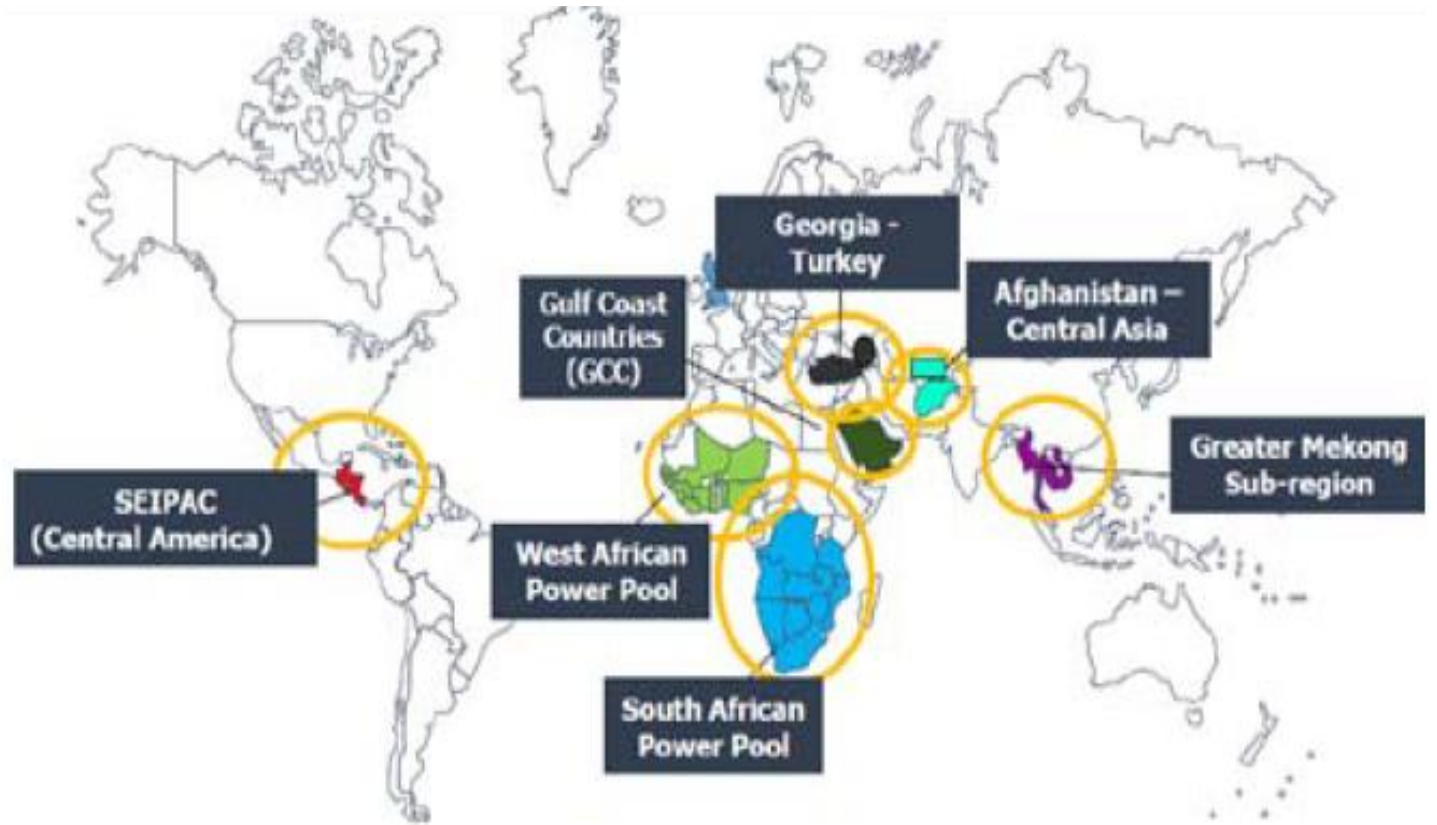
International Experience: Power Market Development



Cross-Border Electricity Trade in South Asia:
Key Policy, Regulatory Issues/Challenges and
the Way Forward

Background Paper

Workshop on the Sustainable
Development of Power Sector and
Enhancement of Electricity Trade
in the South Asian Region
January 15, 2016, New Delhi, India



International Experience: Aspiration behind the Regional integration



West African
Power Pool

14 member countries
Trade Volume : ~7 GWh

**Optimum
Utilization of
resources**



**Economic
benefits**

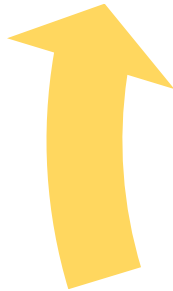
Greater Mekong
Subregion Power Trade
and Interconnection

6 member countries
Trade Volume :



