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**Brief Report
On
SARI/EI Delegation to the “SAARC Training Workshop on “System Operation and
Settlement Mechanism, Cross Border Trade/Regional Power Market in South
Asia”**



**10th -11th December, 2017
The Bengal Blueberry**

Dhaka, Bangladesh





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Based on the Invitation received from SAARC Energy Centre, Mr Rajiv Ratna Panda, PC, SARI/EI/IRADe and Mr. Gaurav Jain, SRA, SARI/EI/IRADe participated as a resource person in the SAARC Training Workshop on “System Operation and Settlement Mechanism, Cross Border Trade/Regional Power Market in South Asia” held on 10-11 December, 2017 at The Bengal Blueberry, Dhaka, Bangladesh. Mr Rajiv delivered a detailed training lecture/presentation (Annexure-I) on “Experiences and Learnings from Competitive Power Market (Power Trading & Exchange) Development in South Asia: Approach for developing Competitive Regional Power Market in South Asia”. In his presentation, he covered a) details about South Asia power sector b) Power Market Structure in South Asian Countries (SACs) c) Power Sector Evolution and Market Development in India d) Indian Power Market e) Power Exchange Evolution in India- Key features f) Regulation of Power Exchange in India g) Key Lessons: Power Market and Exchange Development in India h) System Operation and Settlement in India i) Open access and Trading License j) Approach for South Asia Regional Power Market and the k) Way forward.



He said that for creation of Regional Power Market, the SAARC Countries need to have a) Political consensus at Regional Level is essential for Regional Power Market and Power Exchange Formation-Consensus on the Policy, legal, regulatory, technical and commercial aspects b) Coordinated Harmonization of Legal, Regulatory and Policy Framework from the perspective of CBET only to be put in place c) Power Trading to be identified as distinct activity d) Robust Transmission System Regional Scheduling & dispatch mechanism, imbalance settlement Mechanism e) Congestion Management, regional transmission pricing f) Open access in Transmission, Transmission pricing, Treatment of Losses g) Assessment of Transfer Capability and f) Approach & strategy for South Asia Regional Power Market. All of above are required to be put in place through appropriate legislative and Regulatory Instruments. He also said that Regulatory coordination, Coordinated system planning, an efficient Independent system operator is critical for regional power market functioning.



Mr. Gaurav Jain has presented the detailed presentation (Annexure-II) on “South Asian Regional Power Market Development & Learning from International Power Exchange/Pool”. In his presentation he covered existing system operation and commercial arrangement in Cross-Border Electricity Trade. He has provided the detailed illustration of scheduling and dispatch, deviation settlement in cross-border electricity trade. He also touched upon the suggestions on settlement mechanism and system operation standard process for CBET.



The global best practices for regional power exchange creation including Nord-pool, EPEX, OMEL, APX, integrated Europe through price coupling and SAPP discussed in depth. The power exchange operation has been started in case of power surplus for revenue generation as it was applicable in case of Nord Pool and deficit as it has started in SAPP for optimal utilization of resources.

He dwelled upon the need of having regional power trade through exchange platform as it is providing an opportunity which no other market product is providing. Hourly and monthly regional complementarities is providing a best-suited case for having a day-ahead market in South Asian region. He has showcased the optimal management of daily Demand-Supply position in an illustration and benefits of a Day Ahead Market in South Asian region.



The implementation of a regional exchange market has been delayed on account of multiple factors and these apprehensions discussed in detail. SARI/EI has initiated a mock exercise (South Asian Regional Power Exchange) for removing the apprehension and provide the clarity to South Asian countries. Core activity of SARPEX- Mock Exercise along with the status mentioned during the presentation. This mock exercise will provide the clarity of feasibility and desirability of regional trade through Power Exchange platform.



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Annexure-I Experiences and Learnings from Competitive Power Market (Power Trading & Exchange) Development in South Asia: Approach for developing Competitive Regional Power Market in South Asia

Rajiv Ratna Panda
SARI/EI/IRADe

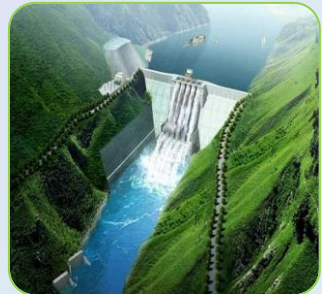
SAARC Training Workshop on
“System Operation and Settlement Mechanism, Cross Border Trade/Regional Power Market in South Asia”
10-11 December, 2017

The Bengal Blueberry, Dhaka, Bangladesh



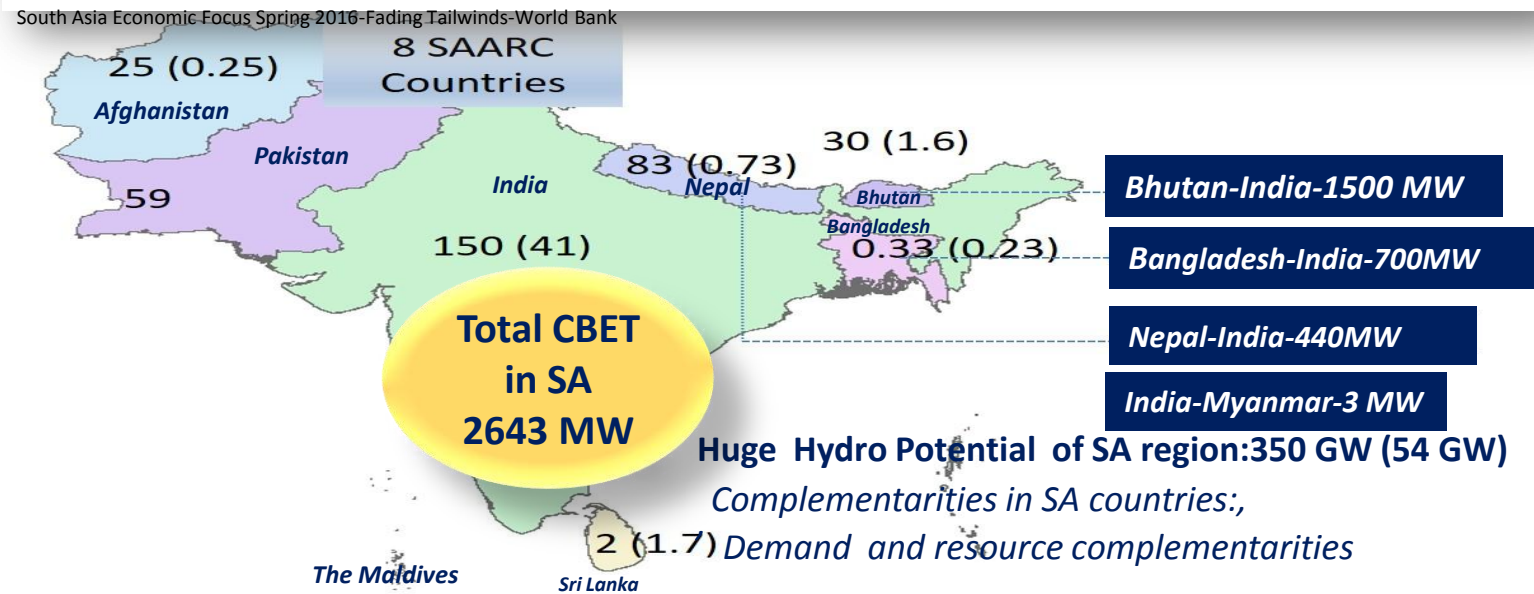
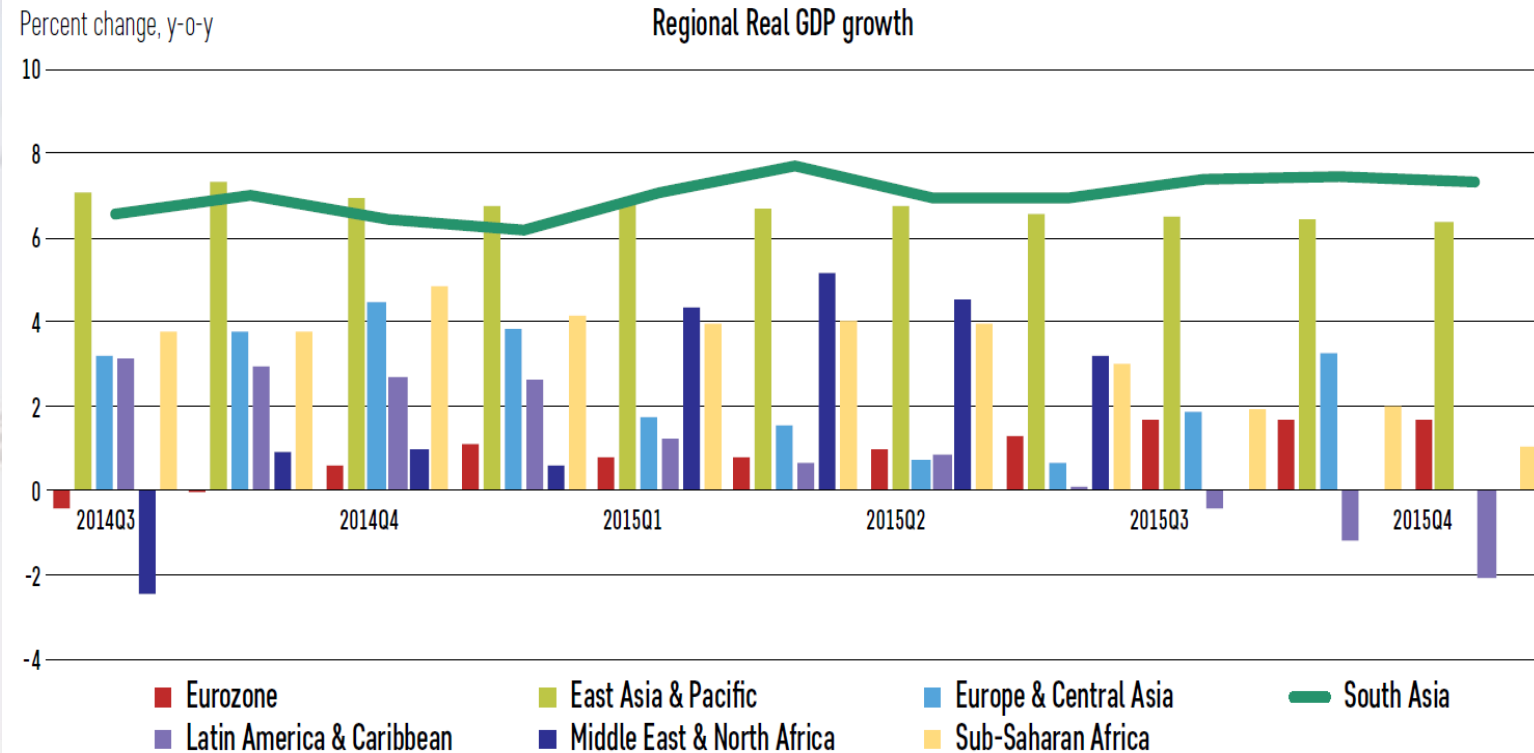
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- South Asia: A Snapshot.*
- Power Market Structure in South Asian Countries (SACs).*
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- Indian Power Market.*
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- Regulation of Power Exchange in India.*
- Key Lessons: Power Market and Exchange Development in India.*
- System Operation and Settlement in India.*
- Open access and Trading License*
- Approach for South Asia Regional Power Market.*
- Way forward*

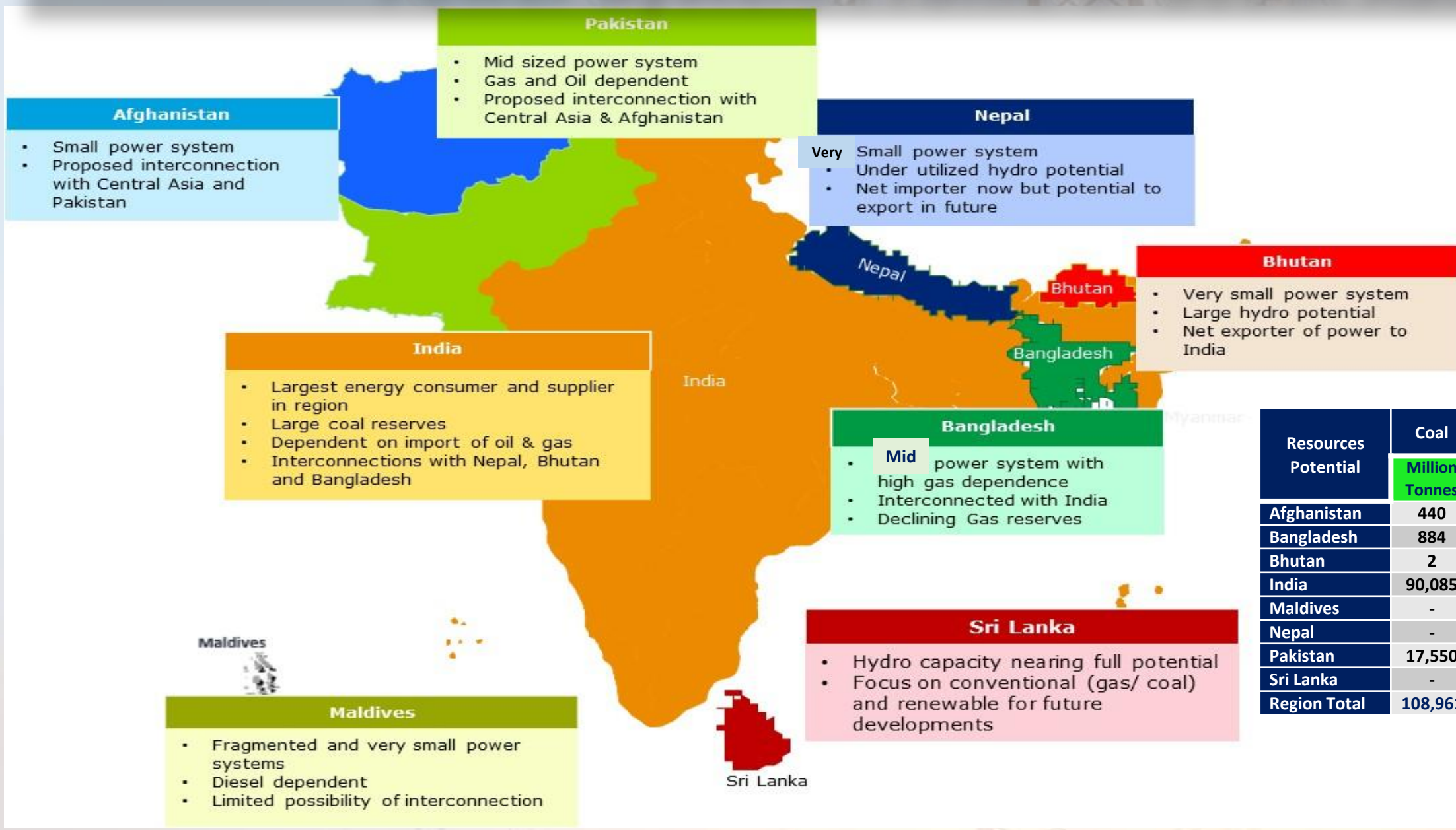


South Asia: A Snapshot

- **South Asia Remains World's Fastest Growing Region.** Economic Growth (EG) expected to accelerate to 7.3 % in 2017 from 7.1 % 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 382GW; (India 330 GW) Required installed capacity by 2040 is *1067 GW
- Cross Border Electricity Trade (CBET) : India, Bhutan - net exporter & Bangladesh, Nepal - net importer of electricity
- Per capita energy consumption (517 KWh/Capita) is one of the lowest in the world (World average 2803 KWh/Capita)
- Huge untapped hydro potential



Power System Profile of South Asia

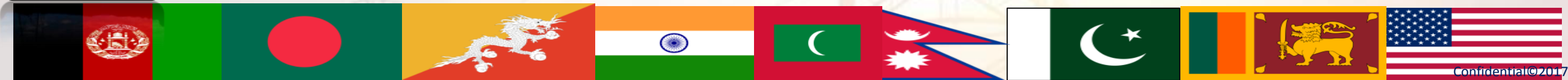


Country	Installed Capacity (MW)
Afghanistan	1341
Bhutan	1614
Bangladesh	15821
India	330860
Nepal	765
Sri Lanka	4050
Pakistan	27995
Maldives	90
Total	382536

Resources Potential	Coal Million Tonnes	Oil Million Barrels	Natural Gas TCF	Biomass Million Tonnes	Hydropower Gigawatts
Afghanistan	440	-	15	18-27	25
Bangladesh	884	12	8	0.08	0.33
Bhutan	2	-	-	26.60	30.00
India	90,085	5,700	39	139.00	150.00
Maldives	-	-	-	-	-
Nepal	-	-	-	27.04	83.00
Pakistan	17,550	324	33	-	59
Sri Lanka	-	150	-	12	2
Region Total	108,961	5,906	95	223	349.33

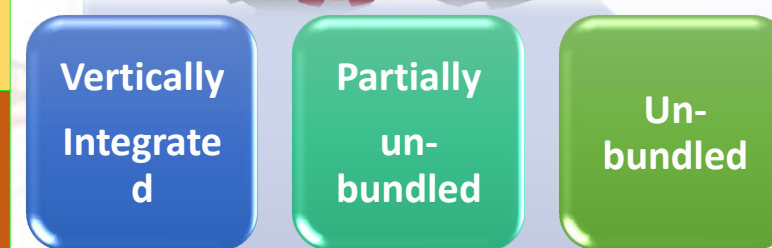


Power Market Structure in South Asian Countries (SACs)



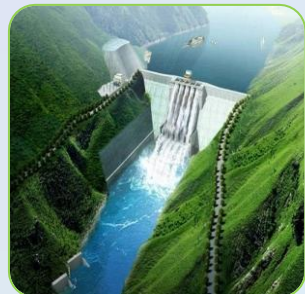
Power Market Structure in South Asian Countries

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 333 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 0.8 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



Indian Power Sector



Power Sector in India – Profile Snapshot

● Installed capacity in India- 331 GW (Dec 2017), 3rd largest producer* & 4th largest consumer of electricity in the world

● Installed Capacity profile (Oct-2017):

● Coal: 58% , Gas: 8.0%, Diesel: 0.3%

● Nuclear: 2% Hydro: 14 % , RE: 18%

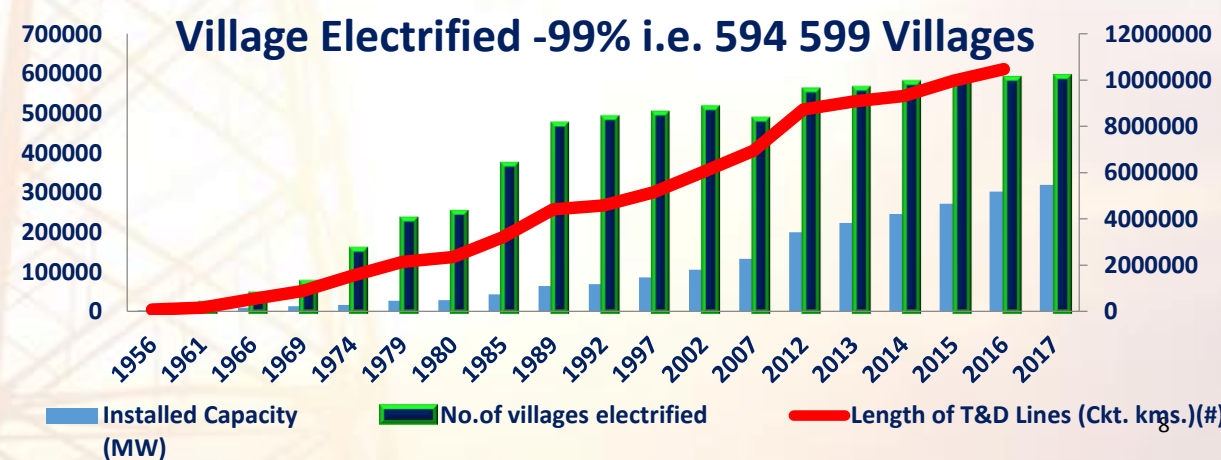
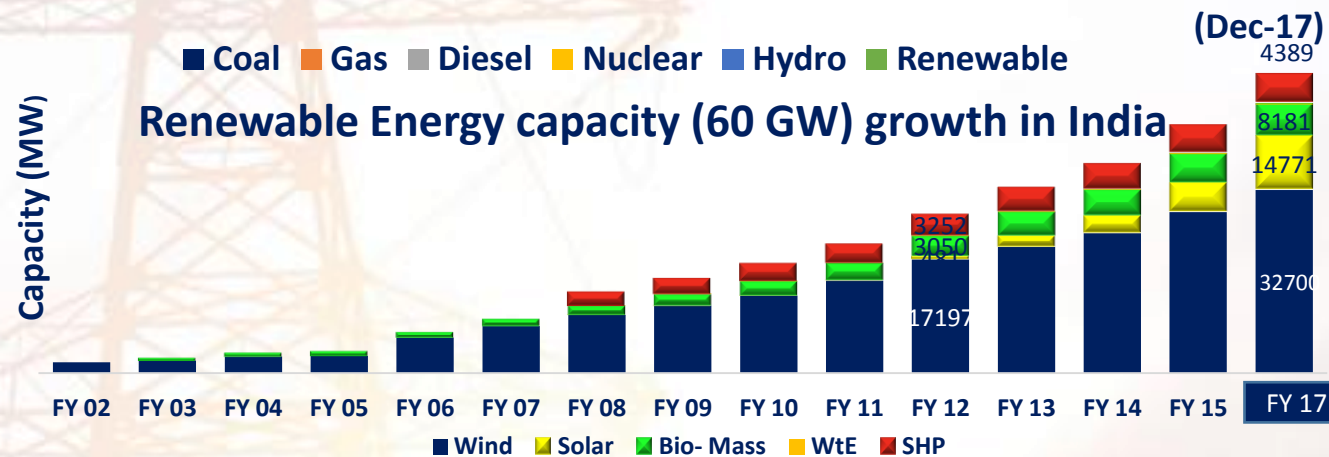
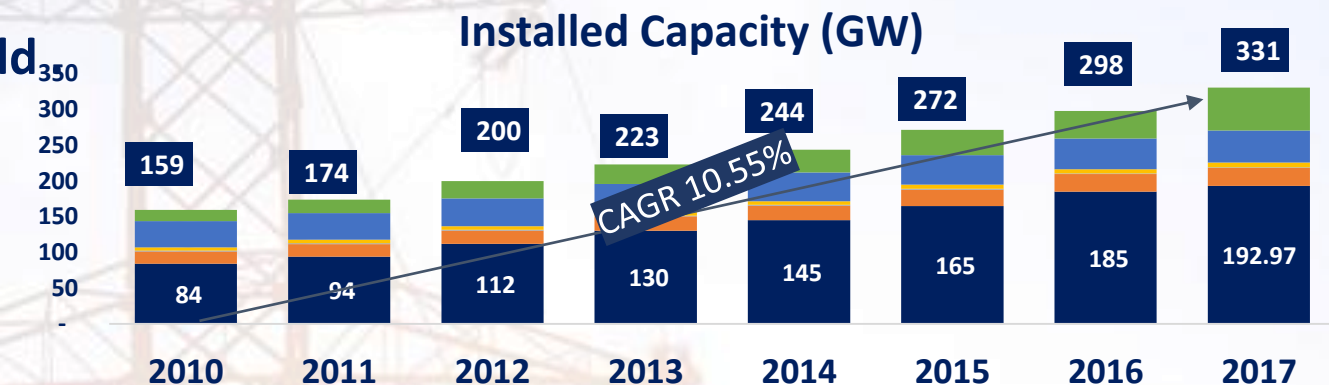
● The Per capita energy consumption- 1074 kWh (2015-16) still less than half of the world average

● The share of Renewable Energy (RE) in India's generation capacity portfolio has progressively increased reaching 60 GW as on Dec, 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 RE in the country is estimated to be about 1095 GW (as on March 2016)

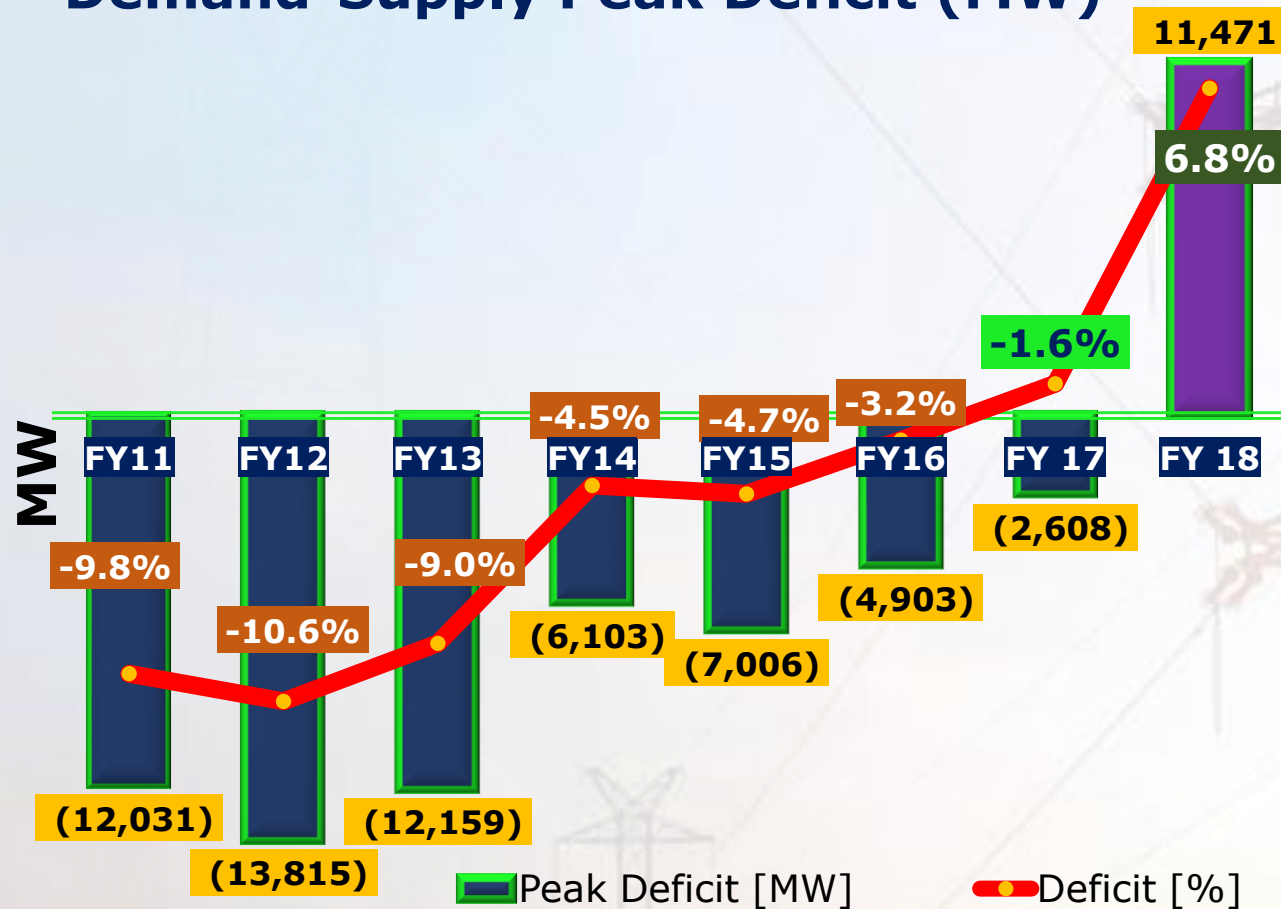


India: Demand-Supply Scenario

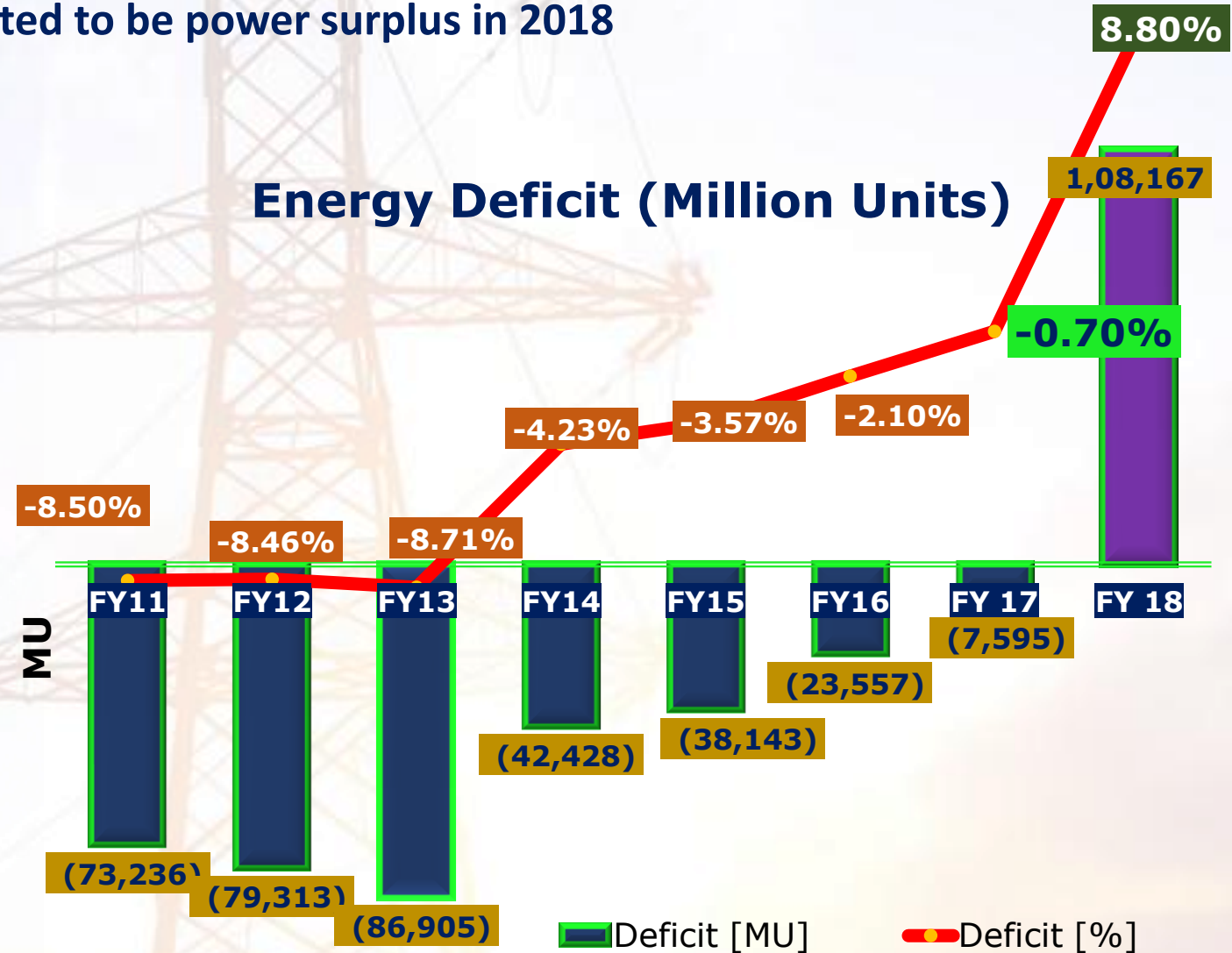
The demand-supply deficit has progressively reduced over the last five years.

For the First time India is expected to be power surplus in 2018

Demand-Supply Peak Deficit (MW)

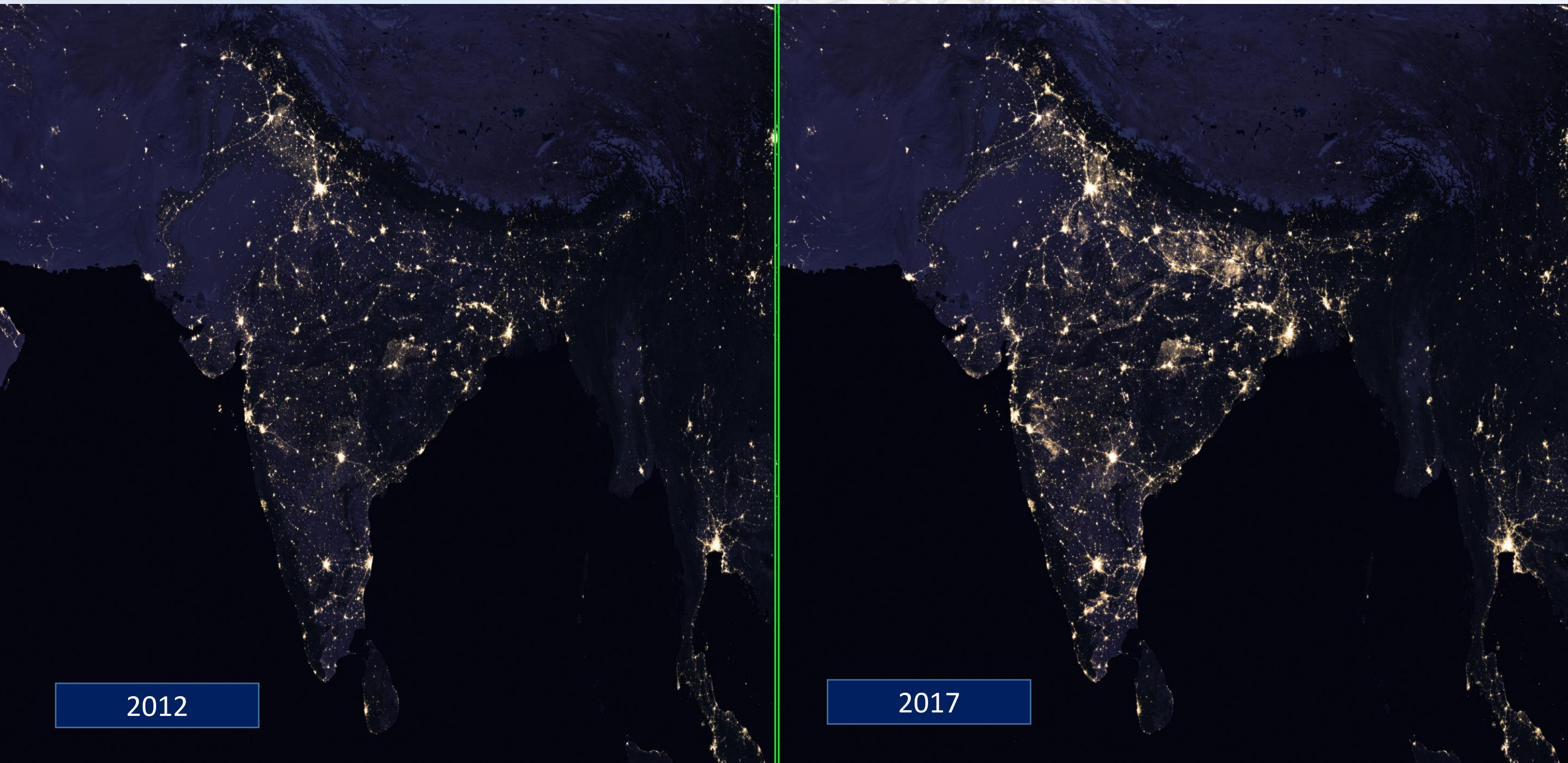


Energy Deficit (Million Units)



Country Recorded the lowest ever demand-supply gap (2017) both in terms of energy (-0.70 %) and peaking (-1.6%)

India Power Sector Growth Impact

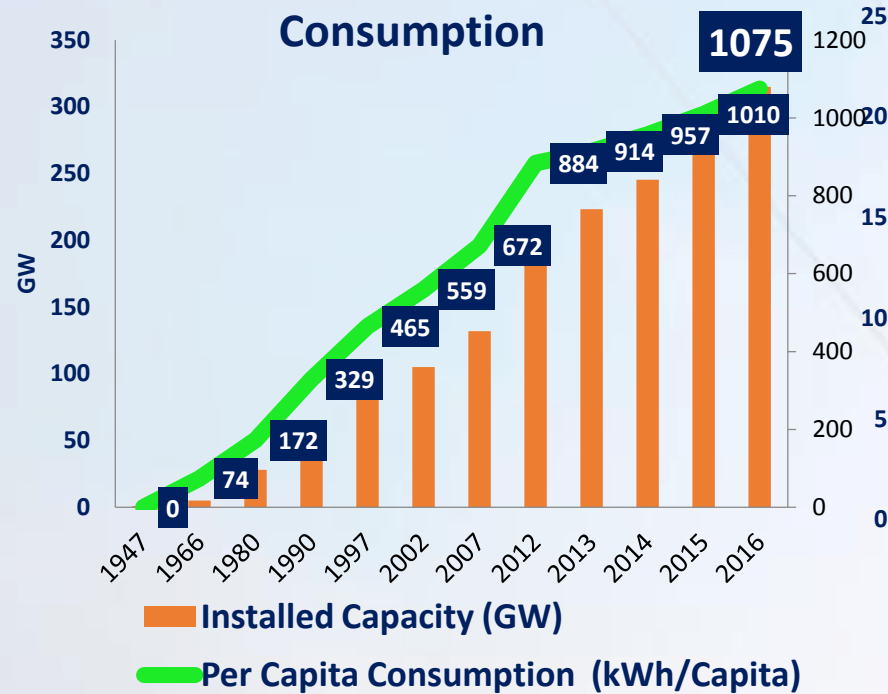


2012

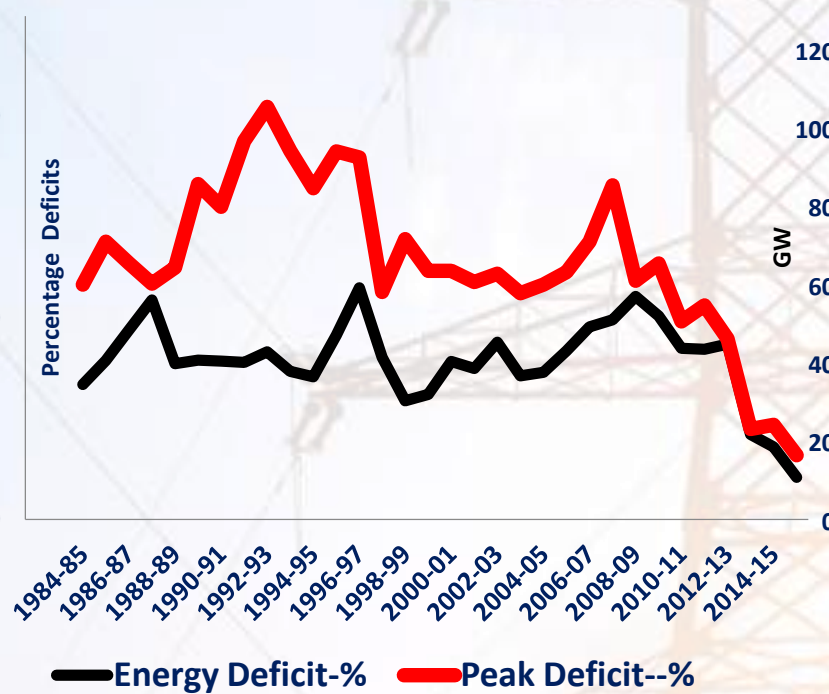
2017

Decades back, story was very different

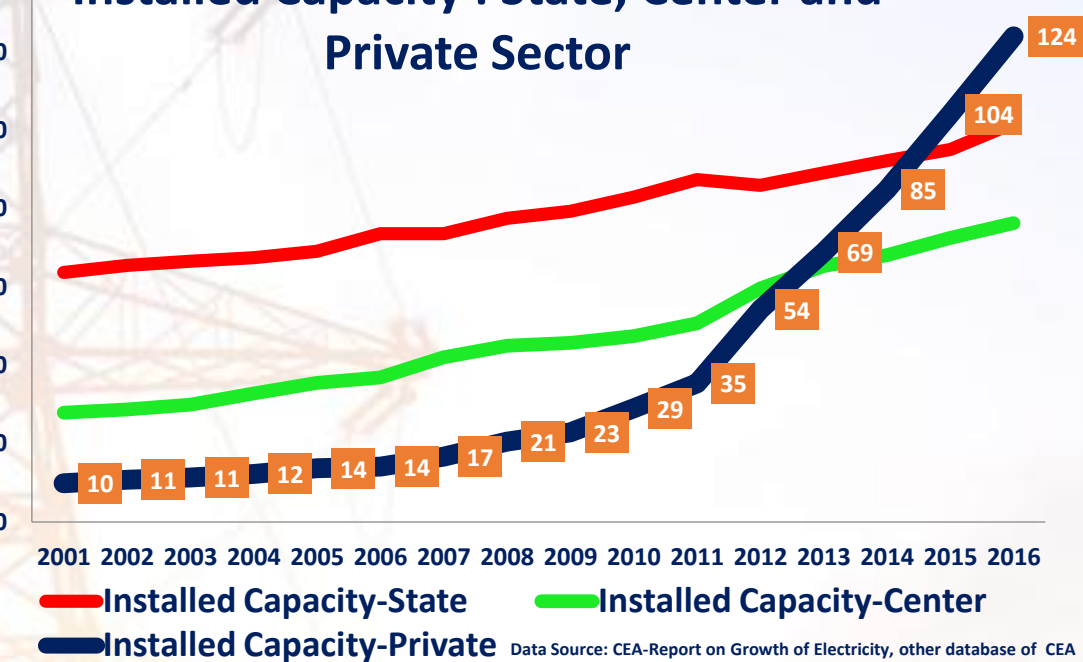
Installed Capacity and Per Capita Consumption



Energy and Peak Deficits -India



Installed Capacity : State, Center and Private Sector

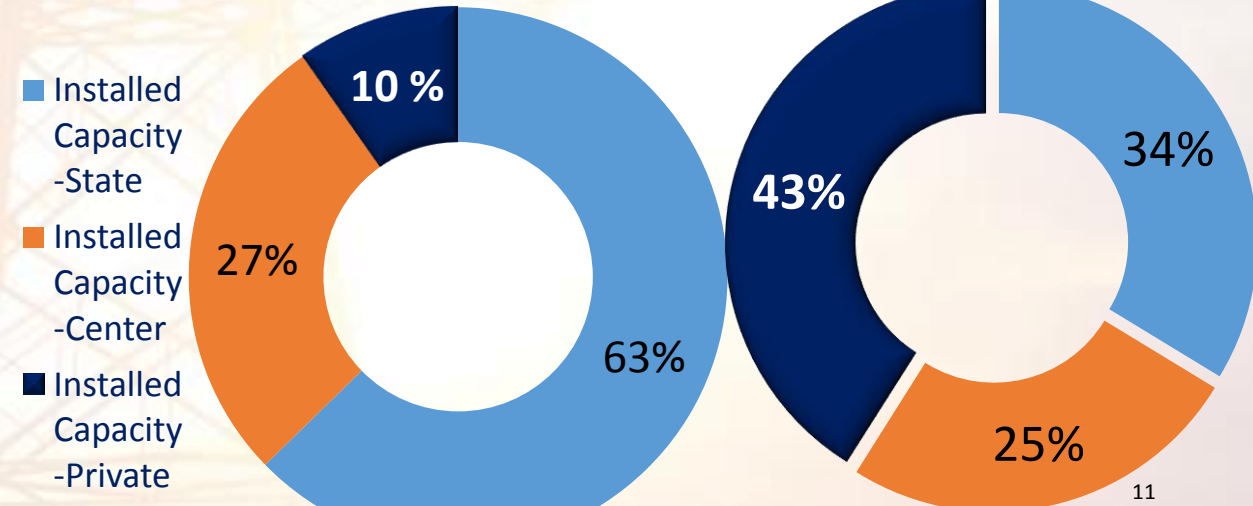


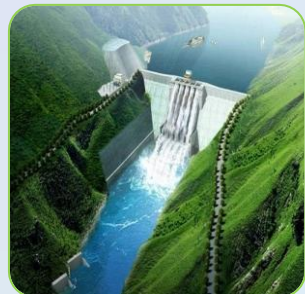
Low Per Capita: In 1990 per capita was only around 172 Kwh/Capita , by 2016 -1075 Kwh/Capita . IC 64 GW in 1990 to 330 GW in 2017

High Deficits: In 1997 Energy and peak deficits were 11.51% and 17.97% respectively.