12 member countries
Trade Volume :1 TWh +

**Availability of
power on market
based pricing**

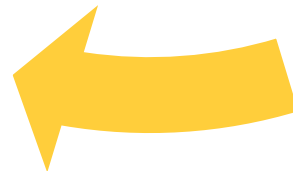


**Long term
security &
Enhancing
liquidity**



**N O R D
P O O L**

20 member countries
Trade Volume :489 TWh





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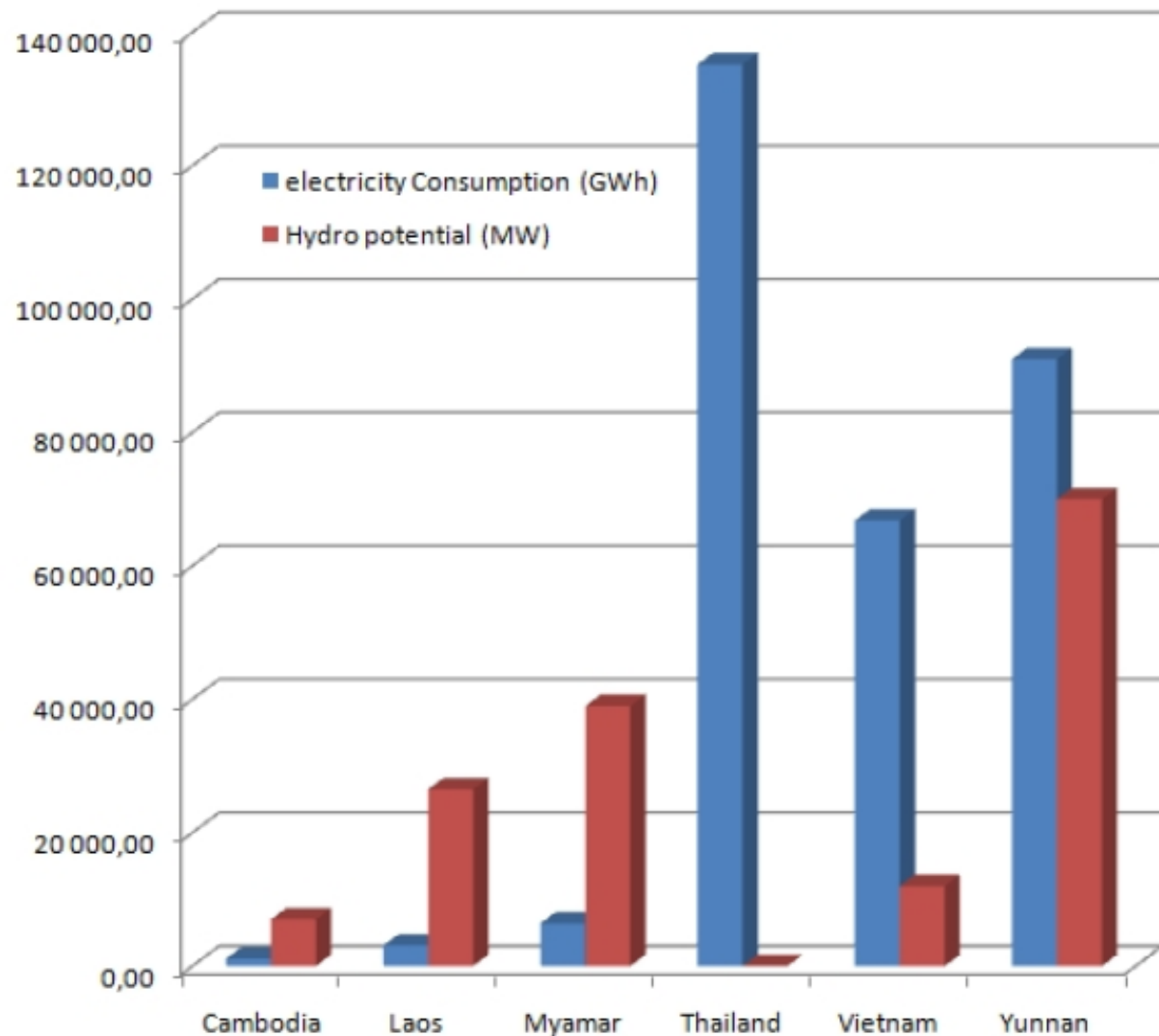
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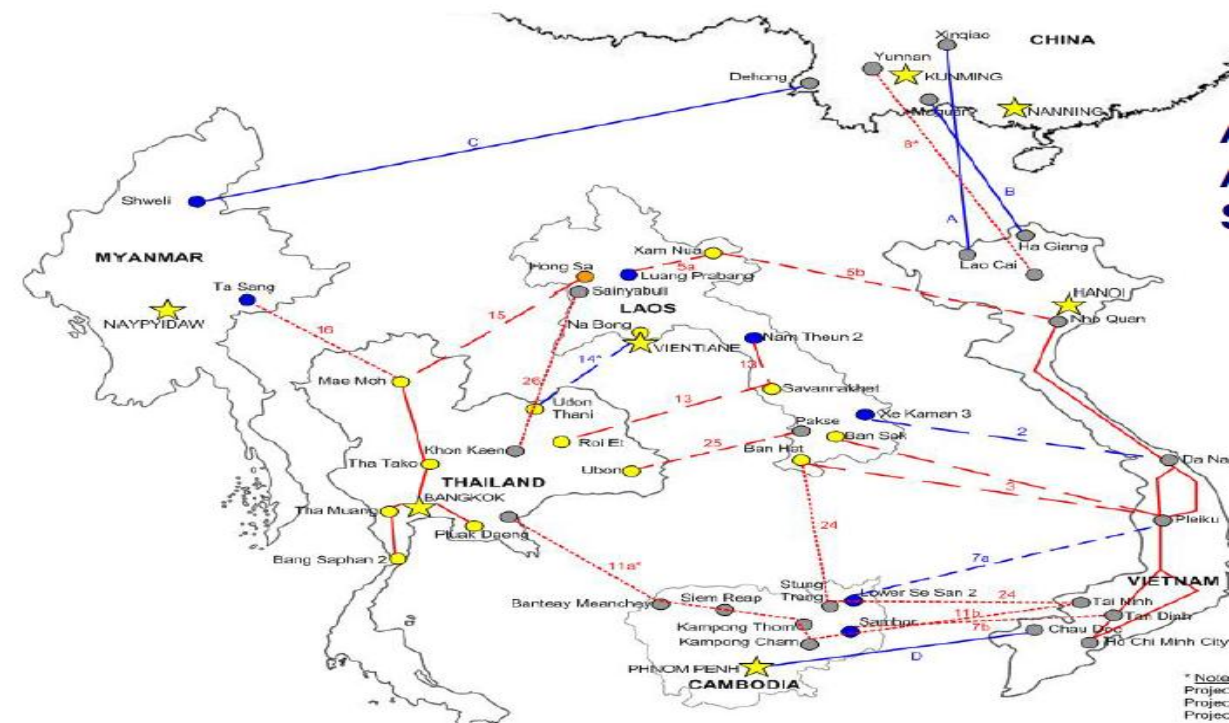
Greater Mekong Subregion

International Experience: Greater Mekong Subregion (GMS)

- Total Six countries: Cambodia, the People's Republic of China (PRC), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand and Vietnam
- Total Hydro Potential 229 GW , Coal is 28065 MT,
- The demand markets are in China, Thailand and Vietnam



Source: RETA No 6440 - GMS Master Plan Study 2008-2010





Greater Mekong Subregion : Key Milestone

April 1995: Electric Power Forum created

Jan 2000: GMS ministers endorsed policy statement on Regional Power Trade.

Nov, 2002: Inter Governmental Agreement signed to establish RPTCC

July, 2005: MoU on guidelines to implement Regional Power Trade & operating agreement (RPTOA)

March, 2008: MoU for Implementation of road map for GMS CBPT was signed



Greater Mekong Subregion (GMS) :Key Instruments

<p>Inter-Country MOU, Treaties, Agreements</p>	<p>The intergovernmental agreement signed in year 2000, provided a framework to implement the Policy Statement on Regional Energy Trade in the GMS.</p>
<p>MoU on the Overall Framework of Regional Trade</p>	<p>MoU on guidelines for the implementation of the Regional Power Trade Operating Agreement (RPTOA) helped to promote efficient development of power trade to aid economic growth.</p>
<p>PPA Terms and Open Access</p>	<p>Dominated by bilateral negotiated long term contracts Presently Bilateral and open access has been recognized through strategy documents .</p>
<p>Transmission Planning/Infrastructure</p>	<p>The Planning Working Group (PWG) was established to fulfil the functions of the operational and system planning working groups, identified in the draft RPTOA . Master Plan at the regional level.</p>
<p>Interconnection Mechanism</p>	<p>Single Synchronous AC Power Grid. All the countries follow same operating codes (regional grid codes) to ensure system stability.</p>
<p>Commercial Mechanism to Settle Imbalances</p>	<p>Settlement procedure for long term bilateral : governed by such agreements .</p>
<p>Sustainable Development of Energy Trade and Provision for Projects Committed to Trade</p>	<p>The 15th GMS Ministerial Meeting during 2009, adopted a roadmap for expanded cooperation in the energy sector of the GMS taking into account the need for improved energy security, better utilization of Resources in the region.</p>
<p>Dispute Resolution</p>	<p>The concession agreement and the PPA, Experts and International Arbitration.</p>



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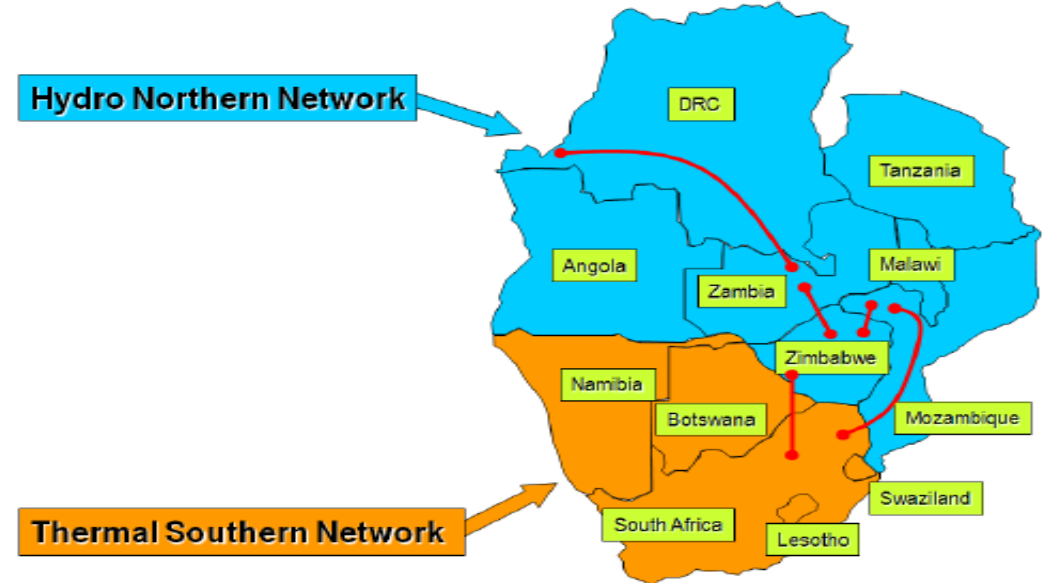
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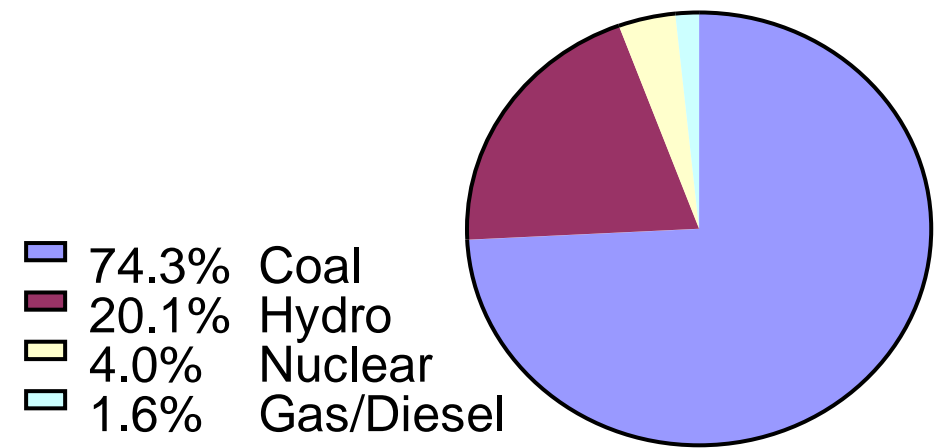
South Africa Power Pool

South African Power Pool (SAPP)- Snap Shot

Installed Capacity	58,608 MW
Available Capacity	52,589 MW
Operating Capacity	46,910 MW
Peak Demand	48,216 MW

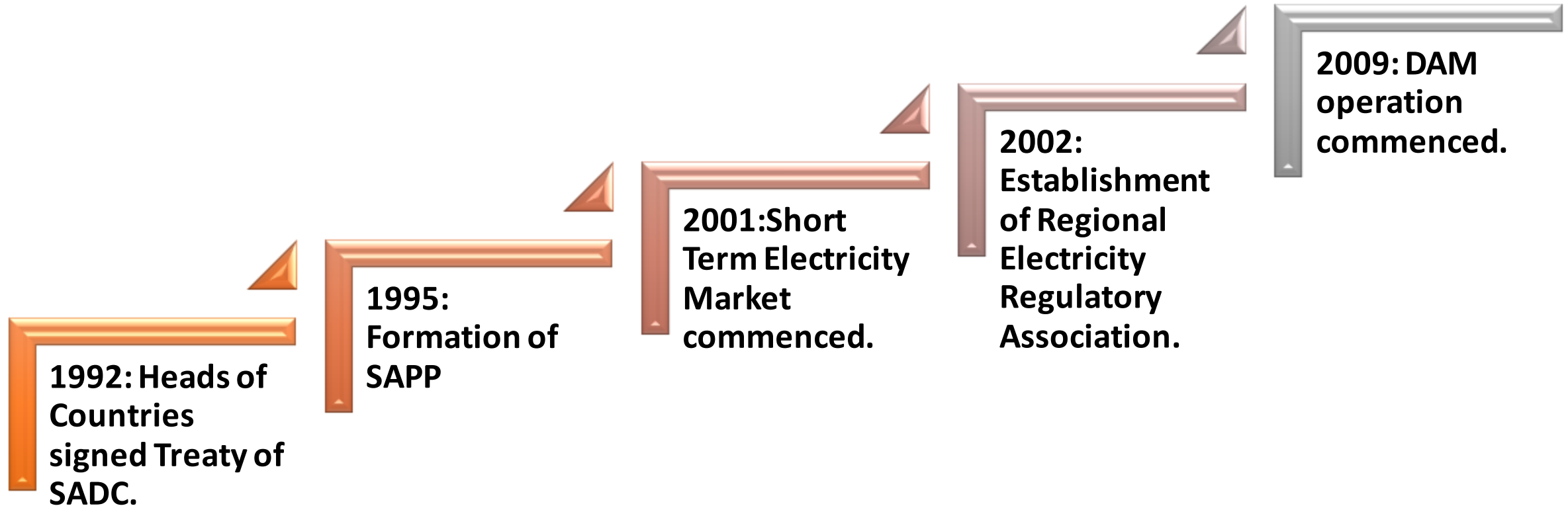


- ❑ 12 Countries :Angola, Botswana, Democratic Republic of Congo (DRC), Lesotho, Madagascar, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe.
- ❑ Trade Volume :1 TWh +
- ❑ Average Electricity growth rate 3% p.a.
 - ✓ For South Africa demand growth was 4.9% in 2007 and for whole region 4.6%.