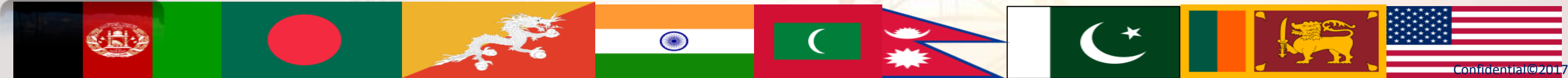
Limited Private Sector (PS) : Share of PS -10% in 2001 to 43 % 2016

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

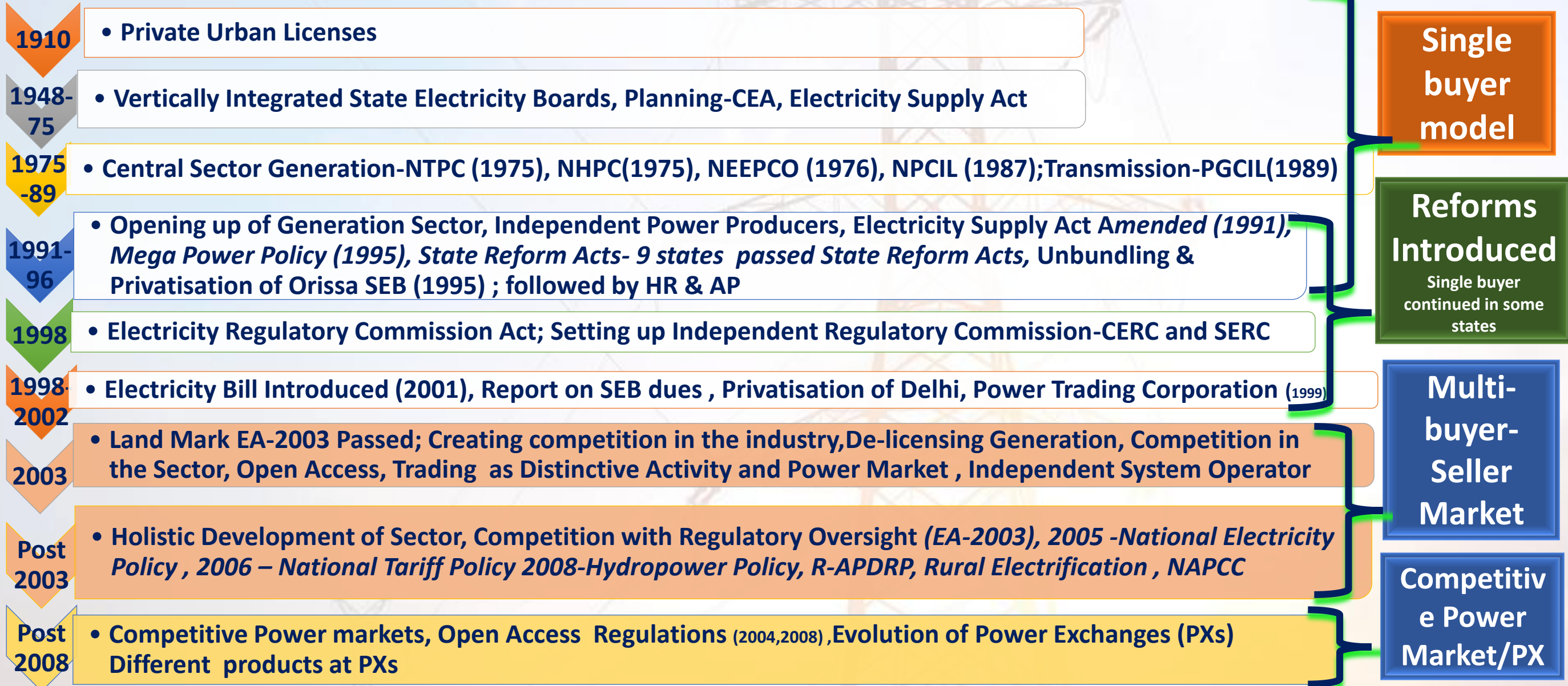




How all this was achieved



Power Sector Evolution in India



With the Legal Framework mandated under EA Act-2003, Power Trading and Power Market 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 to sell Electricity

Electricity cannot be stored

Political-Economy of the Sector

Demand of electricity varies intra-day and seasonally

Electricity has demand side flaws

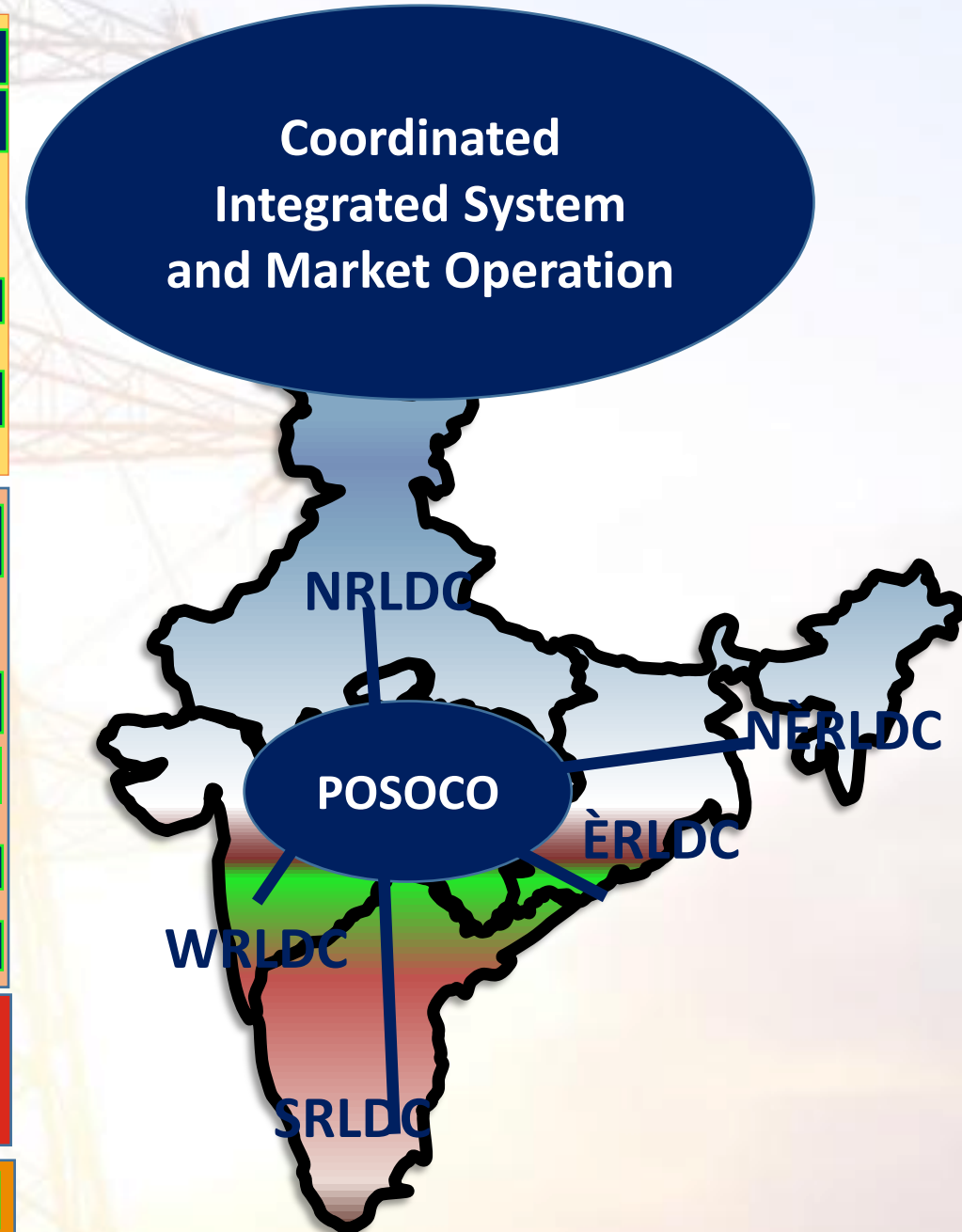
Electricity travels in accordance with laws of Physics

Electricity travels at the speed of light



Indian Power Sector: Very Complex Institutional structure

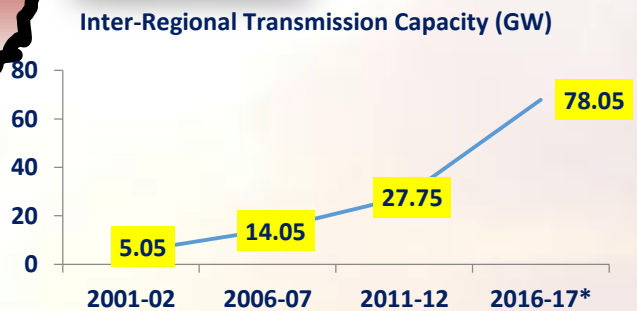
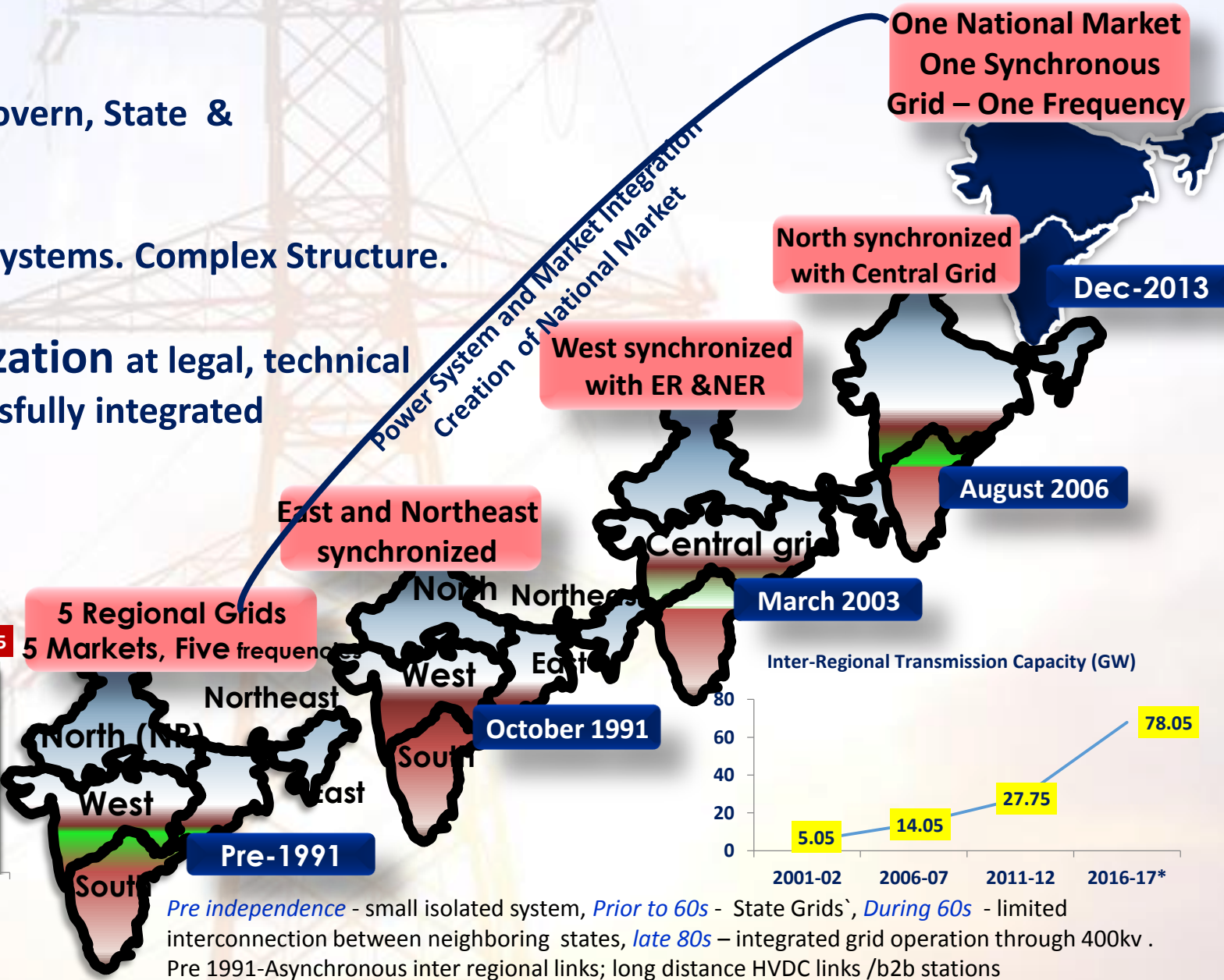
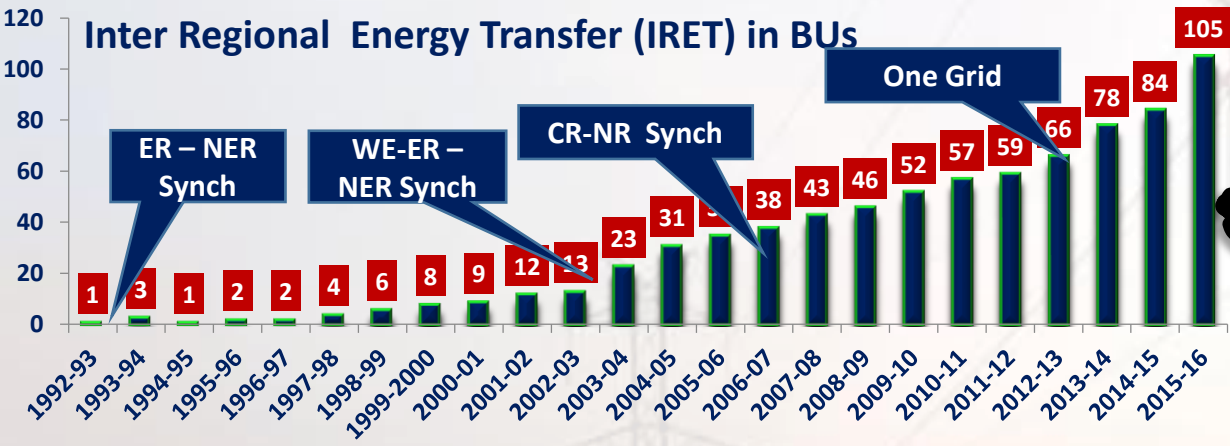
		Inter-state	Intra-state
Legislation & Regulation	Policy and legislation	Ministry of Power, Govt. of India	
		Ministry of Power / Energy / Electricity, State Govt.	
	Plan	CEA	State Government
	Regulation and tariff determination	Central Electricity Regulatory Commission	State Electricity Regulatory Commission
	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 Dispatch Centers(N,E,S,W, NER)	State Load Dispatch Centers
	Billing Settlements	5- Regional Power Committee, Preparation of Regional Energy and Transmission Accounts.	State Power Committee
	Distribution		SEBs, DISCOM, Distribution Licensees
Trading	Trading	Inter State Trading Licensee	Intra State Trading Licensee
	Market Platforms	Trading Platforms , Power exchanges(PXs), Bilateral, OTC etc	
Appeal	Dispute Settlement	Appellate Tribunal	
	CBET	Ministry of External Affairs , Ministry of Power, Designated authority, CERC, POSOCO-Coordination for trans-national exchange /trade of power	SERC, DISCOMs, State Governments



Regional Load Dispatch Centers 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

India's Power Sector Experience : It's Relevance towards Integration of Power system and Market Integration 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; successfully integrated the regional grids.
- Integration of Regional Grid played the crucial role for Development of India's National Power Market.

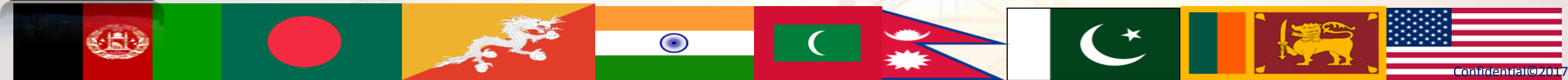


Pre independence - small isolated system, *Prior to 60s* - State Grids, *During 60s* - limited interconnection between neighboring states, *late 80s* - integrated grid operation through 400kv. Pre 1991-Asynchronous inter regional links; long distance HVDC links /b2b stations

Systematic regional planning, grid integration, coordinated harmonization- 9 BUs in 2002 to 105 BUs of IRET by 2016

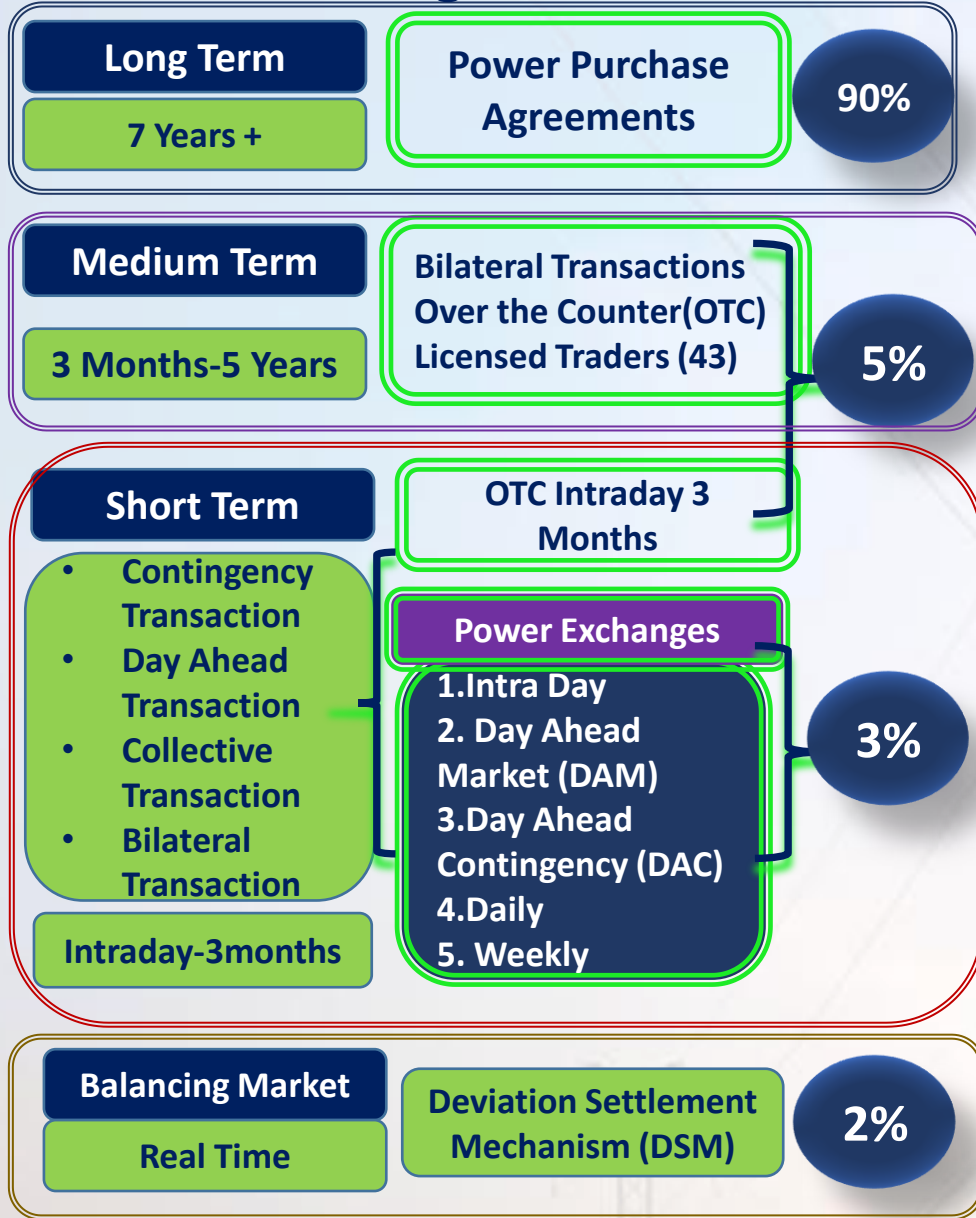


Power Market in India

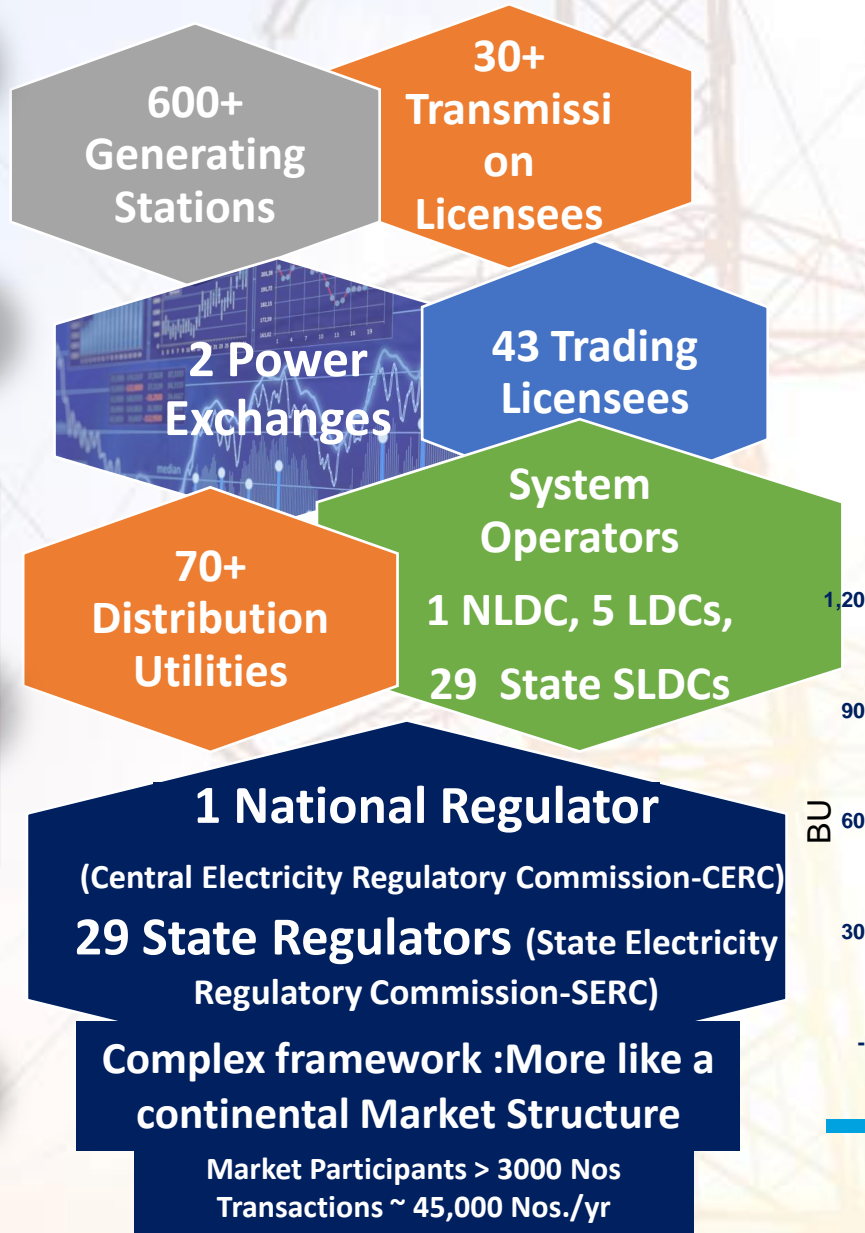


Power Market in India

Market Segment



Competitive Power Market

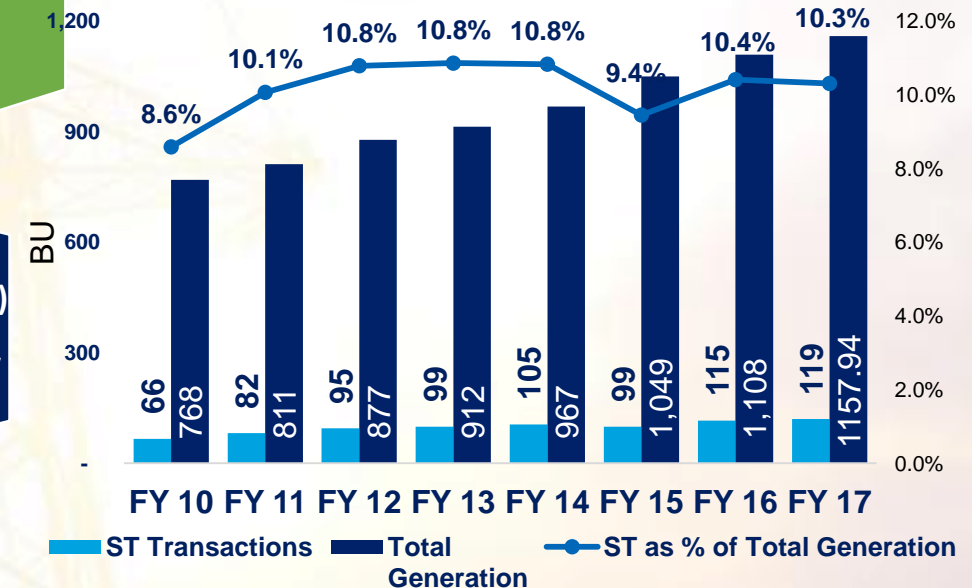


Size of Short Term Power Market
₹ 240 Billion (4.2 Billion US \$)

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 refers to contracts of less than one year- Includes bilateral trader segment, power exchange segment with transactions, DSM segment, Direct transactions of electricity between DISCOMs.

ST power market transaction in FY 2017 was 119.23 BU or 10.3 % of total power procured

Competitive Short Term Power Market

Positive Growth in all segments of the power market (short term).