South Africa Power Pool : Key Milestone



South African Power Pool (SAPP) : Key Instruments

Inter-Governmental MoU (IGMoU):	Signed in the year 1995 must be interpreted in a manner consistent with the SADC treaty. Initial focus on Trading of excess generation in the region based on On-going trans. Lines Projects.
Inter-Utility MoU	The MoU signed in Dec'1994 helped to establish an official cooperation for sharing the costs and benefits of energy generation. Revised in 2007. Power Pool operating Principal, organization structure etc.
PPA terms/Power Trade	Currently CBET dominated by Bilateral and Short term through Exchanges.
Transmission Planning	Generation & Transmission projects of regional importance are prioritized and majority of them are developed together with Private Sector. Mainly bilateral projects for Firm, economy and Emergency purchases.
Interconnection Mechanism	Single Synchronous AC Power Grid, Some far places are also connected through HVDC.
Open Access to Network	Yes. Obligation to wheel except where technical problems prohibit.
Commercial imbalance settlement mechanism	Settlement as per long term bilateral trade .Currently based on hourly average power system frequency at different blocks of pool generation cost. Settlement happens in cash.
Regulatory Coordination	Regional Electricity Regulators Association of Southern Africa (RERA) is a formal association of independent electricity regulators to promote cooperation, transparency , efficient and sustainable development of CBET .
Dispute Resolution	Dispute Resolution Tribunal. SAPP agreement must be interpreted in a manner consistent with the SADC treaty which is final and binding .



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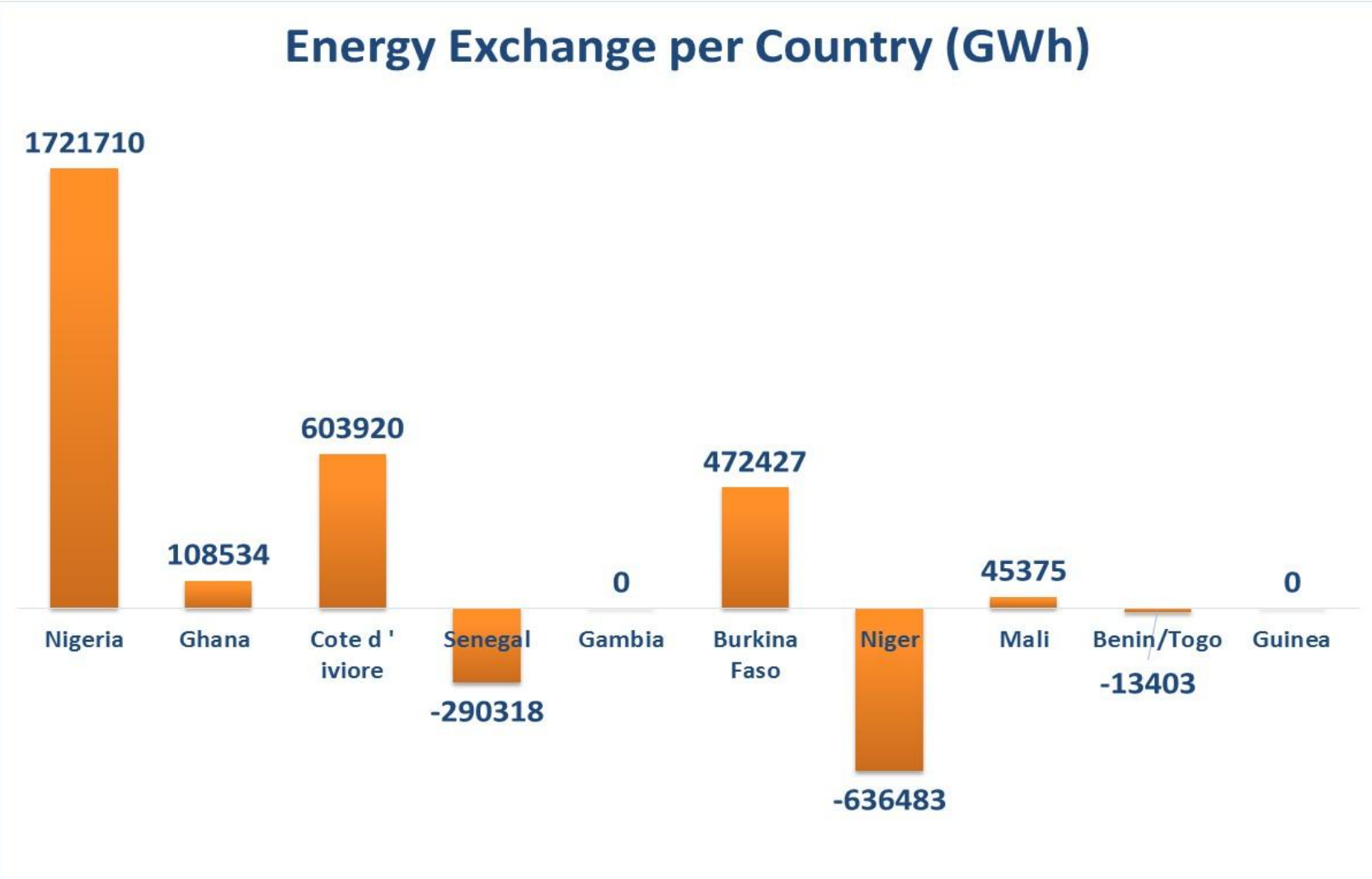
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West Africa Power Pool

West African Power Pool (WAPP)-Snap Shot

- **15 countries** :Benin, Togo, Nigeria, Niger, Mali, Cote d'Ivoire, Ghana, Gambia, Sierra Leone, Liberia, Senegal, Burkina Faso, and Guinea Bissau
- **22 Utilities**
- **Trade Volume : ~7 GWh**
- **10,000MW Total available gene. Capacity**



Source: WAPP Website



West African Power Pool : Key Milestone

1975: Treaty on Economic Community of West Africa States (ECOWAS)

2000: Intergovernmental MOU to create WAPP.

2006 :Utilities signed Article of Agreement, covering operating procedures, regulatory affairs, Dispute Resolution etc.

2008: Creation of ECOWAS Regional Electricity Regulatory Authority (ERERA).

West African Power Pool (WAPP) : Key Instruments

Inter-country MoU, Treaties, Agreements:	ECOWAS Ministers of Energy adopted an inter-governmental MoU on the establishment of WAPP in 2000. The MoU set forth the mutual obligations of the Parties and created an oversight, coordination, and administrative apparatus.
PPA Terms	Long term Bilateral/ Trilateral , since 1970. Many PPAs have been renegotiated or replaced with short term contracts
Interconnection	Single Synchronous AC Power Grid. All countries follow same frequency. Some far away places are also connected by HVDC.
Transmission Planning/Infrastructure:	ECOWAS Master Plan for the Generation and Transmission of Electrical Energy developed in 1999. Focuses on Hydro and Transmission Network .
Open Access to Network :	Yes. The Energy Protocol of ECOWAS has specific provisions related to nondiscriminatory conditions for trade in energy to ensure reliable cross-border energy transit flows.
Regulatory Coordination :	The ECOWAS Regional Electricity Regulatory Authority (ERERA) to ensure regulations and to give support to national regulators.
Dispute Resolution :	Mutual Settlement as per PPA. ERERA also empowered to settle disputes.



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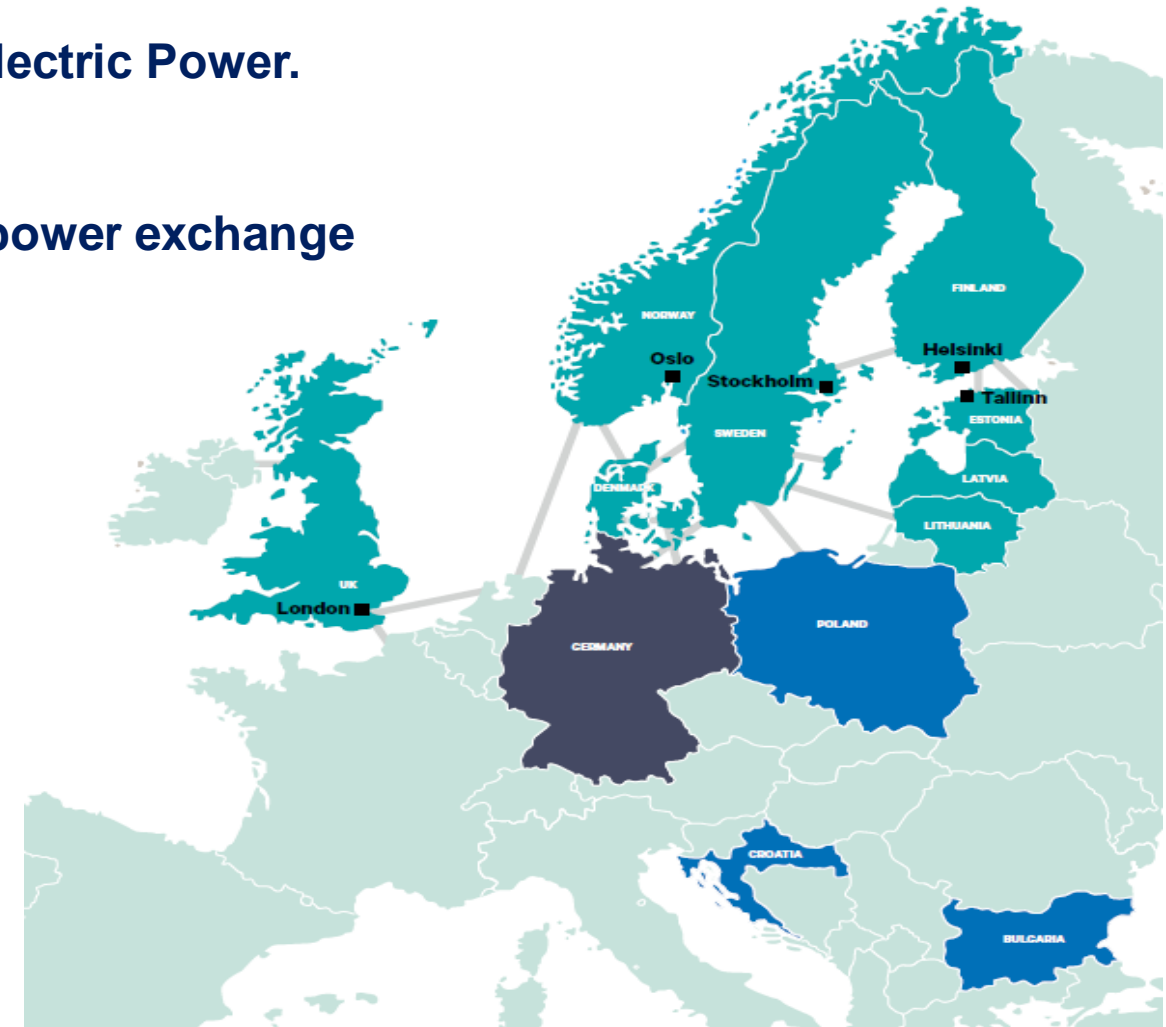
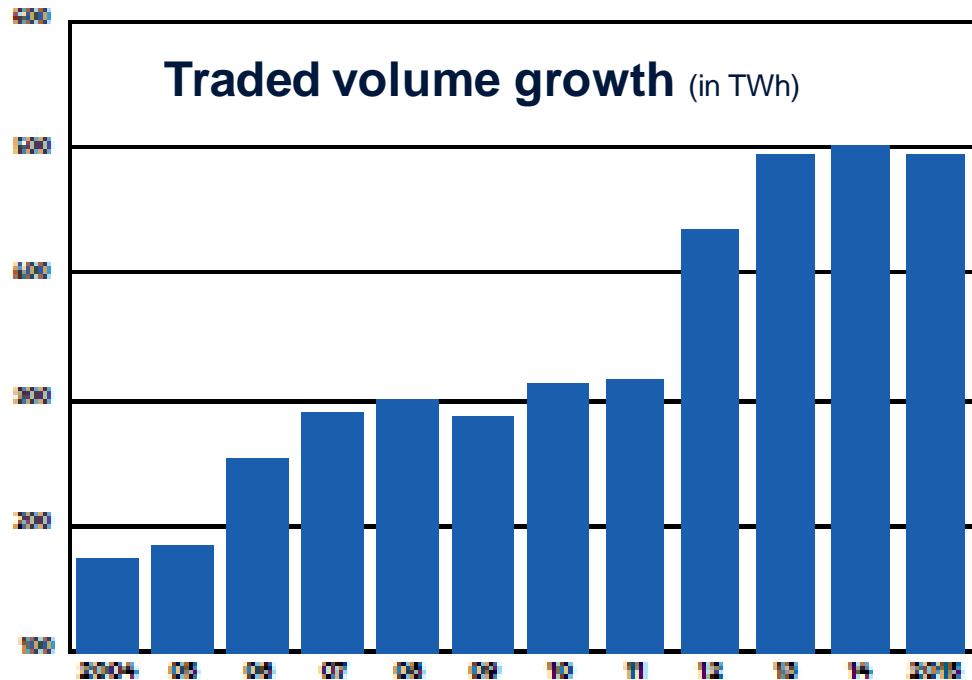
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Nord Pool

Nordic Pool

- World's First international commodity of exchange for Electric Power.
- Hydro Power covers half of Nordic region needs.
- Total Trade : 489TWh (2015)
- Close to 370 companies from 18 countries trade on the power exchange