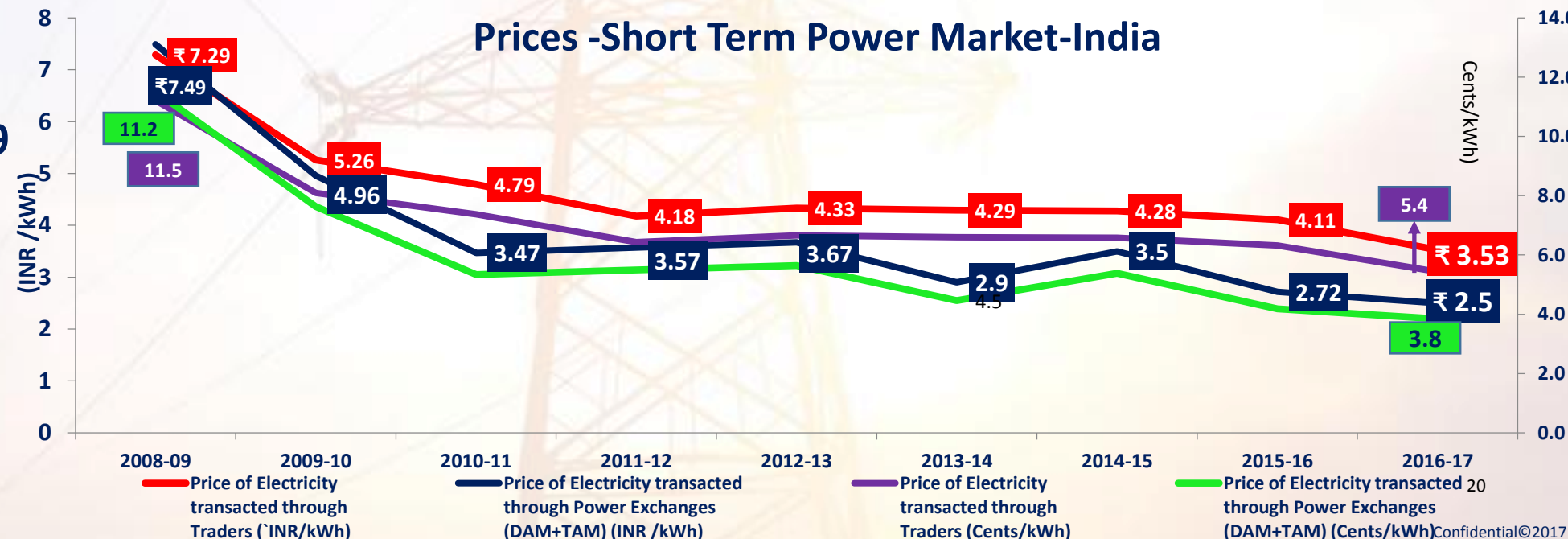
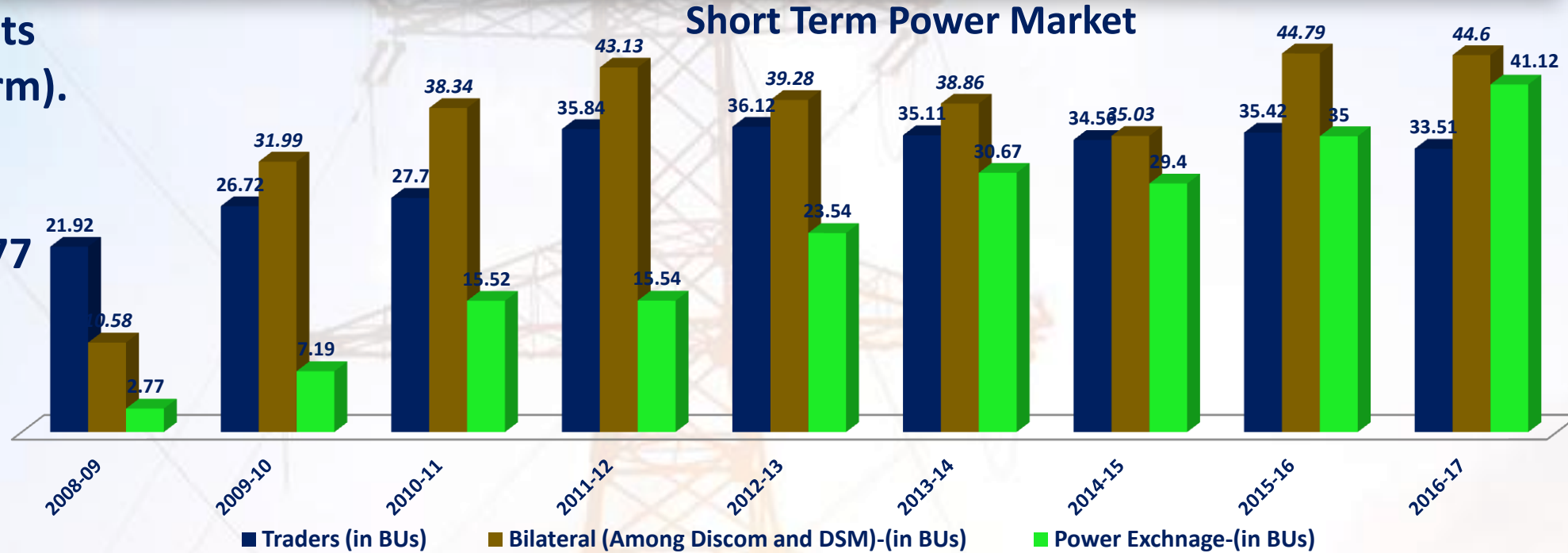
Growth in Volume in Power Exchange is Significant from 2.77 BUs in 2008 to 41 BUs in 2017.

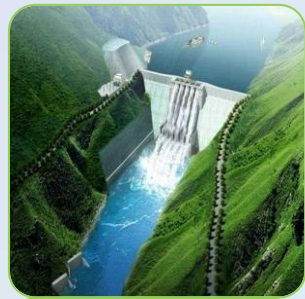
What is for the Consumer ?

Price have gone down due to competition, choice and market

Price through Exchange : ₹ 7.49 /Kwh (11.5 Cents) in 2009 to ₹2.5/ /Kwh (3.8 cents) in 2017

Price of Electricity (Trader): ₹ 7.29/Kwh (11.2 Cents) in 2009 to 3.53/Kwh (5.4 Cents) in 2017

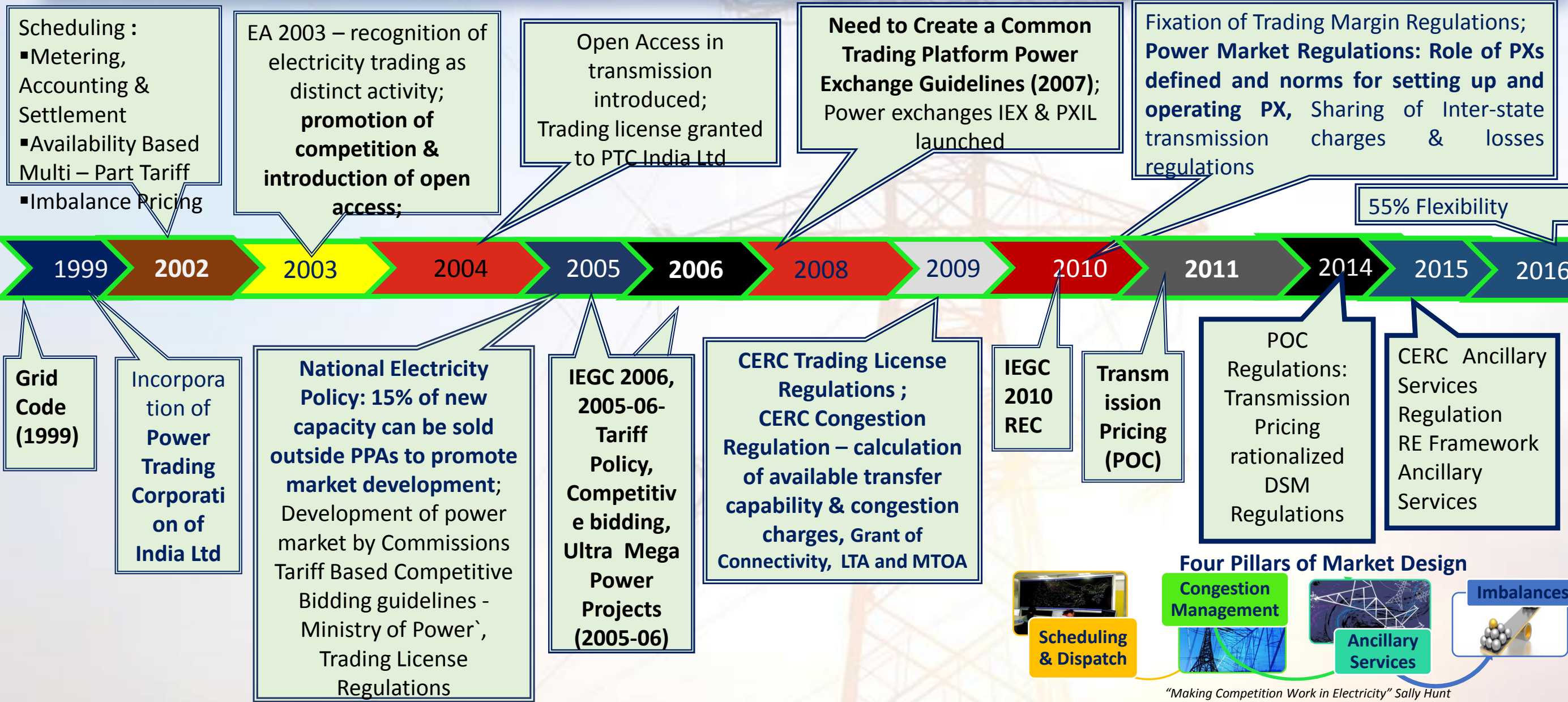




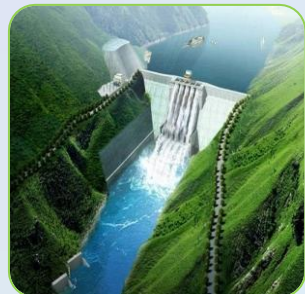
How the Power Market Evolved



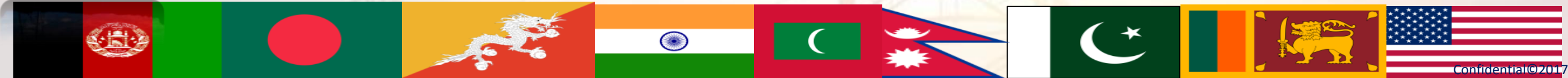
Evolution of Power Trading/Power Market in India



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



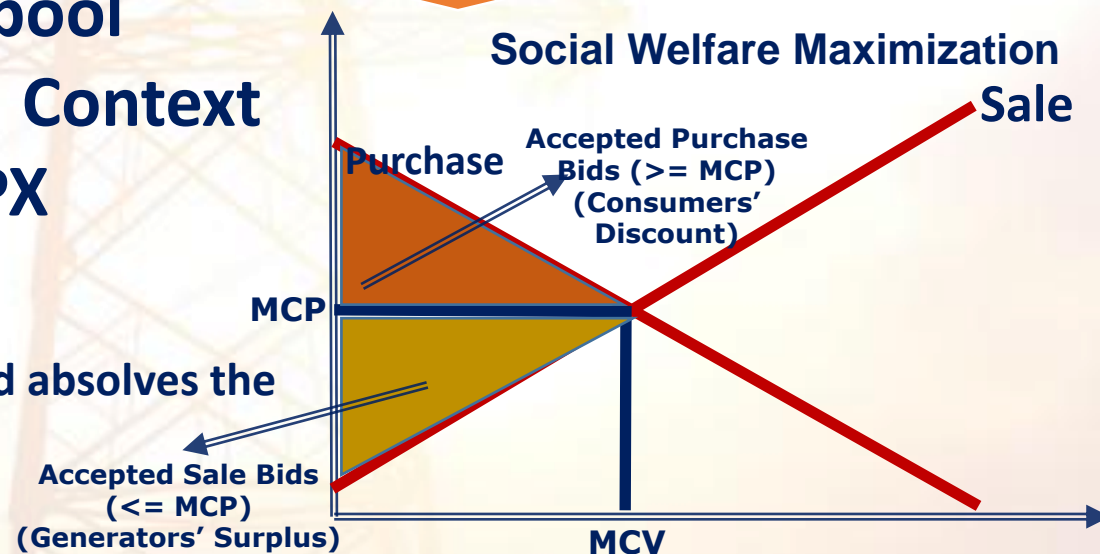
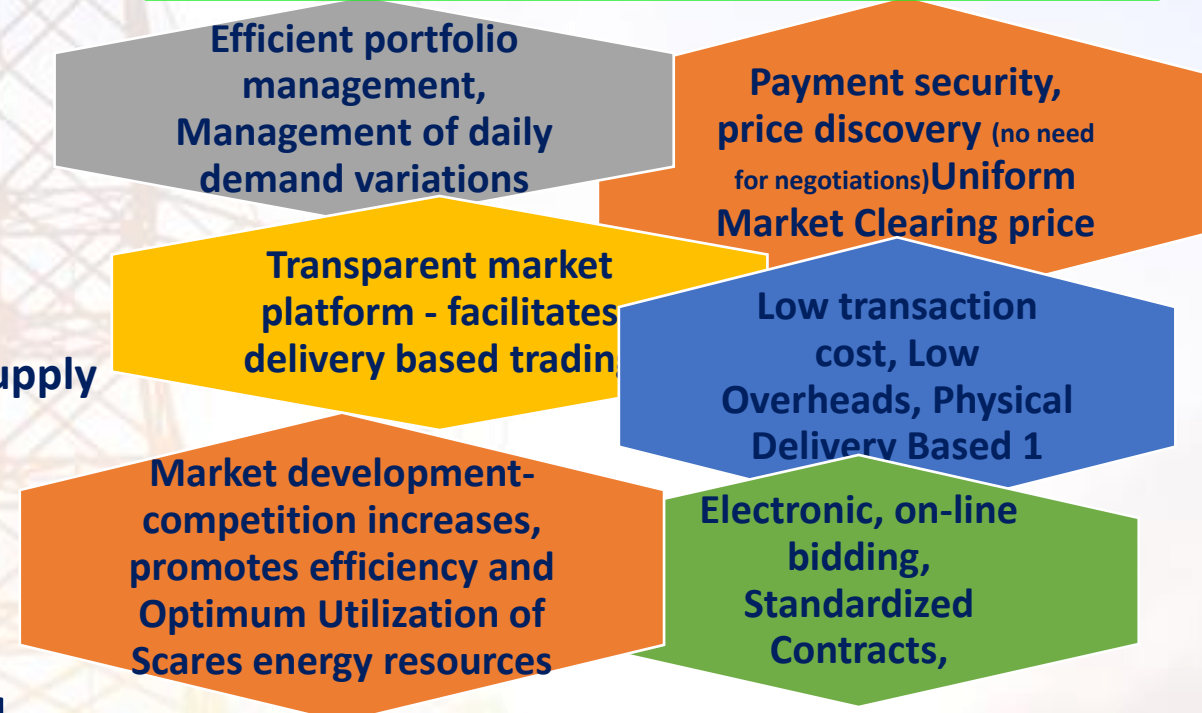
Power Exchange (PXs) in India



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 has similarity with Nord pool market concept*, but customized for Indian Context
- 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



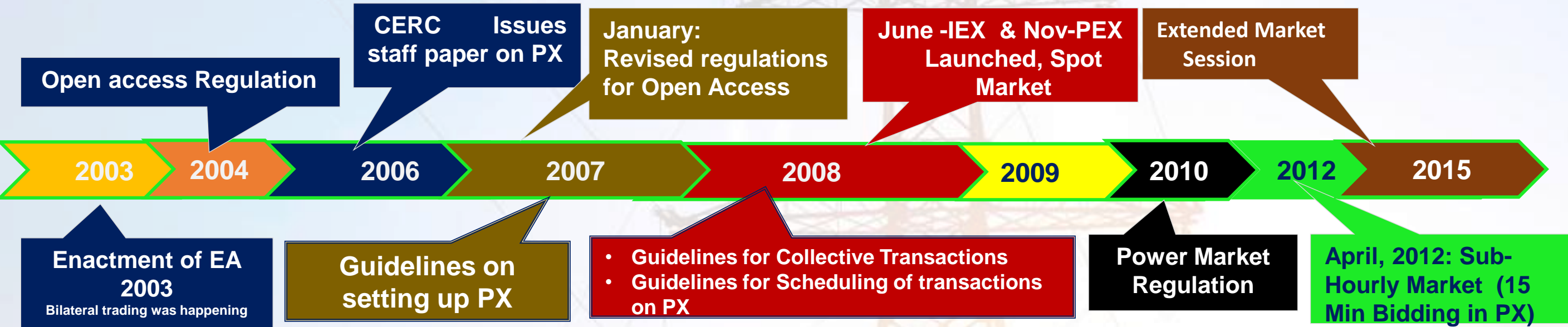
No Financial products such as Derivatives and Forward contracts **-DAM Market

* Restructuring Developments and Issues in Indian Power System, <http://searchd1.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

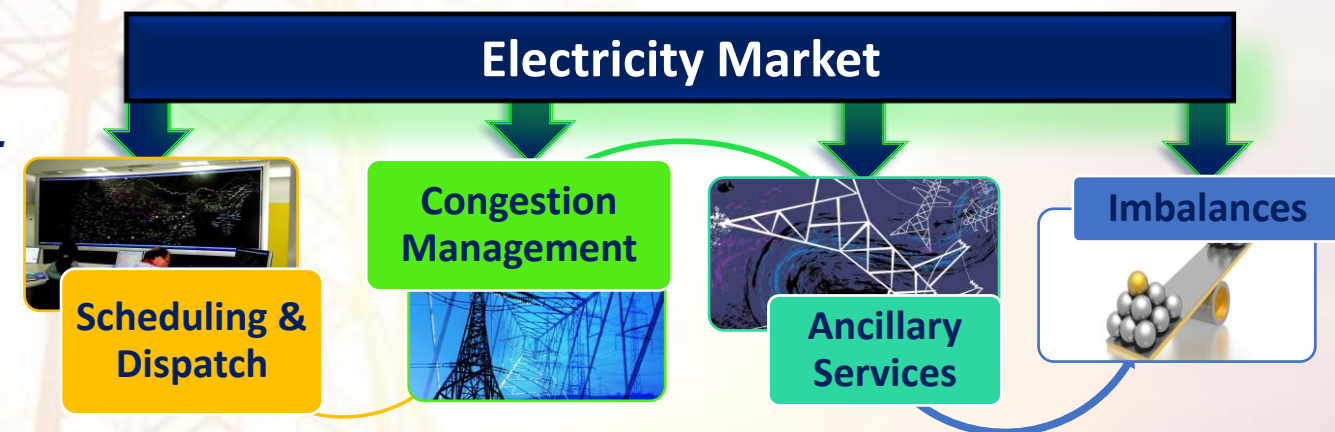
Development of Power Exchanges in India



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

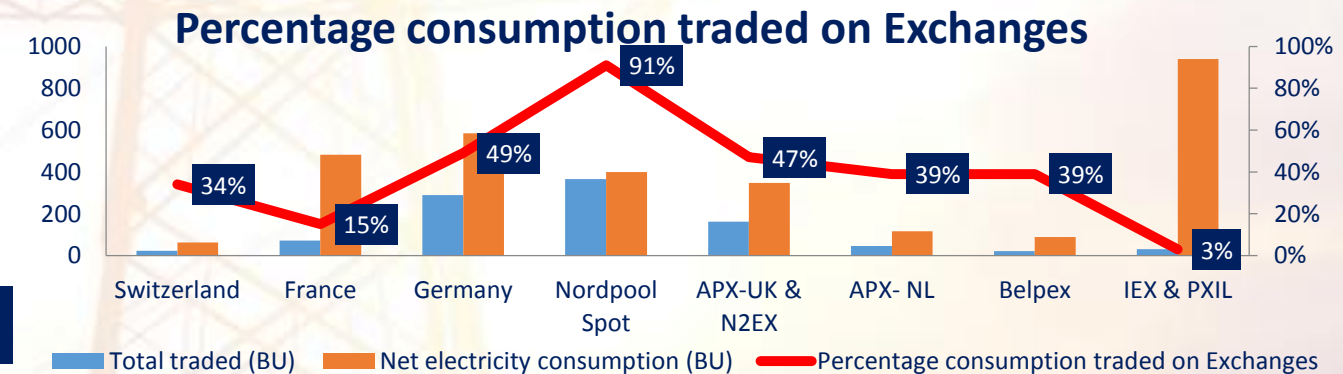
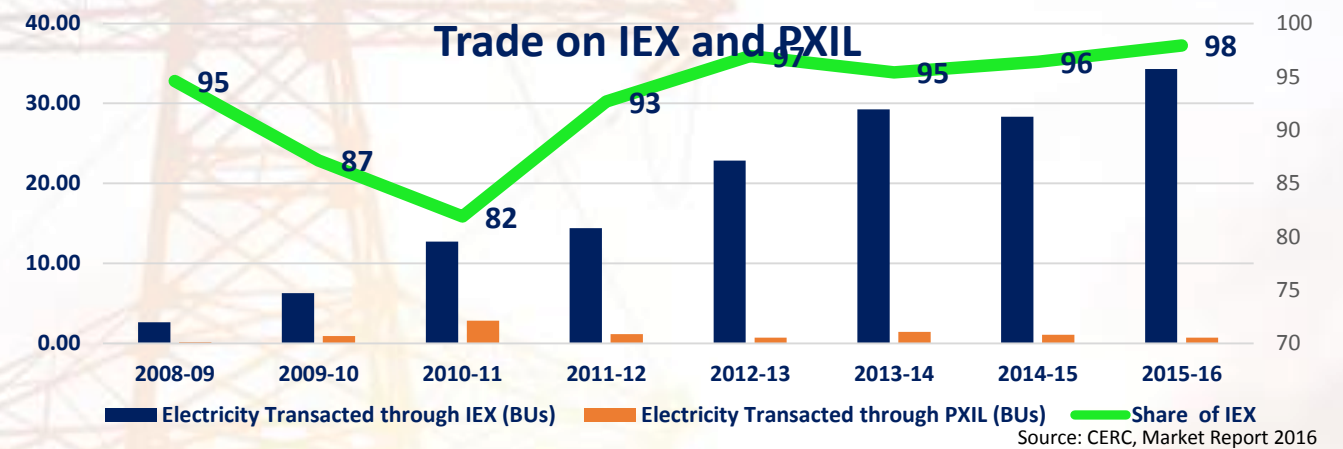
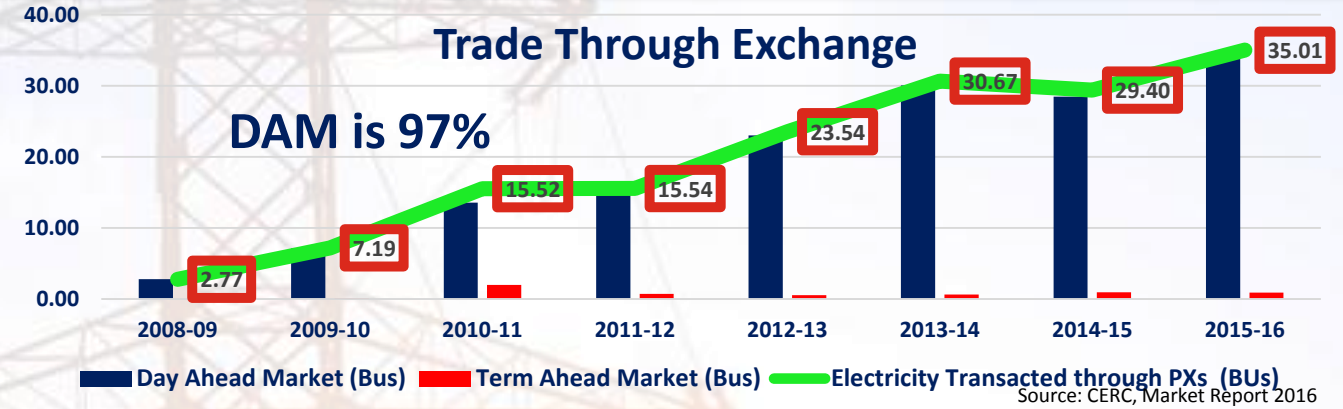
Term-Ahead Market
Since Sep 2009
Extended Markets
Since July 2015
(TAM provides a range of products allowing participants to buy/sell electricity on a term basis for a duration of up to 11 days ahead.)