Nord Pool : Key Milestone

1990: Power industry liberalization began

1996 : Nord Pool commenced its operation

1998: Nordic TSOs took over the leadership role

2000: NORDEL governance structure transformed – Legally binding agreement among TSOs



Nordic Pool : Key Instruments

Inter-country MOU, Treaties, Agreements	The inter-Nordic Transmission System Operation Agreement (TSOA) signed in the year 2000, defines framework on Security standards, Congestion management etc.
Power Trade/PPA Terms	Physical (spot market) and Financial (Price hedging & risk management)- for future forward options. Physical - Hourly bids, 5 blocks. Intraday – Continuous 24 x7 a week, 1 hour prior to delivery. All Contracts are standardized in confirmative with Nordic OTC and bilateral market rate.
Regulatory Coordination	Nord REG- Nordic Energy Regulator – to promote legal and institutional framework. With deeper energy integration across Europe, ACER was formed in 2009.
Transmission Planning/Infrastructure	Transmission planning is done by Planning Committee; objective is smooth functioning, efficient utilization, consistent with environmental system. Master Plan at regional level .
Mechanism of interconnection .	AC Inter-connection .HVDC link are also in place.
Open Access to Network	Yes. All networks were opened for third-party access.
Transmission Pricing/Wheeling Charges and Transit	The point of Connection Tariff is used. Distance between seller and buyer – no significance.
Commercial Mechanism to Settle Imbalances	Settlement procedure for long term bilateral agreement governed by conditions attached to such markets .Common imbalance settlement is therefore a prerequisite for a common end user market

International Experience: Key Learnings

- ✓ **Inter- Governmental Agreement/ Treaties**
- ✓ **Inter -Utility MOUs.**
- ✓ **Institutionalizing the Process of CBET such as Creating Forum/Association of Regulators, Forum/Association of Transmission utilities**
- ✓ **Regional Cooperation on Regulatory and Contractual Aspects**
- ✓ **Transmission Planning/infrastructure Development**
- ✓ **Coordinated Grid code and regional Interconnection and operating mechanism**
- ✓ **Third Party Access/Open Access**
- ✓ **Transmission Pricing**
- ✓ **Mechanism of Commercial Framework for Energy exchanges**
- ✓ **Settlement of Energy Imbalances and Grid Security**
- ✓ **PPA/Contract Terms**
- ✓ **Regional Funding/Investment Framework**
- ✓ **Dispute Resolution**



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Experiences and Leanings of South Asia Region



South Asia Region Experience : Key highlights

- ✓ **1985- South Asia Association of Regional Cooperation (SAARC) was created to promote economic growth, welfare of people, social progress and cultural development etc.**
- ✓ **SAARC comprises of eight member states.**
- ✓ **1987 : Secretariat of Association was set up in Kathmandu, Nepal.**
- ✓ **1989 :Process of Regional centers were created. SAARC energy Center was created at Islamabad, Pakistan in 2006.**
- ✓ **2014: Intergovernmental framework agreement (IGFA) on Energy Cooperation was signed between the member countries.**
- ✓ **SAARC has proposed to form Council of Energy Experts of Regulators to oversee various articles of IGFA. However Forum /Association/Agency for coordination of regulations yet to established.**

South Asia Region Experience : Key highlights

- ✓ **Currently Electricity Trade is between Eastern Region of the South Asia viz. between India-Nepal, India-Bhutan, India-Bangladesh.**
- ✓ **Current form of trade between South Asian countries is Bilateral- Long and Medium term. Multi-lateral and Trade of electricity on Exchanges is yet to commence.**
- ✓ **Transmission Planning : Jointly/Bilateral.**
- ✓ **Interconnection Mechanism: AC and HVDC both**
- ✓ **Open Access: Only in India in Transmission and Distribution**
- ✓ **Imbalance Settlement Mechanism: Only in India.**
- ✓ **Dispute Resolution – SAARC arbitration council OR Singapore arbitration.**

South Asia: Power Industry Structure Overview

Vertically Integrated

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

Partially unbundled

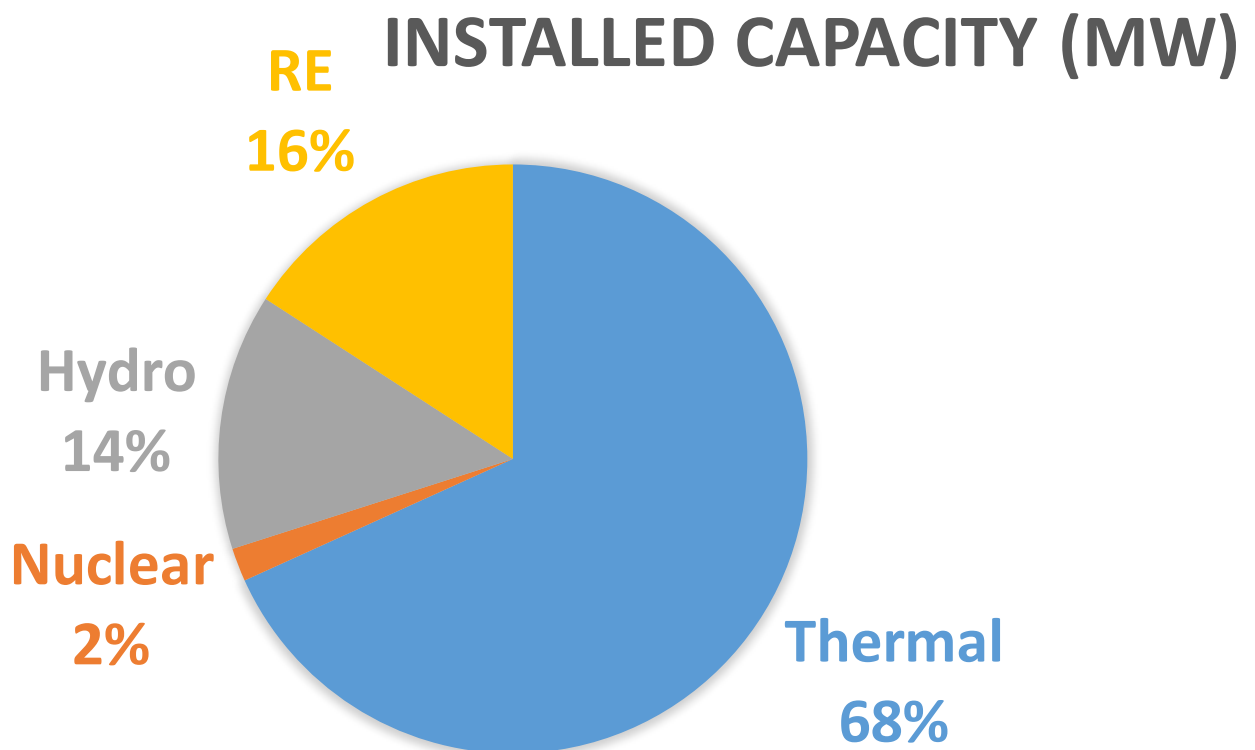
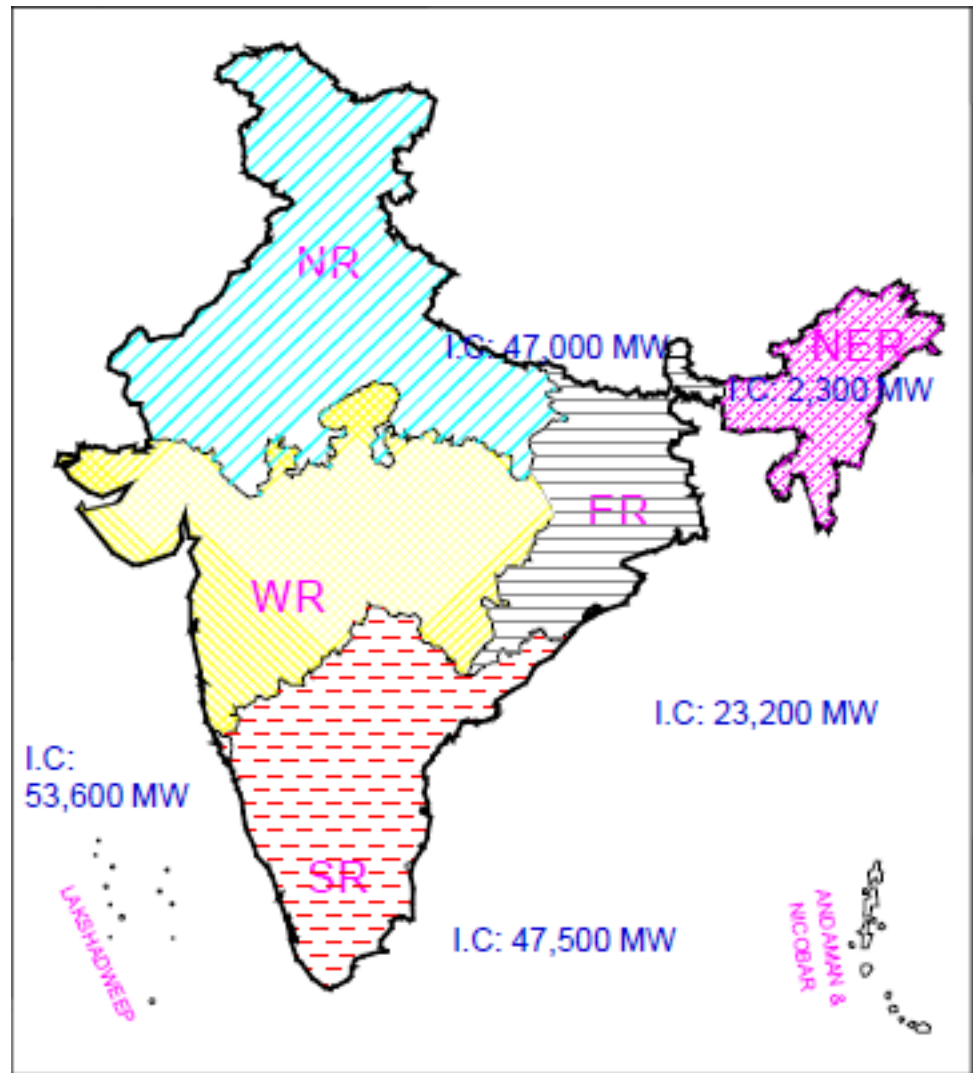
- Bangladesh (separate transmission utility)
- Bhutan (separate generation utility)

Unbundled

- India (separate G, T, D utilities)
- Pakistan (separate G, T, D utilities)

India Power sector Status

Total Installed Capacity	315426 MW
Thermal	215214 MW
Renewable energy	50018 MW
Nuclear	5780 MW
Hydro	44413 MW



Electricity Industry Structure in India

	CENTRE	STATE
Policy	Ministry of Power	State Government
Plan	CEA	State Government
Regulations	CERC CAC	SERC SAC
Generation	CGS, Mega Power Plants , UMPPs	Gencos IPPs
Transmission	CTU PTU	STU PTU
Systems Oprn	NLDC, Regional LDCs (N,E,S,W, NER)	State LDC
Billing Settlement	Regional P Cs	S P Cs
Distribution		SEBs, DISCOMs
Trading	Trading Licensees	Trading Licensees
Market	Trading Platform - PXs, Bilateral, OTC etc	
Appeal	Appellate Tribunal	



Indian Power Market Development : Key Lessons

Issue	Lesson Learnt
Private Sector Participation	Rapid Capacity Addition-Prior to 2003 - 3 % ,presently - 40%
Unbundling	Generation delicensed ,Trading distinct activity, Independent TSO's
Transmission and Losses	Improved Efficiency – Losses Reduced.
Competitive Bidding	Efficient and Competitive Tariffs
Open Access	In Transmission and distribution
Trading / Merchant Operations	Trading still at 3% – 5% of the Total Market
Distribution Reforms	In some selected cities ,Privatization happened which led to significant reduction in T& D losses and efficiency was improved
Grid Discipline	Entire country is having an uniform Frequency. Deviation settlement mechanism has disciplined
Spot market Platform	Two Power exchanges come up – Day Ahead Market ,Term Ahead Market.

SARI/EI Task Force Approach for Energy Integration for CBET: Key leanings for South Asia