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

Source: Annual Reports 2014 of all the Power Exchanges and World Energy Statistics, IEA 2014 26

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

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

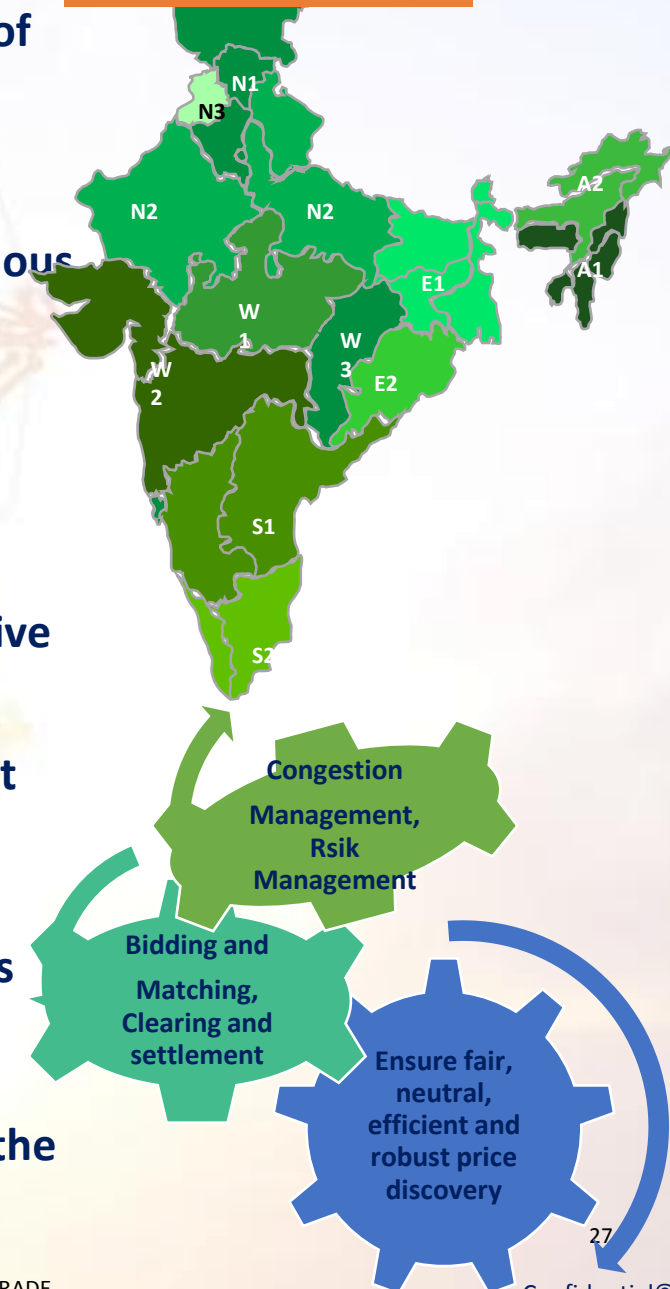


Power Exchange Market Products: Day Ahead Market (DAM)

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



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

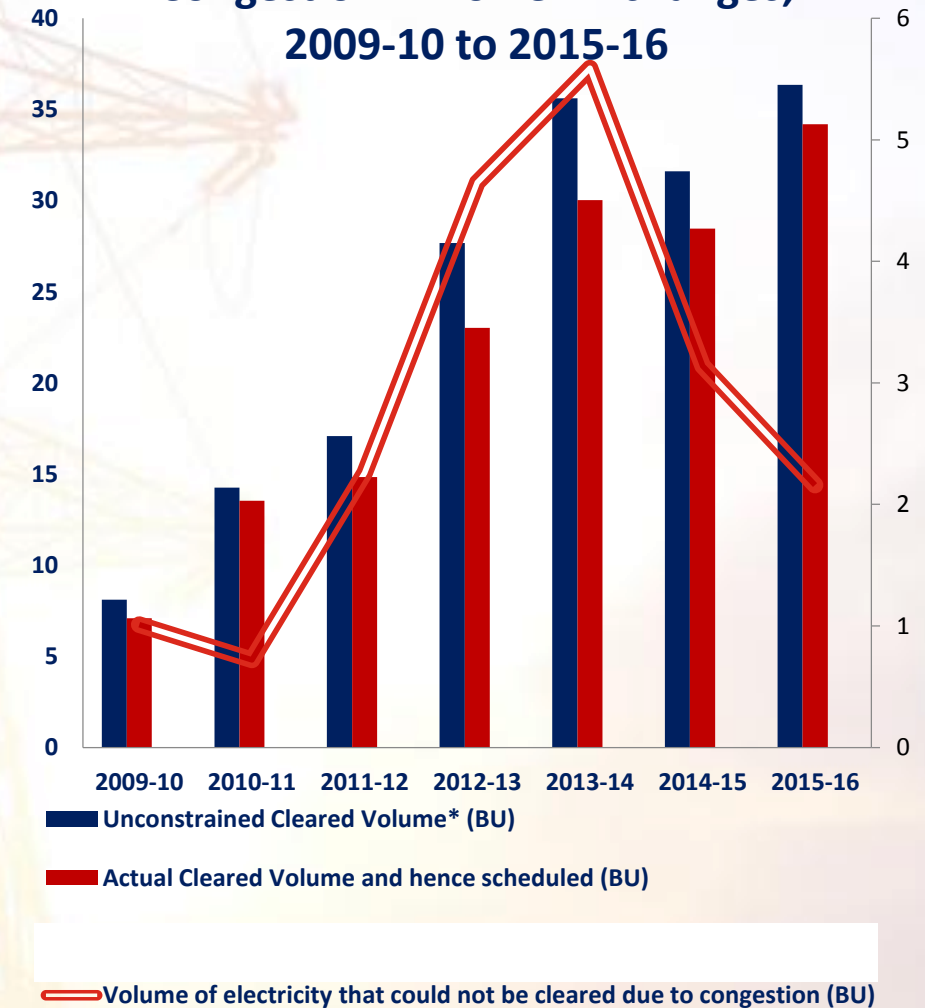
Manage contingencies and utilize surplus

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

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.

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



System Operation in India

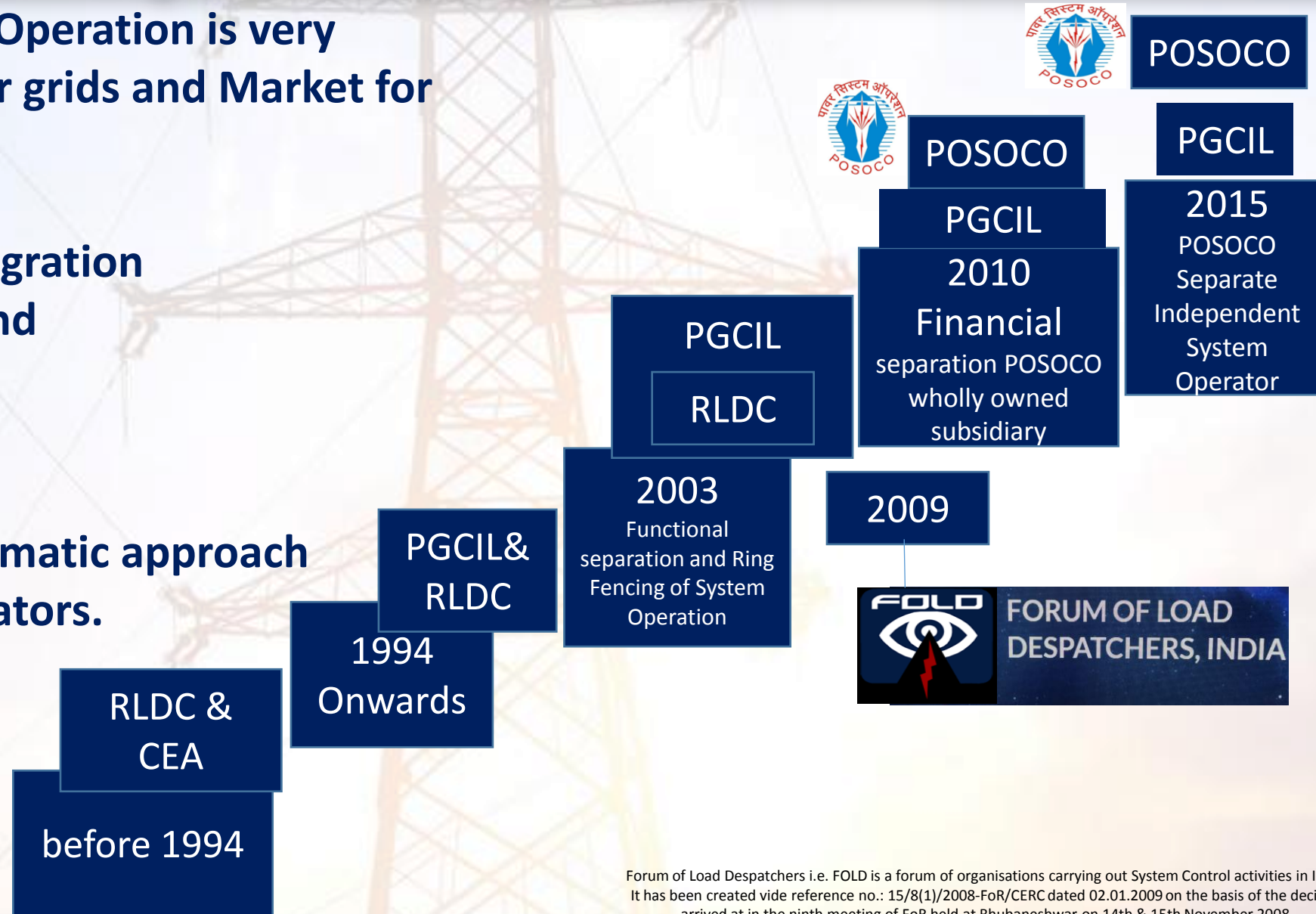
● A strong and independent System Operation is very important for Integration of power grids and Market for

- Safe
- Secure
- Reliable Interconnection and Integration
- Development of Power market and
- Market Operation

● India followed a gradual and systematic approach towards a independent system Operators.



Forum of Load Despatchers envisions being a catalyst in reliable, efficient and economic operation of the Indian bulk electric power supply system.



Forum of Load Despatchers i.e. FOLD is a forum of organisations carrying out System Control activities in India. It has been created vide reference no.: 15/8(1)/2008-FoR/CERC dated 02.01.2009 on the basis of the decision arrived at in the ninth meeting of FoR held at Bhubaneshwar on 14th & 15th November 2008.



System Operation - Hierarchy

1

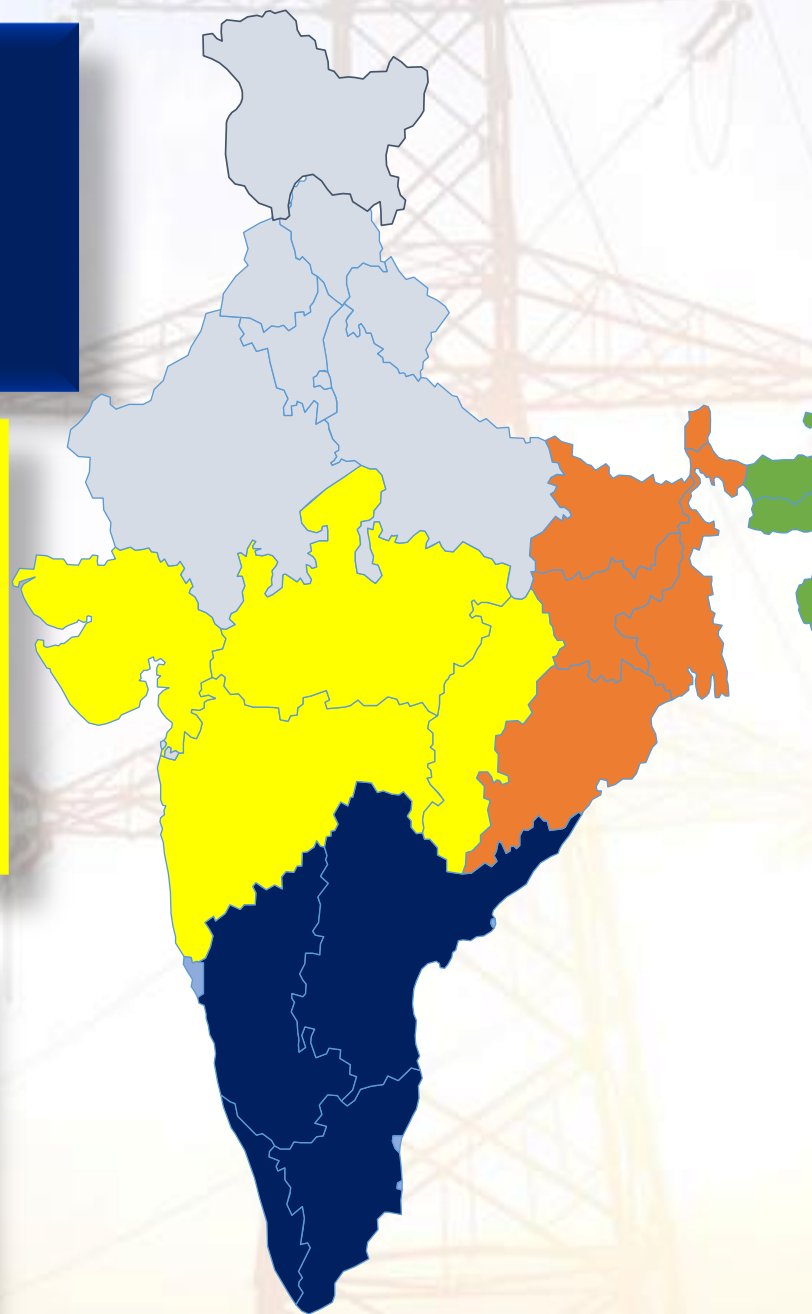
NLDC:
Apex body to ensure integrated operation of National Power System.

5

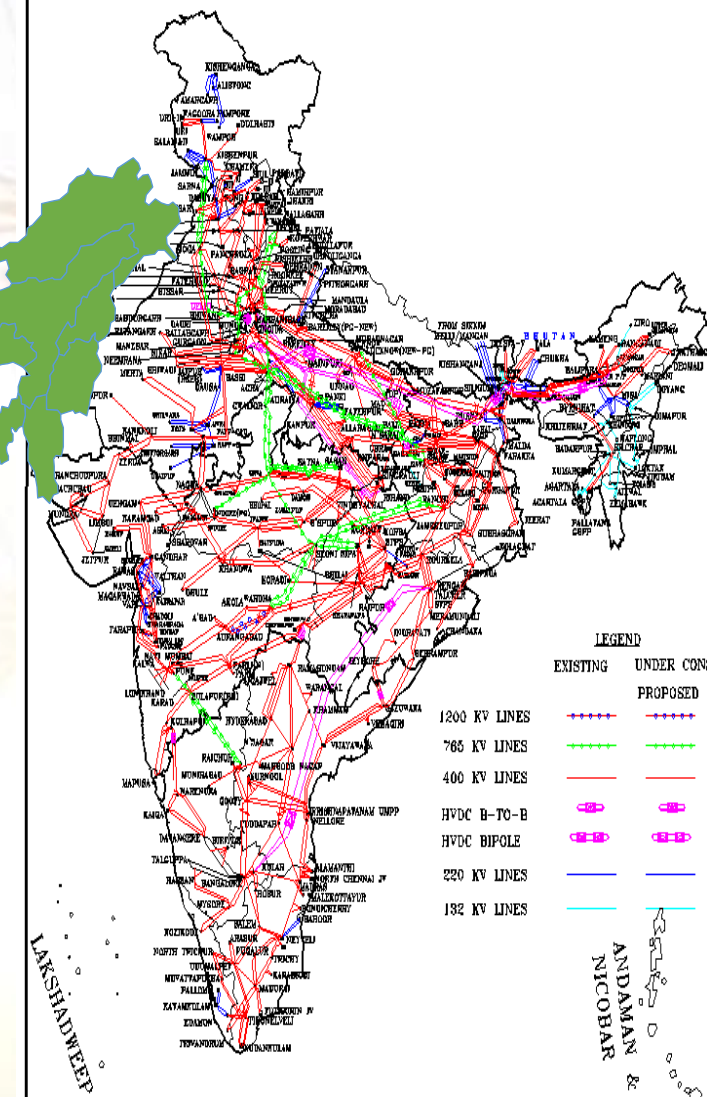
RLDC:
Apex body to ensure integrated operation of power System in the concerned region.

32

SLDC:
Apex body to ensure integrated operation of power System in a state.

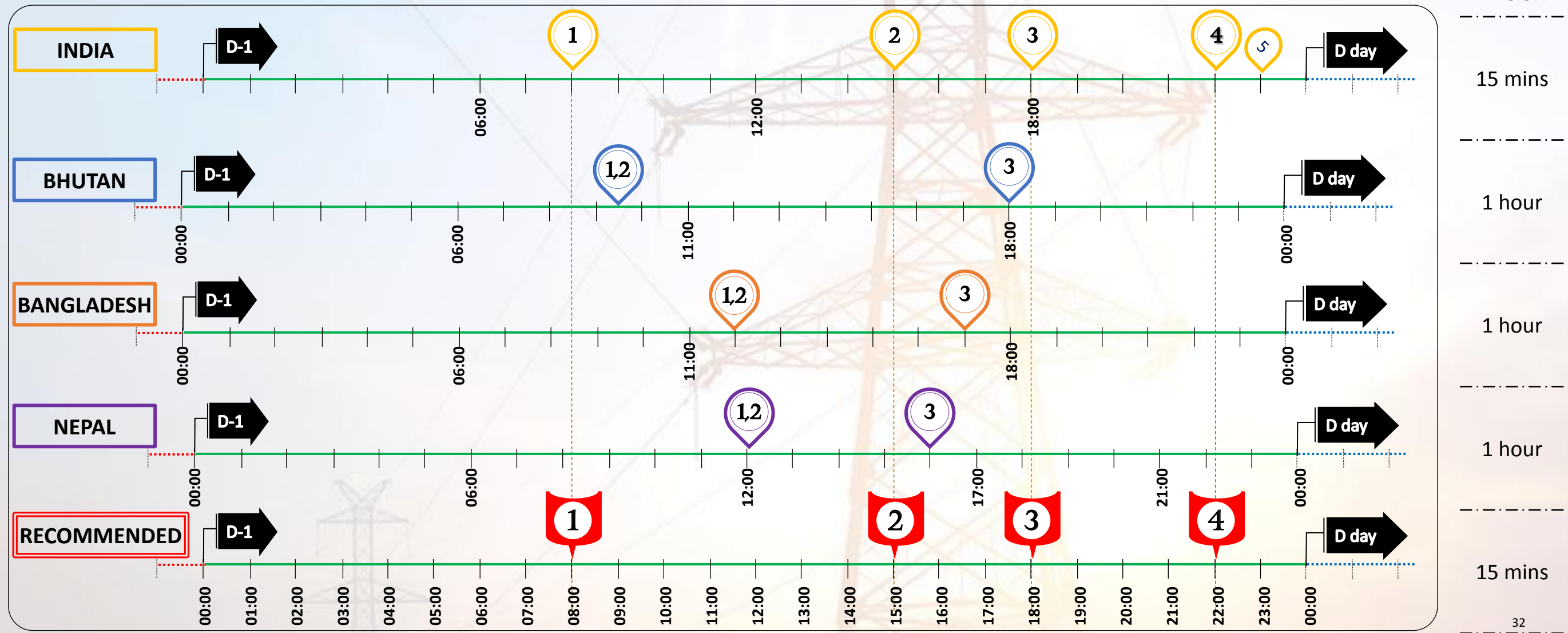


POWER MAP OF INDIA



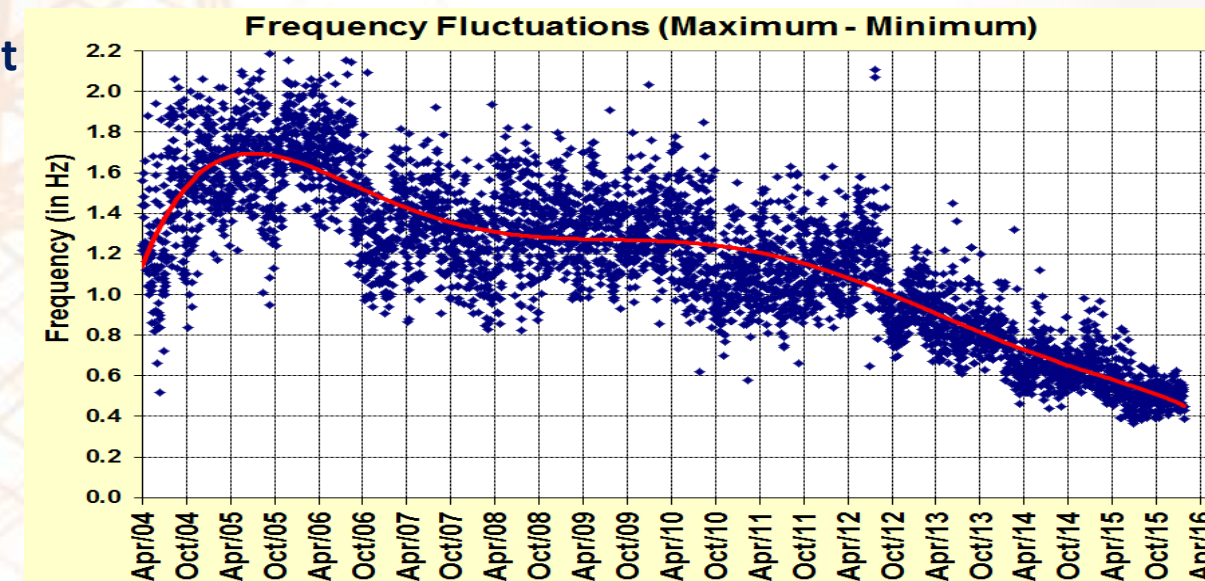
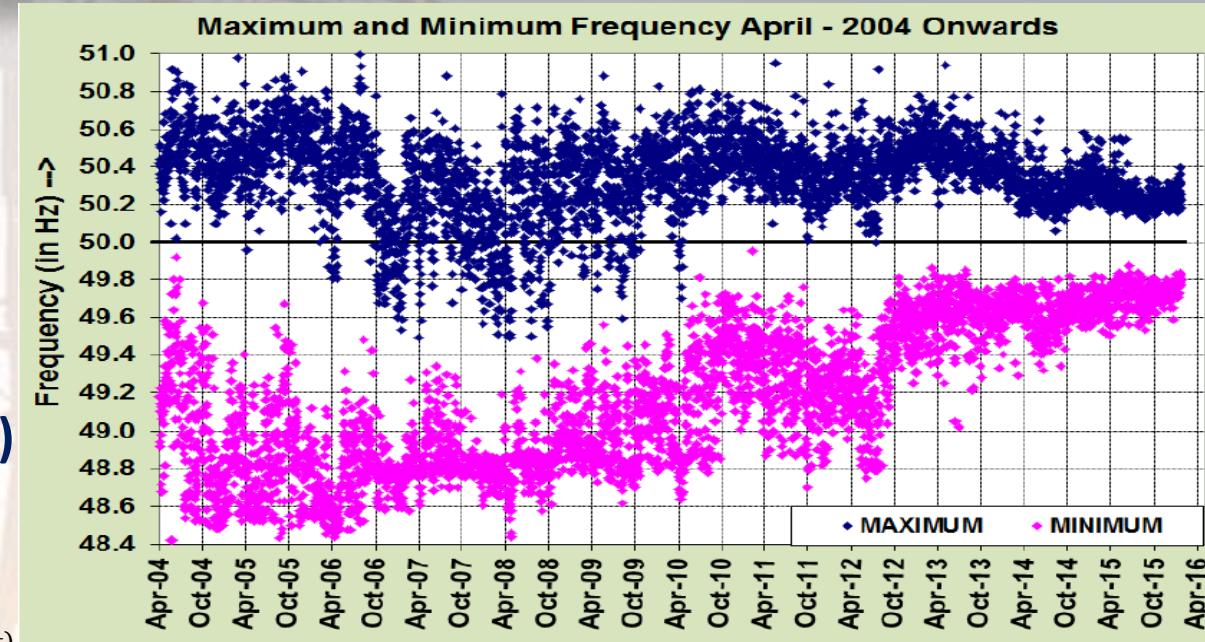
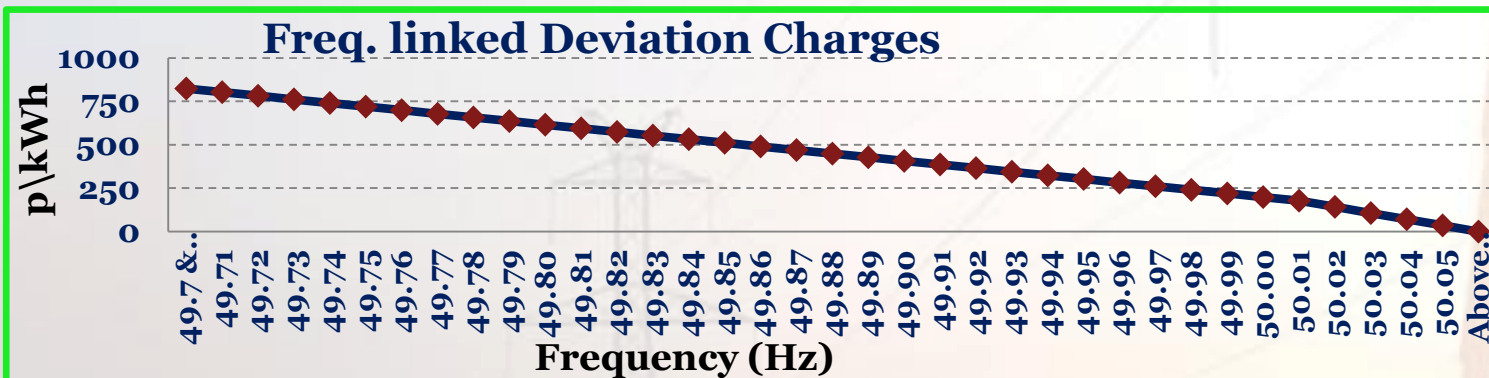
Scheduling & Dispatch Guidelines: Timeline

1: Capability Declaration 2: Drawal Declaration 3: Drawal and Dispatch Finalization & Declaration 4: Last Call for Modifications



Grid Discipline and Energy Accounting & Deviation Settlement

- Significant improvement in Grid Frequency stability
- Achieved through regulation -Grid Code, Availability Based Tariff, Deviation Settlement Mechanism etc.
- Availability Based Tariff
 - Fixed / Capacity charge - based on ex-bus MW availability (DC)
 - Variable / Energy charge - based on ex-bus MWh schedule
 - Deviation - Difference between actual and scheduled MWh settled at frequency-linked rates. (RPC issues Weekly Deviation Settlement Account)
- Regional : Regional Power Committee (RPC) issue Regional Energy Account (REA)* on a monthly basis for regional entities (i.e. ISGS, State as a whole)
- State Level: SLDC issue State Energy Account (SEA) on a monthly basis for intra-state entities (i.e. SSGS, Discoms)

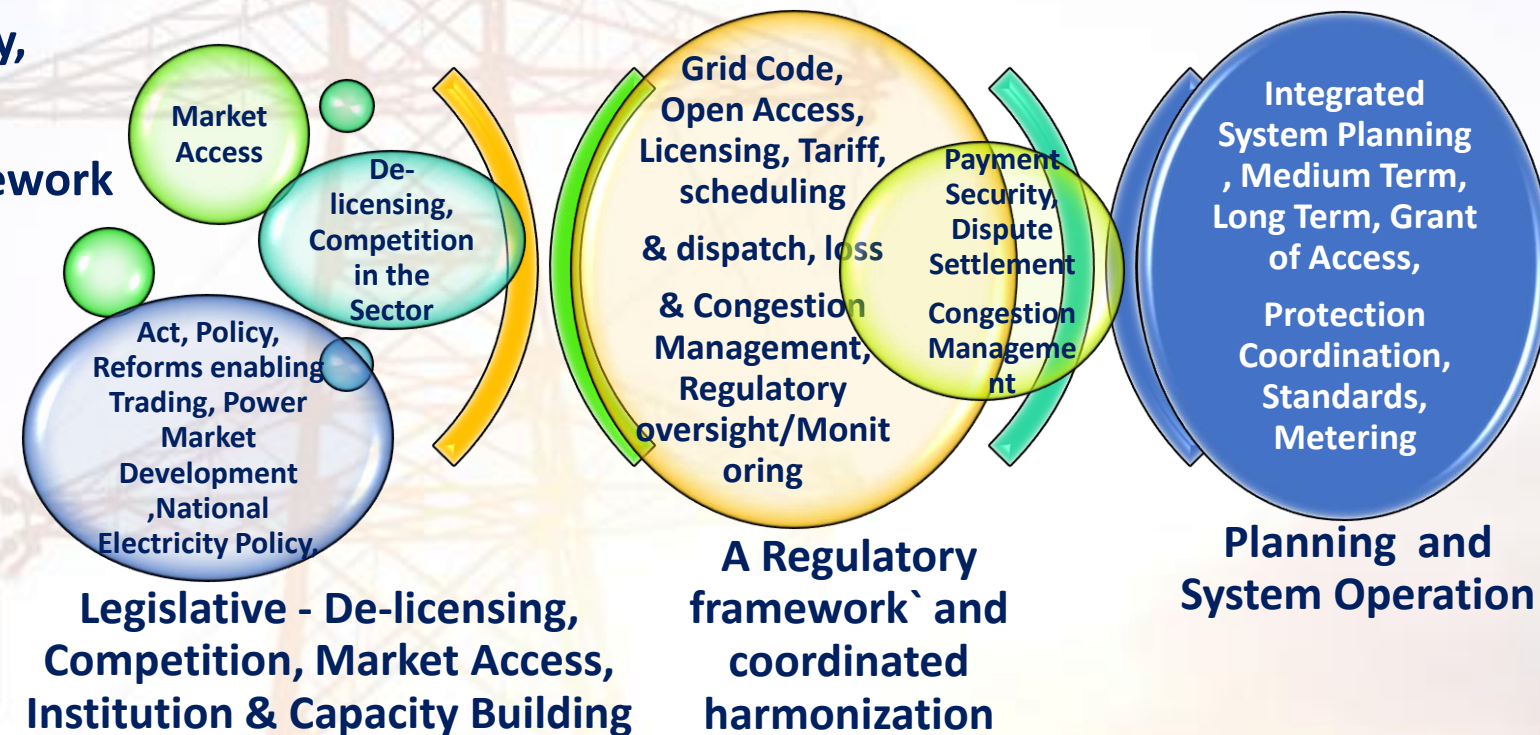


Achieved through regulation , viz. Grid Code, Availability Based Tariff, Deviation Settlement Mechanism etc. 33

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 70 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 Power 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*
- Streamlined Scheduling, Metering, Deviations Settlement, Transmission Charge Sharing, Transmission Losses calculation *

Ecosystem for Market Development

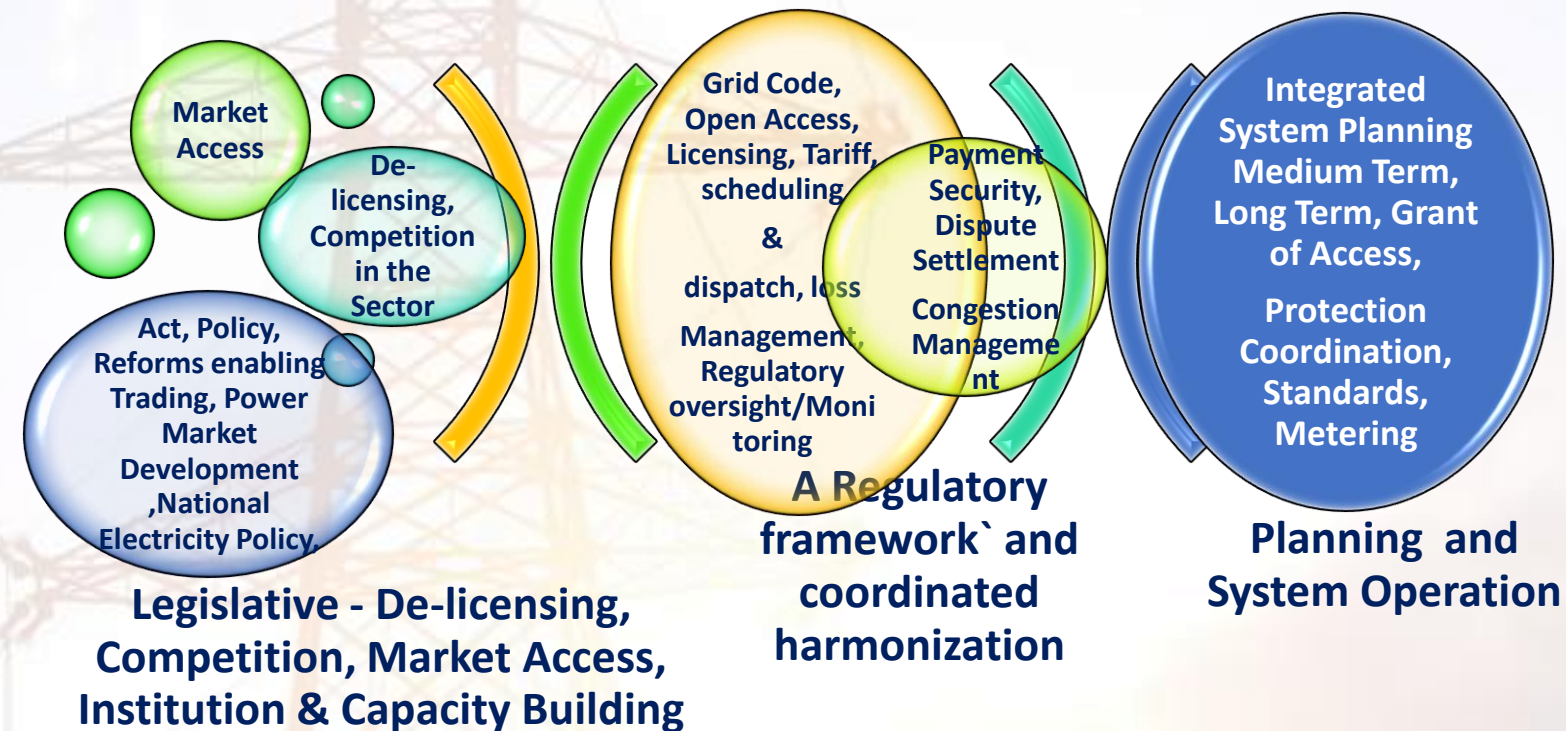


* Pre requisite **Desirable

Key Lessons :Power Market and Exchange Development in India (Contd.)

- Putting basic ingredients in place before Launching the PX*.
- Wholesale market with out retail market integration.
- 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



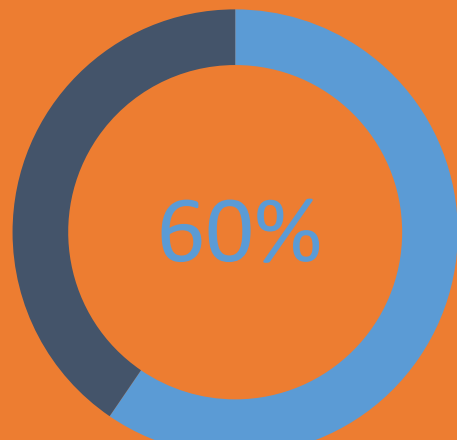
* Pre requisite

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.

But there are Challenges also.....

Per capita consumption remains low as compared to world bench marks. (1/3rd of Global Average)

Aspiration to ~2000 kWh / capita by Year 2024

High Level of Distribution Losses impacts the credit worthiness of the buyer.

DISCOMs have an accumulated losses of approx. Rs. 3.8 Lakh crore and outstanding debt of approx. Rs. 4.3 Lakh crore (as on March, 2015).

Revenue Gap is 1.08 INR/Unit.

UDAYA has made improvements*

Gap reduced to 0.4 Unit (target is zero ACS - ARR gap)

AT&C loss reduced to 23.90% (target - 15%)

Tariff Revision: 25 of 27 states

Bonds Issued : Rs.232163 Crore (86.29%)

Bonds to be Issued : Rs.269056.35 Crore

Due to these bonds, the state gross fiscal deficit ratio is up by 0.7 percentage points to 3.6 per cent

in 2015-16 from 2.9 per cent without UDAY - Economic Survey, Volume II

*Data Accessed from <https://www.uday.gov.in/home.php> as on 8th December,2017

Financial viability of DISCOMs

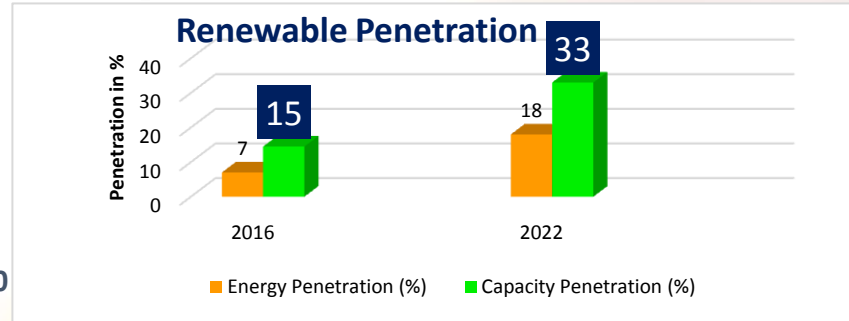
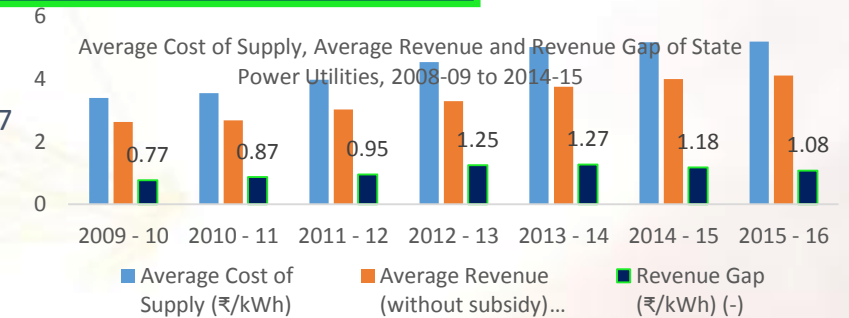
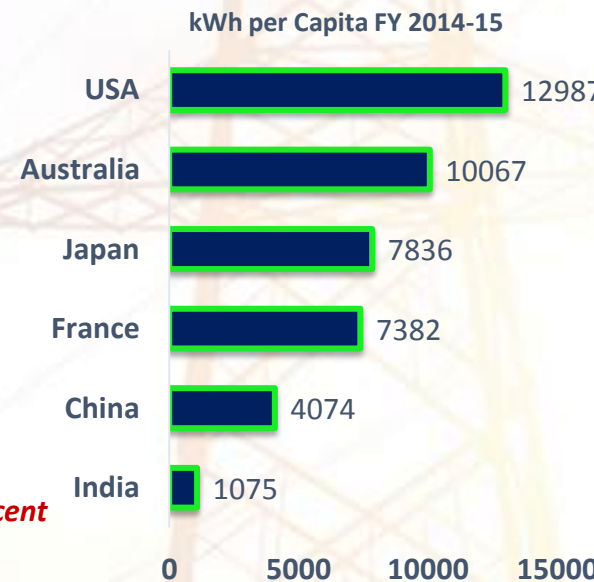
Energization of Household

Cross-Subsidies

Low per capita Consumption

Renewable Energy Integration Challenges

ACCESSIBILITY & AFFORDABILITY IN SUSTAINABLE BASIS.



India –Cross Border Power Trading

2016-17	Bhutan	Bangladesh	Nepal	Myanmar
Energy (Export/ Import)	5863 MU (Import)	4420 MU (Export)	2022 MU (Export)	MW (Export)
Transaction Type	Gol Allocation (LTA), STOA	Gol Allocation (LTA), MTOA, STOA	Gol Allocation (LTA), STOA	Bilateral b/w Manipur and Myanmar (LTA)
Scheduling	NLDC/ERLDC	NLDC/ERLDC/ Tripura SLDC	NLDC/NRLDC/ ERLDC/Bihar SLDC	Manipur SLDC
Metering	ERLDC	ERLDC/Tripura	NRLDC, ERLDC, Bihar	Manipur
Nodal Agency for Accounting and Settlement	PTC (ER Pool) , TPTCL (Eastern Region DSM pool) The DSM charges borne by the beneficiary *	NVVN (ER Pool) / Consumer of Tripura. Any DSM liability on NVVNL is passed on to BPDB.** Tripura- No settlement mechanisms mode***.	PTC (NR Pool), NVVN (ER Pool), Consumer of Bihar DSM charges (were levied on NEA for the short terms contracts) ***	Consumer of Manipur
Payment of ISTS Transmission Charges(PoC)	STOA	STOA	STOA	Nil

* Chhukha, Tala and Kurichhu, are not covered under ABT/DSM mechanism. Scheduling is done by ERLDC (India) at India-Bhutan border point and The DSM charges are borne by beneficiaries (mostly, Indian discoms).
Dagachu is Covered under DSM . TPTCL (Trader) is the Eastern Region DSM pool member and is settled as per CERC DSM Regulation . Bhutan NLDC declared the transmission loss as 2 %

** Both NVVNL and PTC transactions are subject to CERC, DSM Reg.

*** Due to radial mode

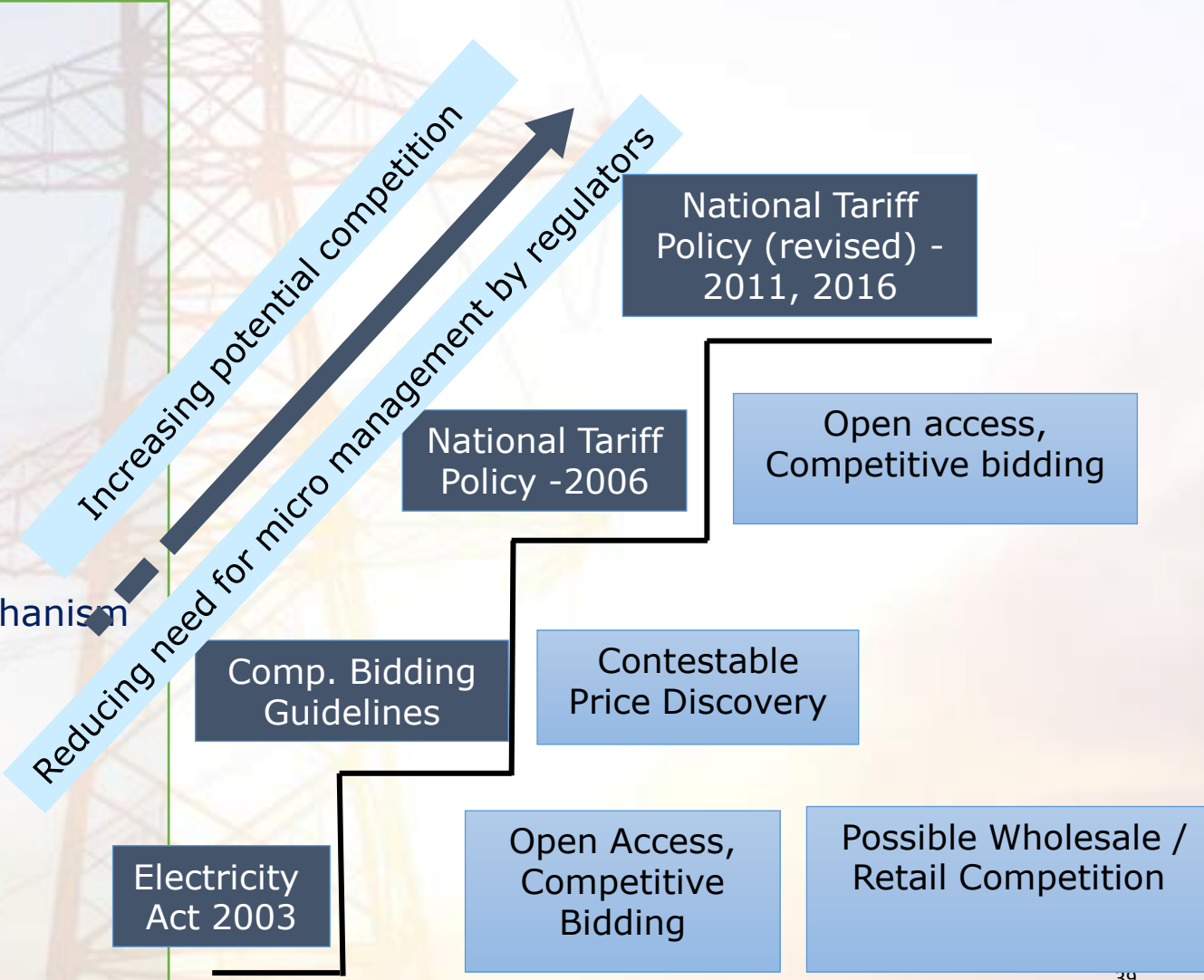
*** The import of power by Nepal from India is under various bilateral treaties / contracts-The Billing is on Actual Energy and hence, no requirements of scheduling or DSM settlement.