Key leanings

1. Political Conesus : Regional Cooperation and Recognition of CBET/Trade in the National Policy, Law

2. Government Commitment & Policy Coordination

3. Financial Challenges, Investment , Financial Viability

4. Mechanism of Inter-connection

5. Market form of Trade

6. Regional Cooperation on Regulatory and Contractual Aspects

7. Open Access in Transmission

8. Transmission Charges/Pricing

9. Transmission Plan

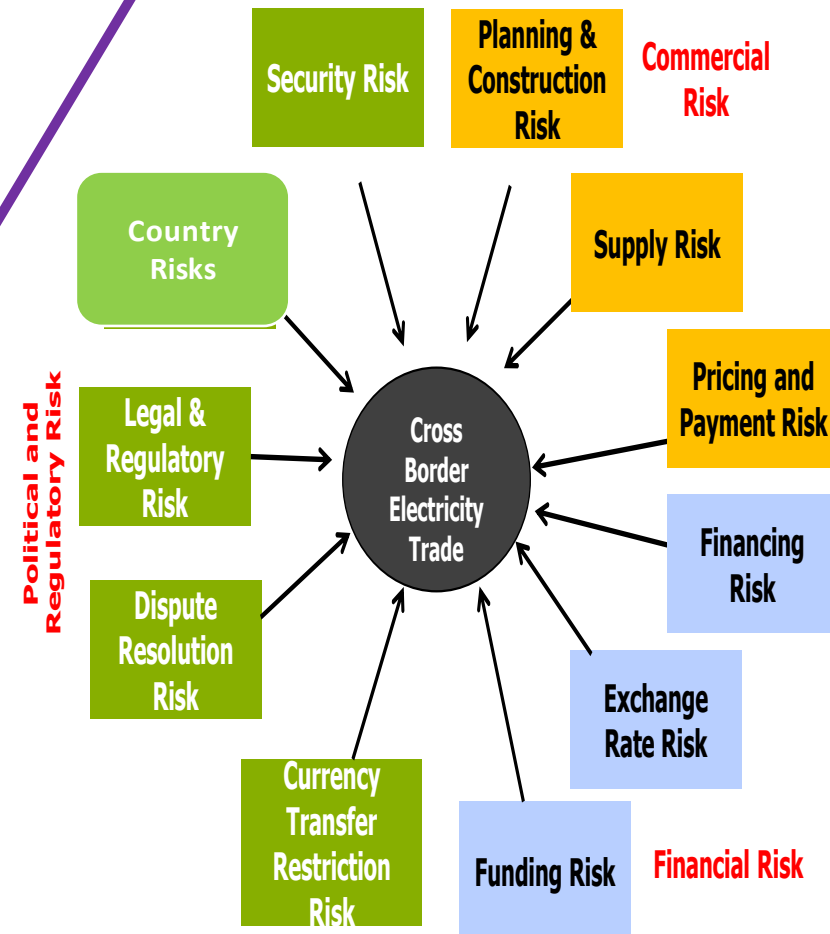
10. Commercial Mechanisms to Settle Imbalances

11. Dispute Resolution

Regional Power System/ at Initial Stages

Regional Power System at in Transition and Mature Stages

Motivation behind these challenge is to address the typical Risks in Cross-Border Projects. What are the Risk?



Key Impacts Milestone Achieved in South-Asian Region CBET since 2012-13

2012-13	2013-14	2014-15	2015-16	2016-17
India-Bangladesh 500 MW HVDC link commissioned	India- Nepal Power Trade Agreement Signed	SAARC framework agreement on energy (electricity) co-operation signed	Tripura (India)-Comilla (Bangladesh) 400KV transmission interconnection commissioned & 100 MW power is being exported to Bangladesh	GOI issued guidelines for CBET, Created SAARC Council of Experts of Energy Regulators. Trade CBET Increased by 800 MW since 2012.

Major Publications



The collage features several key documents:

- REGIONAL REGULATORY GUIDELINES FOR PROMOTING CROSS-BORDER ELECTRICITY TRADE IN SOUTH ASIA** (Task Force-1 Report)
- Suggested Changes/Amendments** in Electricity Laws, Regulations and Policies of South Asian Countries for Promoting Cross-Border Electricity Trade in the South Asian Region (TF-1 Report)
- Cross-Border Electricity Trade in South Asia: Challenges and Investment Opportunities** (South Asia Investor's Workshop 'Cross-Border Electricity Trade' 24th-25th SEPTEMBER 2014, NEW DELHI, INDIA)
- Cross-Border Electricity Trade in South Asia: Key Policy, Regulatory Issues/Challenges and the Way Forward** (Background Paper)
- Workshop on the Sustainable Development of Power Sector and in the South Asian Region** (January 15-17, 2014)
- STUDY TOUR TO EUROPEAN REGIONAL POWER MARKET AMSTERDAM & PARIS 13th to 19th July, 2014**
- Prospects for Regional Cooperation on Cross-Border Electricity Trade in South Asia** (February 2013)
- South Asia Regional Initiative for Energy Integration (SARI/EI) SUMMARY of South Asia Regional CROSS BORDER ENERGY TRADE Issues before Regulators in the South Asia Region** (February 2013)
- Conference Proceedings South Asia Regional Inaugural Conference Cross-Border Electricity Trade** (October 4-5, 2012, New Delhi, India)
- ExpertSpeak: Need to institutionalize cross border electricity trade in South Asia** (April 2014)
- Figure 1. Electricity Import by India from Neighboring Countries** (Bar chart showing data from 2002 to 2014)

Way Forward

Implementation of Intergovernmental Framework Regional/bilateral Agreement/Treaties.

*Institutionalizing the Process of CBET such as Creating Forum/Association of Regulators(SAFER) ,
Forum/Association of Transmission utilities (SAFTU)*

Alignment of Regulations ,Technical Standards, Grid Codes ,Operating Procedures

Regional investor friendly framework.

Multilateral Power Trading and Power exchange, imbalance settlement mechanism

Financial Viability of power sector needs to be improved to sustain CBET in long run

Regional level Generation and Transmission Planning

Transparent Regional Dispute Settlement mechanism .



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Country	Policy	Regulation	Generation	Transmission	System Operation	Distribution	Trading
Afghanistan	Ministry of Energy and Water (MEW)	Afghanistan Electricity Regulatory Authority (AERA) (Proposed)	DABS	DABS	DABS	DABS	DABS
Bangladesh	Ministry of Power, Energy and Mineral Resources (MPEMR)	Bangladesh Energy Regulatory Commission (BERC)	BPDB, EGCB, APSCL, NWPGC, IPPs, SIPPs, Rental Plants	PGCB	PGCB	BPDB, WZDPC, APSCL, DPDC, DESCO, REB	BPDB
Bhutan	Ministry of Economic Affairs (MEA)	Bhutan Electricity Authority (BEA)	Druk Green Power Corporation (DGPC)	Bhutan Power Corporation (BPC)	BPC (NLDC)	BPC	-
India	Central: Ministry of Power under the Government of India)	Central: CERC	Central: NTPC, NHPC, NPCIL, UMPPs, IPPs, MPPs	Central: POWERGRID (CTU), Private/JV Licensees	Central: POSOCO (NLDC & 5 RLDCs)	Central: Nil	Central: Inter-state Licensees
	State: Power/Energy Department under the State Government	State: SERCs/ JERCs	State: State-owned GenCos, IPPs, CPPs	State: STUs, Private/JV Licensees	State: SLDCs	State: State-owned Discoms, Private Licensees, Distribution Franchisees	State: Discoms / TradeCos (Include State Holding Cos) / Intra-state Licensees
Maldives	Ministry of Environment and Energy (MOEE)	Maldives Energy Authority (MEA)	STELCO, FENAKA	STELCO, FENAKA	STELCO, FENAKA	STELCO, FENAKA	-
Nepal	Ministry of Energy (MoE)	Electricity Tariff Fixation Commission (ETFC) under Department of Electricity Development (DOED)	Nepal Electricity Authority (NEA), IPPs	NEA	NEA	NEA	NEA
Pakistan	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	KESC & Distribution Companies formed after restructuring of WAPDA (total 10 in nos.)	-
Sri Lanka	Ministry of Power and Energy (MOPE)	Public Utilities Commission of Sri Lanka	Ceylon Electricity Board (CEB), IPPs	CEB Transmission Licensees	CEB Transmission Licensees	CEB Distribution Licensees 1-4	-