Open Access in Transmission vis-à-vis evolving competitive power market

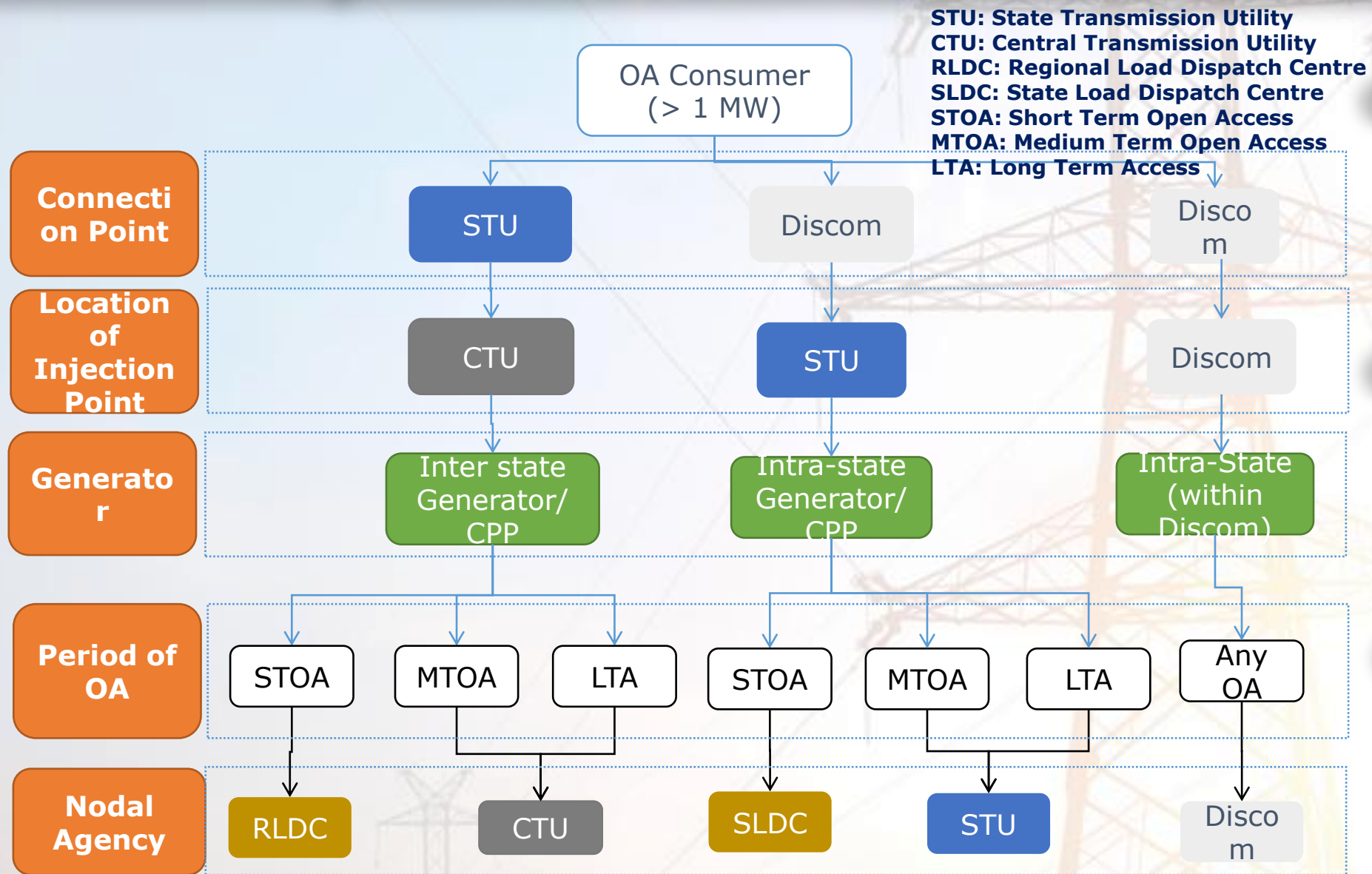
Policy actions

- **EA 2003 introducing**
 - Non-discriminatory open access transmission
 - Sec 63 - ERCs to follow competitive bidding process
 - Sec 79(2) - CERC to advise GoI on promoting competition
 - Section 60 – Controlling abuse of market power
- **Competitive Bidding Guidelines - 2005/06**
 - Generation
 - Transmission
- **National Tariff Policy – 2006**
 - Promoting retail competition
 - Power procurement through transparent competitive bidding mechanism
 - Transmission investment through competitive bids
 - Bidding deferred for Public Sector Projects till 05-Jan-2011
- **National Tariff Policy (revision) – 2011, 2016**
 - Competitive bidding route for CTU projects w.e.f. 06-Jan-11
 - Competitive bidding route for STU after 2 years
 - Exemptions for first two 1200 kV HVDC & for urgent works

Evolving market structure in Indian power sector



Open Access Consumer Categories



Long-term OA customer

- A long-term open access customer is one who avails open access for a period of 7 years to 25 years

Medium-term OA customer

- A medium-term open access customer is one who avails open access for a period of 3 months to 7 years

Short-term OA customer:

- A short-term open access customer is one who avails open access for a period upto three months at one time





Evolution of Transmission Pricing

Upto 1991

Cost of transmission clubbed with generation
Implicit

1992-2002

Apportioned on basis of energy drawn
Usage based

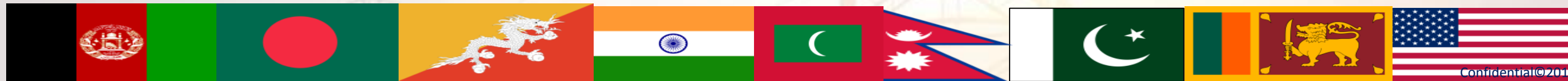
2002-2011

Apportioned on the basis of MW entitlements
Access Based

2011 onwards

Distance and direction sensitive
Hybrid methodology

- Change in pricing framework
- Synchronous integration of Regions
- Changes caused by law and policy - Electricity Act; National Tariff Policy
- Open Access and Competitive Power Markets - Pricing Inefficiencies, Market Players' concern
- Pan caking effect
- National Grid / Trans-regional ISGS
 - Changing Network utilization
 - Agreement of beneficiaries a challenge
 - Ab-initio identification of beneficiaries difficult



Open Access Transactions : Charges & Losses

PoC charges

- Inter-State Transmission charges payable by the open access consumer

Transmission Charges or STU Charges

- Payable to the state transmission utility for the use of the transmission system for availing power through open access

Wheeling charges

- Charge to the Discom for conveyance of electricity through open access as determined by the SERCs

Cross Subsidy Surcharge

- Subsidising open access consumer has to pay a cross subsidy surcharge to the Discom. – As approved by SERC

Others

- Additional Charges, if any – As approved by SERC
- NLDC application fee, scheduling and operating charges, SLDC Charges
- IEX transaction charges/Trading Margin
- Reactive Charges – As approved by CERC and SERC

Point of connection (PoC) loss

- Inter-State transmission system loss

Transmission loss or state loss

- Consumer to absorb apportioned energy losses in the transmission system as per the relevant regulations

Wheeling loss

- Technical losses in the distribution system determined at various voltage levels by SERCs

International experience - Open Access Evolution

• Evolutionary Phases

Open Access Stages	Initial phase	Evolving phase	Mature phase
Transmission	Bundled	Functional Unbundling	Fully Unbundled
Eligible Consumer	<ul style="list-style-type: none"> • Big Captive • DISCOM 	Medium captive	<ul style="list-style-type: none"> • Small captive • Households
Power Market	Long term PPA (Bilateral)	Short-term (day ahead and term)	Real time market



International example	Domestic/ regional case	Open access stage
USA	● Domestic open access	● Mature phase (Trade through Open access in wholesale market)
SAPP	● Regional open access	● Mature phase (term ahead, day ahead market)
South America	● Regional case (Argentina-Brazil and Brazil-Paraguay)	● Initial phase (Bi-lateral; no open access in regional pool)
Brazil	● Domestic open access	● Evolving phase (Open access)



International experience: Summary and key takeaways

- In all these cases it took several decades to move from beginning of open access to mature open access regime. Bangladesh can start open access and keep modifying rules/ regulation as OA acceptance unfolds

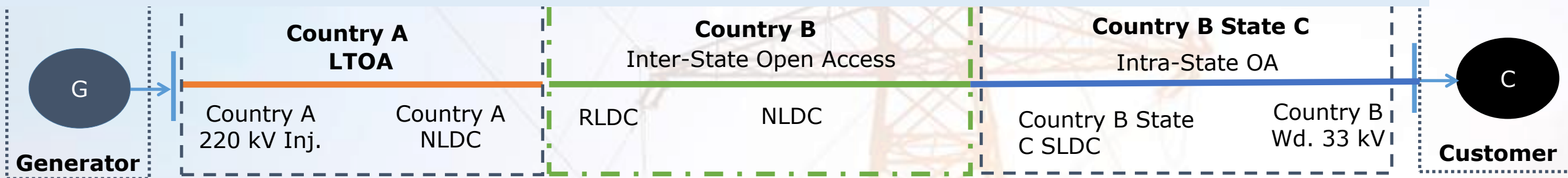
Parameter	Example	International best practice	Key takeaways
Transmission unbundling	USA, India	<ul style="list-style-type: none"> Transmission is functionally unbundled in USA which means tariffs provided by a transmission company to its generation company should be same as it provide to other 3rd party also there should not be discrimination in quantum or schedule for dispatch. India has over the years unbundling process at central and state level with varied level of unbundling. 	<ul style="list-style-type: none"> Start with unbundled transmission and introduce functional unbundling/ total unbundling as OA framework progresses
Neutral system operator	USA, India, Brazil	<ul style="list-style-type: none"> In USA and Brazil, system operator is a neutral not-for-profit agency and responsible for marinating schedule and dispatch in unbiased manner. India is on the way to have completely neutral system operator (POSOCO) 	<ul style="list-style-type: none"> Expand the scope of current system operator
Eligibility for open access	Brazil, India, USA	<ul style="list-style-type: none"> Brazil started with eligibility of 10 MW and above customer which gradually reduced to 3 MW then 50 kW. India started with open access for 10 MW and above customers and now have 1 MW customers as eligible one. 	<ul style="list-style-type: none"> Start open access with large customers
Generation	USA	<ul style="list-style-type: none"> USA have quota (in GWh) allocated for open access 	<ul style="list-style-type: none"> Consider allocating OA quota which operationally feasible



South Asian Context

- Case: Bilateral LTOA between two countries

Customer is situated in Country B procuring power from generating station in Country A



Injection	Country A transmission losses		Country B CTU transmission losses			State C transmission losses			Landed Tariff for Customer
Generation Tariff for 100 MW	Country A Transmission charges	Country A SLDC charges	POC charges Injection	National/Regional Operating Charges	POC charges Withdrawal	Transmission and Wheeling Charges	SLDC Operating Charges, processing fess	Cross Subsidy Surcharge	
Rs 3 per kWh	Rs 0.18 per kWh	Rs 2000 per day	Rs 0.16 per kWh	Rs 2000 per day	Rs 0.16 per kWh	Rs 0.30 per kWh	Rs 2000 p.d.; Rs 5000 p.t.	Rs 0.13 per kWh	

Rs 3 per kWh

Rs 3.33 per kWh

Rs 3.79 per kWh

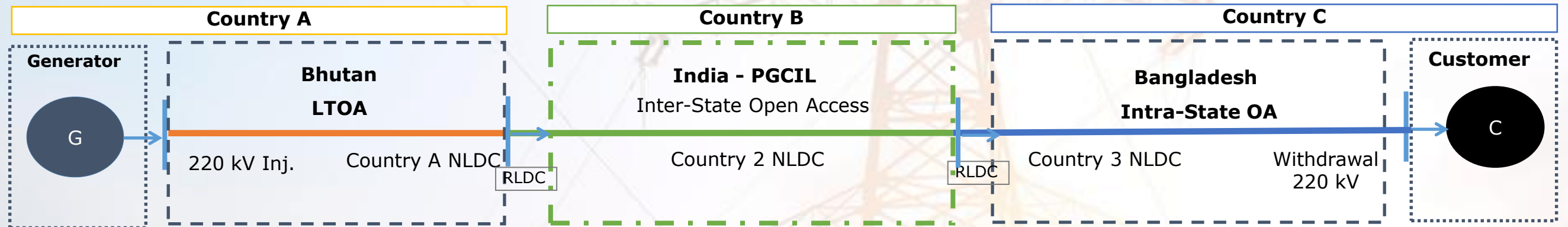
Rs 4.74 per kWh



South Asian Context

- Case: Regional LTOA between two countries

Customer is situated in Country C procuring power from generating station in Country A using transmission system of Country B



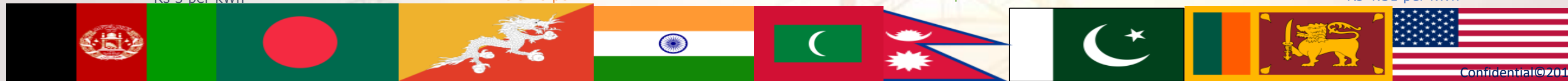
Injection	Country A transmission losses		Country B transmission losses		Country C transmission losses		Other Charges	Landed Tariff for Customer
Generation Tariff for 100 MW	Country A Transmission charges	Country A Operating Charges	Country B Transmission charges	Country B Operating Charges	Country C Transmission charges	Country C Operating Charges		

Rs 3 per kWh

Rs 3.28 per kWh

Rs 3.76 per kWh

Rs 4.31 per kWh



Developing Open Access Framework : Key requirements

- Specifying the Open Access eligibility criteria
 - Contract demand
 - Type of consumers
 - Type of OA – Short, Medium and Long Term
- Roles and responsibilities of Transmission Company
 - Independence of operations
 - Computation of Available Transmission Capacity (ATC)
 - Segregation of costs
- Identification of Infrastructure requirements
 - Installation of Special Energy Meters (SEMs)
 - Energy Accounting System
- Commercial Framework
 - Payment terms
 - Payment security for availing Open Access

Regional Open Access Regulations

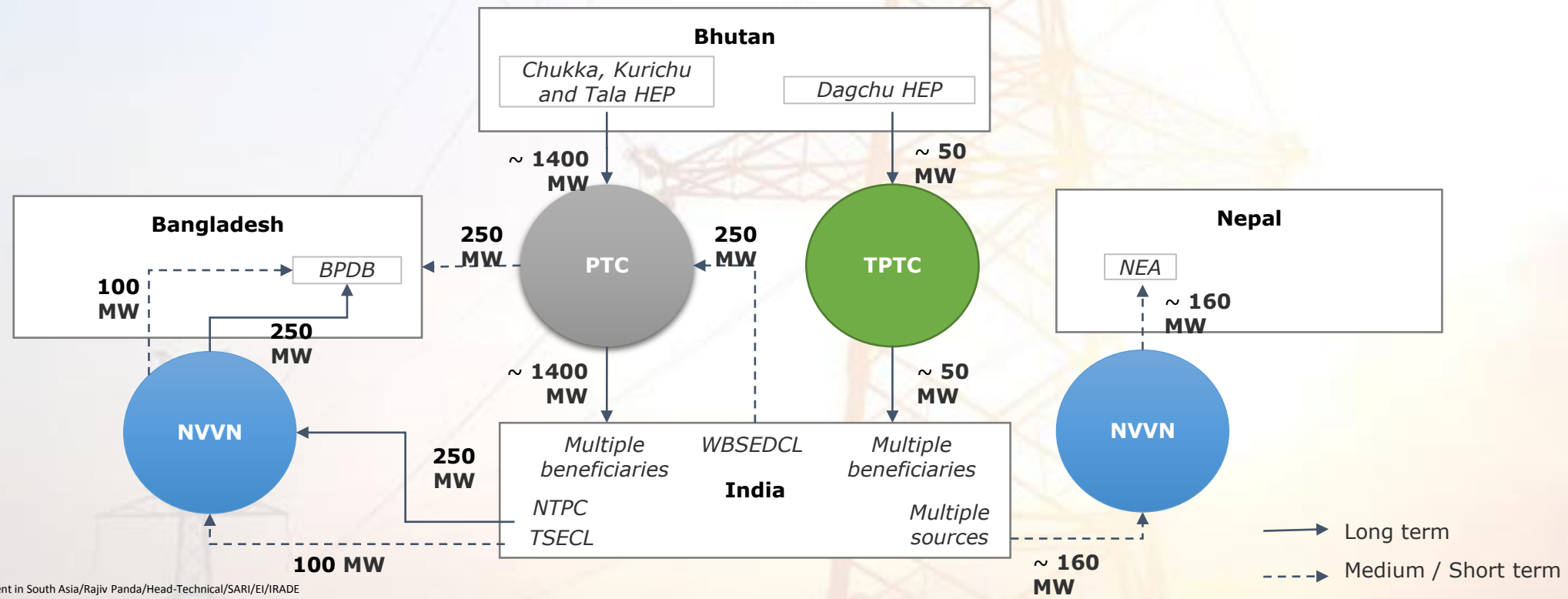
- Specify Open Access Categories – Short, Medium and Long Term
- Identify regional institutes for
 - Independence of operations
 - Computation of Available Transmission Capacity (ATC)
 - Determination of costs at inter-regional level
 - Standardization of infrastructure
- Commercial Framework
 - Transmission Service Agreement
 - Connection Agreement
 - Regulations specifying payment terms, settlement timelines



Power trading licensees and cross-border trade

- The presence of trading licensees in a power market can act as a catalyst to the development of cross border trade, as such licensees are expected to have access to a wide portfolio of buyers and suppliers.
- Trading licensees are also better placed to offer short term supplies that may be needed only on a seasonal basis.
- Trading licensees can participate in cross border electricity trade through Over The Counter contracts, without the aid of regional power exchanges, the setting up which may take time. This model is followed in South Asia, where India conducts cross border trade with neighboring countries through various trading licensees.

Major cross border trade through trading licensees in cross-border trade



Evolution of power trading license regime

- It was the market requirement and Government's vision to meet them that acted as the key driver for institutionalization of trading license regime in India.
- The need for a risk mitigation intermediary to encourage private participation in generation, as envisaged under revised Mega Power Policy 1998, led to the establishment of PTC India in 1999.
- A comprehensive framework for trading was provided by Electricity Act 2003 which led to the establishment of a robust trading license regime in India.

Incorporation of PTC India Ltd in April 1999 as a Government promoted entity.

Cross border trade: PTC takes over the cross border trade between Bhutan and India, from PGCIL, in Oct 2002

Open Access in transmission introduced; CERC's Trading License Regulations notified

Power Exchange Guidelines; Power exchanges IEX & PXIL launched

Major revisions in Fixation of Trading Margin Regulations. Trading margin of 4ps/kWh and 7ps/kWh depending on cost

1999

2000

2002

2003

2004

2006

2008

2009

2010

Commencement of trading – PTC India commences trading, with trading volume of 28 MU in FY 1999-2000.

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

CERC's Fixation of Trading Margin Regulations notified; Trading margin capped to 4 ps/kWh

Major revision in CERC Trading License Regulations – Specifies sets of eligibility & compliance criteria for a trading licensee



India Power Trading License Regime - Profile

Trading has become a well-established business in the Indian power sector. As on end of March 2016, there were 40 inter-state trading licensees, as per data made available by CERC.

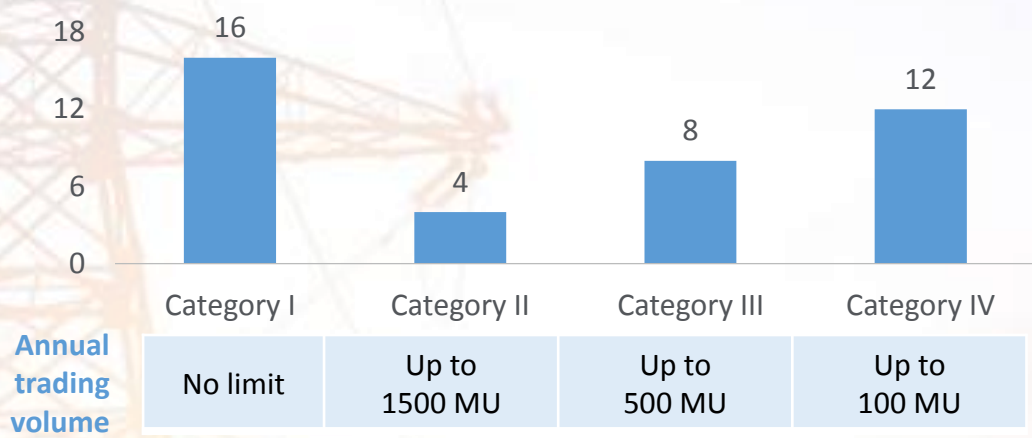
Out of the 40 licensees, 16 have Category I licenses, which is the highest category of license, with no limit on annual trading volume.

Trading licensees in India typically engage in both OTC based trade and trade through power exchanges.

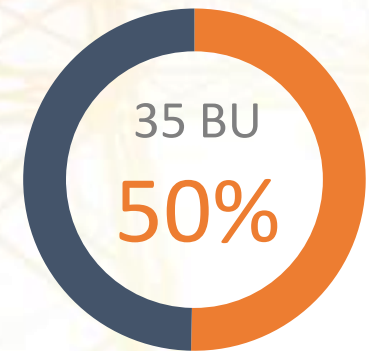
In FY 15-16, the volume of electricity transacted by the electricity traders was 35.43 BU, which is 50.31% of the total electricity transacted through traders and power exchanges. This is equivalent to around 4000 MW of RTC power.

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

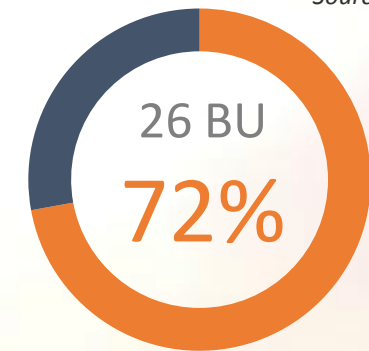
Number of inter-state trading licensees in India
(as on end of FY 2015-16)



Source: CERC



Share of traders in overall OTC and exchange based transactions in FY16



Share of top 5 traders in overall trading volume in FY16

Source: CERC



Developing Trading License Framework : Key requirements

Statutory support to trading as a licensed activity through legislation

- Definition of trading
- Specification of nodal agency for grant, amendment and revocation of licence
- Specification of nodal agency for monitoring, regulation and dispute resolution of trading licensees
- Emergency provisions to control / curtail trading

Detailed regulations regarding trading licensees

- Categories of trading licensees
- Financial and technical qualification criteria
- Procedure for grant, amendment and revocation of license
- Terms and conditions of trading licence
- Monitoring and reporting framework
- Specification of license application fee

Ancillary regulations

- Price control through cap on trading margin
- Specification of annual license fee

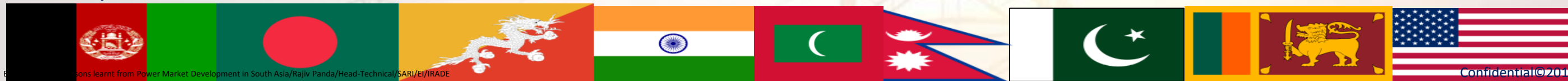
Regional Trading License Regulations

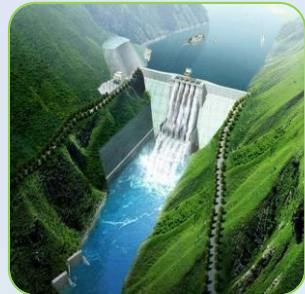
Regulation on grant of authorization for cross border trade

- Specification of nodal agency for grant, amendment and revocation of authorization
- Specification of nodal agency for co-ordination and implementation of cross border trade
- Additional qualification criteria, reporting framework and terms & conditions for authorization to conduct cross border trade

Operational framework for authorization for cross border trade

- Agreement with the nodal agency for establishing co-ordination mechanism, communication, payment security etc.





Prospect for South Asia Regional Power Market Development for Cross Border Electricity Trade (CBET) in South Asia



Current CBET Policy and Regulatory Governing Framework

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

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

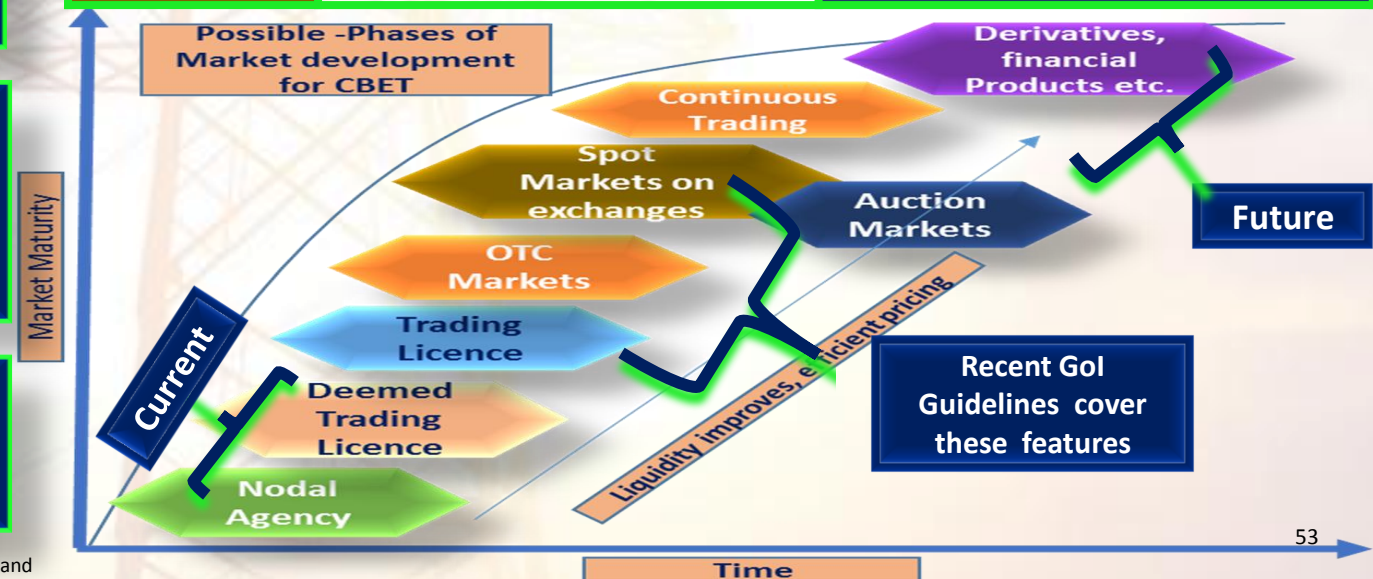
India-Nepal-:1.Power Exchange Treaty 2. Agreement on electric power trade, cross-border transmission interconnection 3. River Treaties

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

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

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

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



Approach and Challenges for CBET & Development of South Asia Regional Power Market

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 CBET through Power Exchange(Gradual opening of Products**)

Challenges

✓ Different of policy, legal, and regulatory mechanisms

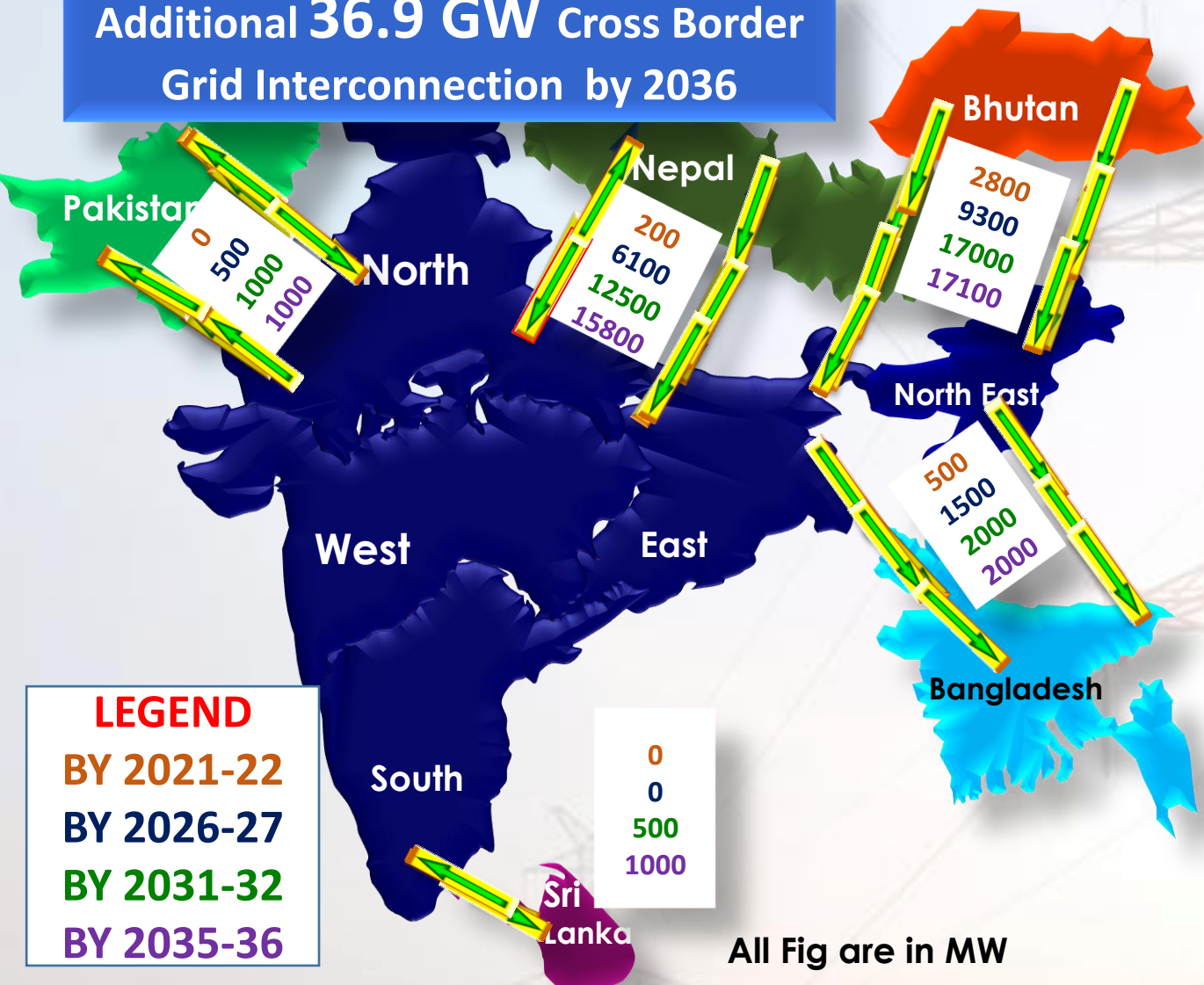
✓ Countries are Different stage of power sector , depth of regulatory framework

✓ Building Strong of transmission system interconnections;

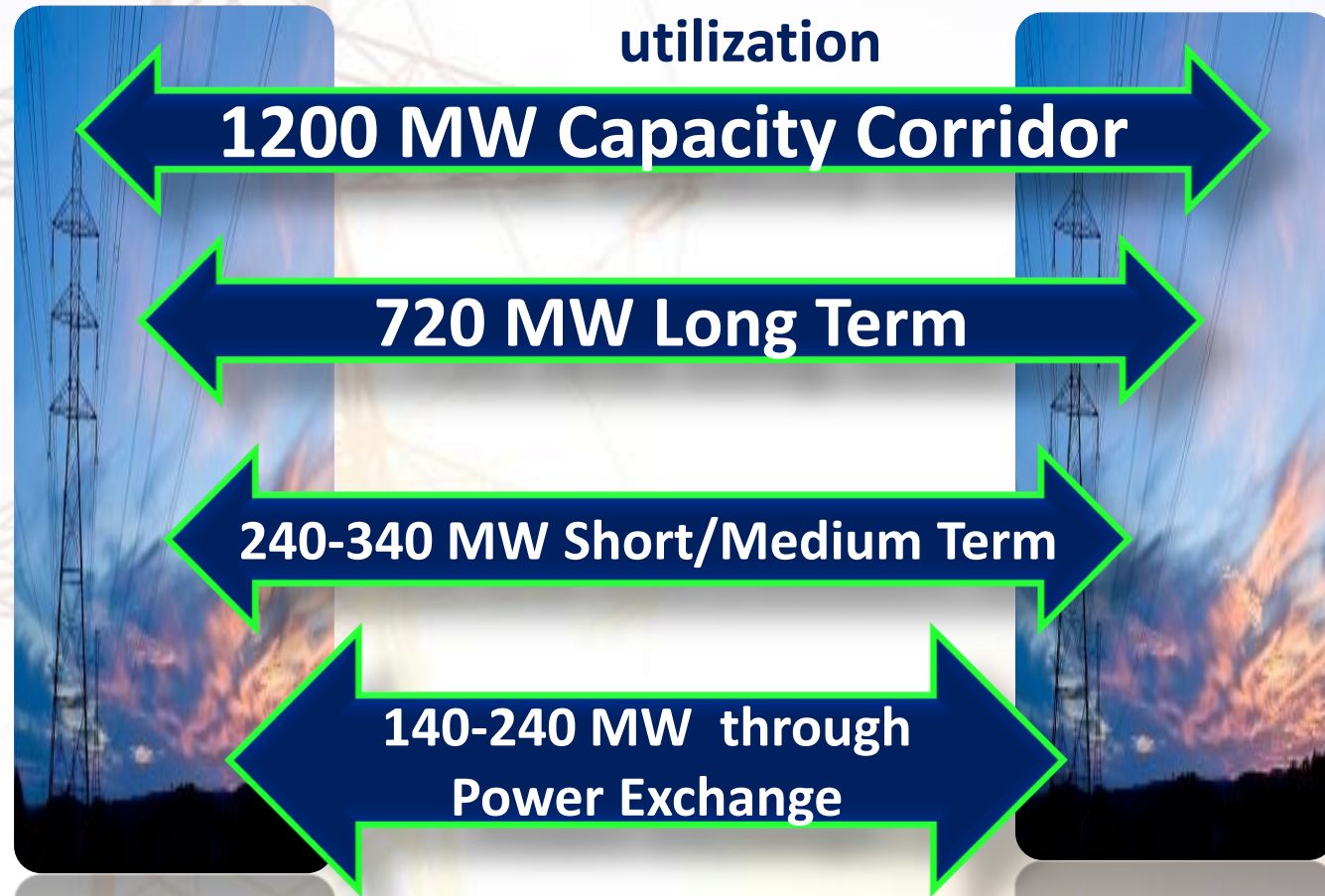
✓ Developing Regional Electricity Markets from bilateral markets

Regional Transmission Interconnection Capacity by 2036, Development of Cross Border Transmission Infrastructure, Regional Power Market Segment

Additional 36.9 GW Cross Border Grid Interconnection by 2036



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



Regional Power Market Segment Balance Product Portfolio

Source Data : <http://www.cea.nic.in/reports/others/ps/pspa2/ptp.pdf>

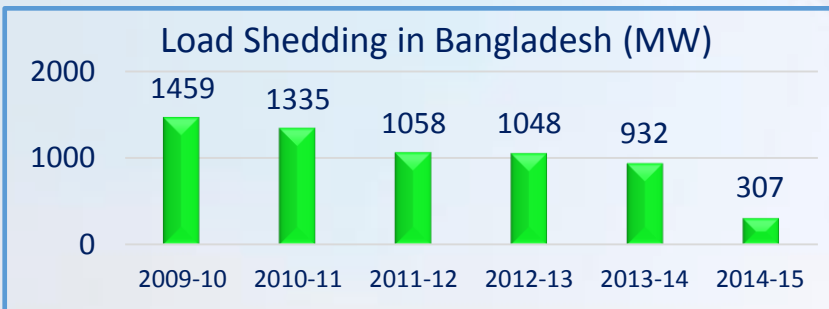
Perspective Transmission Requirements for 2022-36 Bangladesh is in the process of Planning to Import around Apprx. 6000 MW by 2034 (PMSP 2015-JICA Presentation, 4th June, 2015)

Disclaimer : By making any reference to a particular geographic area or by using the term "country" and Map in this document, IRADe/USAID does not intend to make any judgement as to the legal or other status of any area/Map. The map used is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area

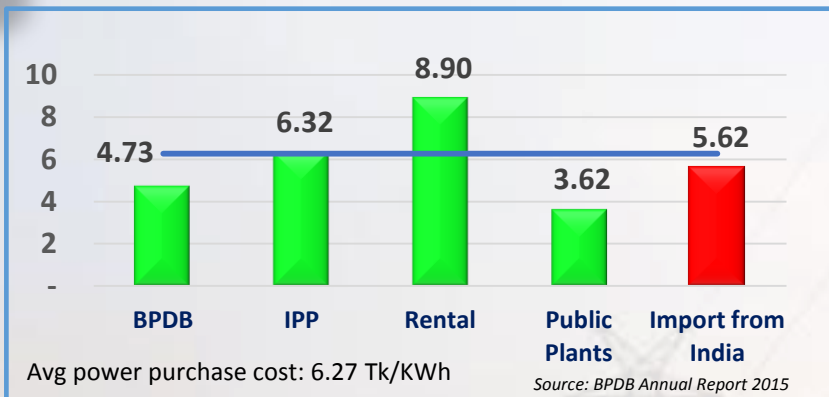
Cross Border Electricity Trade in South Asia and Key Message

India-Bangladesh Interconnection

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



Access to Cheaper source of Electricity



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

India-Bhutan Interconnection

- Bhutan envisages the development of at least 10,000 MW by 2020.

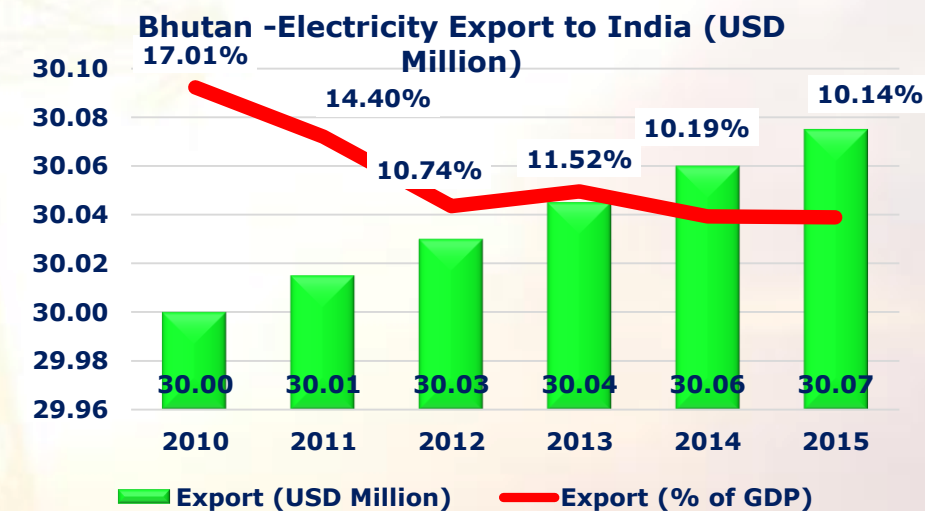
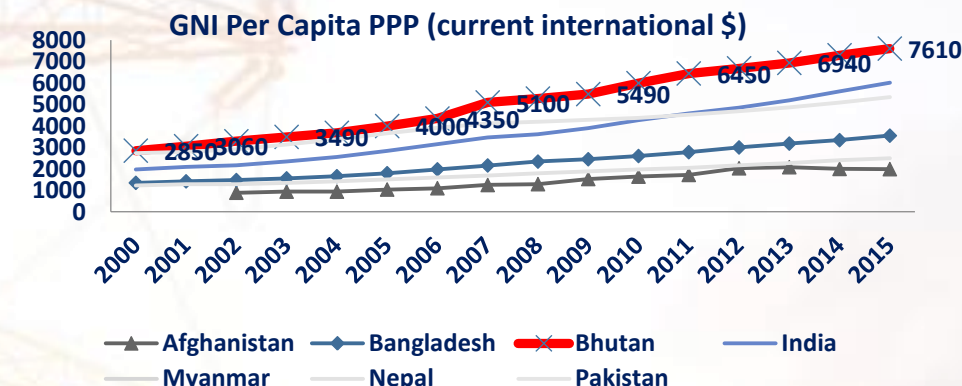
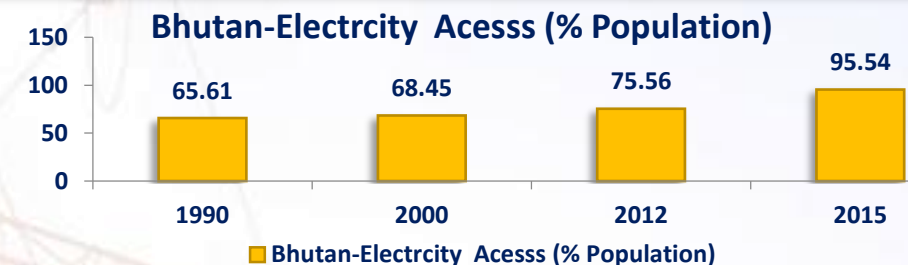
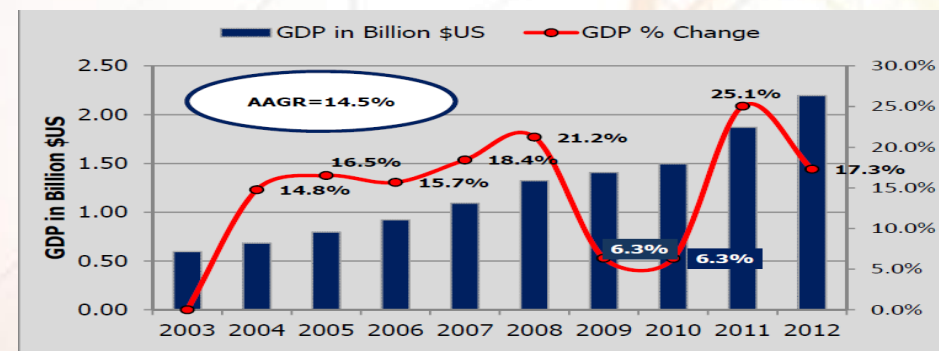
- 95% of Population Electrified.

- Close to 75% of all electricity generated is exported to India.

- Hydropower exports (only surplus) provided more than 40% of Bhutan's revenues, and constitute 25% of its GDP *. Now it is around average 12.28%. Since 2010.

- Helps in Sustaining High GDP Growth Rate, Modernization of power infrastructure.

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



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

* <http://www.oecd.org/countries/bhutan/48651659.pdf>

Why Short Term Spot Market ?

CBET 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).

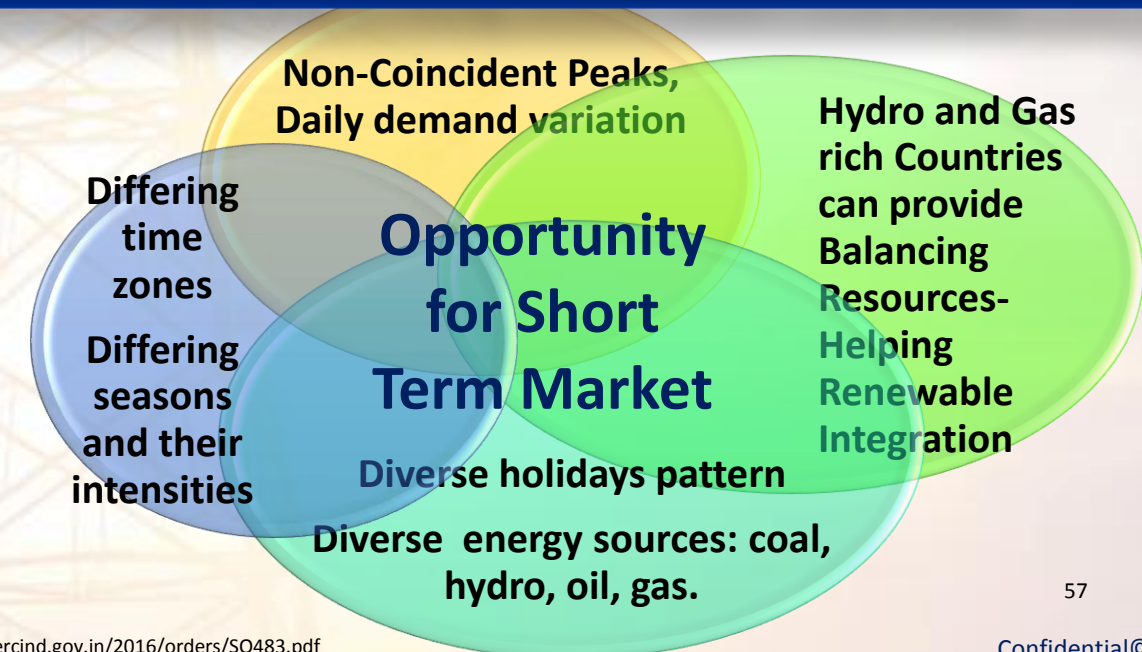
Draft Regulation by CERC has been issued , public hearing has been conducted(Feb,2017)

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 CBET through Exchange –Options for South Asia

- Existing power exchanges in one country in the region was graduated to operate as cross border power exchange. Other countries of the region start joining the exchange (Nord Pool*)
- No existing power exchange in the Region, Countries together Jointly form a Regional Power Pool (SAAP, WAAP) .
- Power exchange exist in various countries of a Region, power exchanges coordinated among themselves through coupling for cross border power exchange (Europe).
- Cross Border Power Exchanges mostly have TSOs, national PXs or market operators as owners.
- In South Asia, India** has two operating power exchanges. In India power exchange are private sector initiative.

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

Options for South Asia

Immediate Step

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

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

Medium/Long Term

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

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

Four Pillars of Market Design



Congestion Management



Ancillary Services



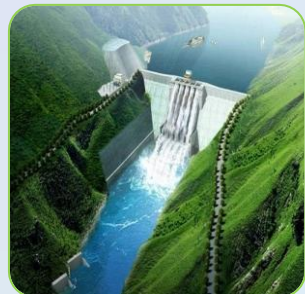
Imbalances



Way Forward for creation of Regional Power Market

- Political Support at Regional Level is essential for Regional Power Market and Power Exchange Formation. Consensus on the Policy, legal, regulatory, technical and commercial aspects.
- Coordinated Harmonization of Legal , Regulatory and Policy Framework form the perspective of CBET only. A minimalist approach is advised to be followed from the view of CBET only, But no compromise on transparency, accountability.
- However basic requirements for Regional Power Market to be put in place such as
 - *Power Trading as distinct activity, Robust Transmission System*
 - *Regional Scheduling & dispatch mechanism , imbalance settlement Mechanism ,Congestion Management, regional transmission pricing*
 - *Open access in Transmission, Transmission pricing, Treatment of Losses ,Assessment of Transfer Capability.*
 - *Regulatory coordination, Coordinated system planning, Monitoring.*
 - *Efficient and Independent system operator; rule, process and guidelines for coordination of trade transactions among operators.*
- Strong transmission interconnection infrastructure will be crucial

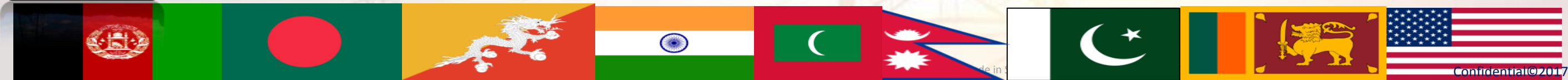




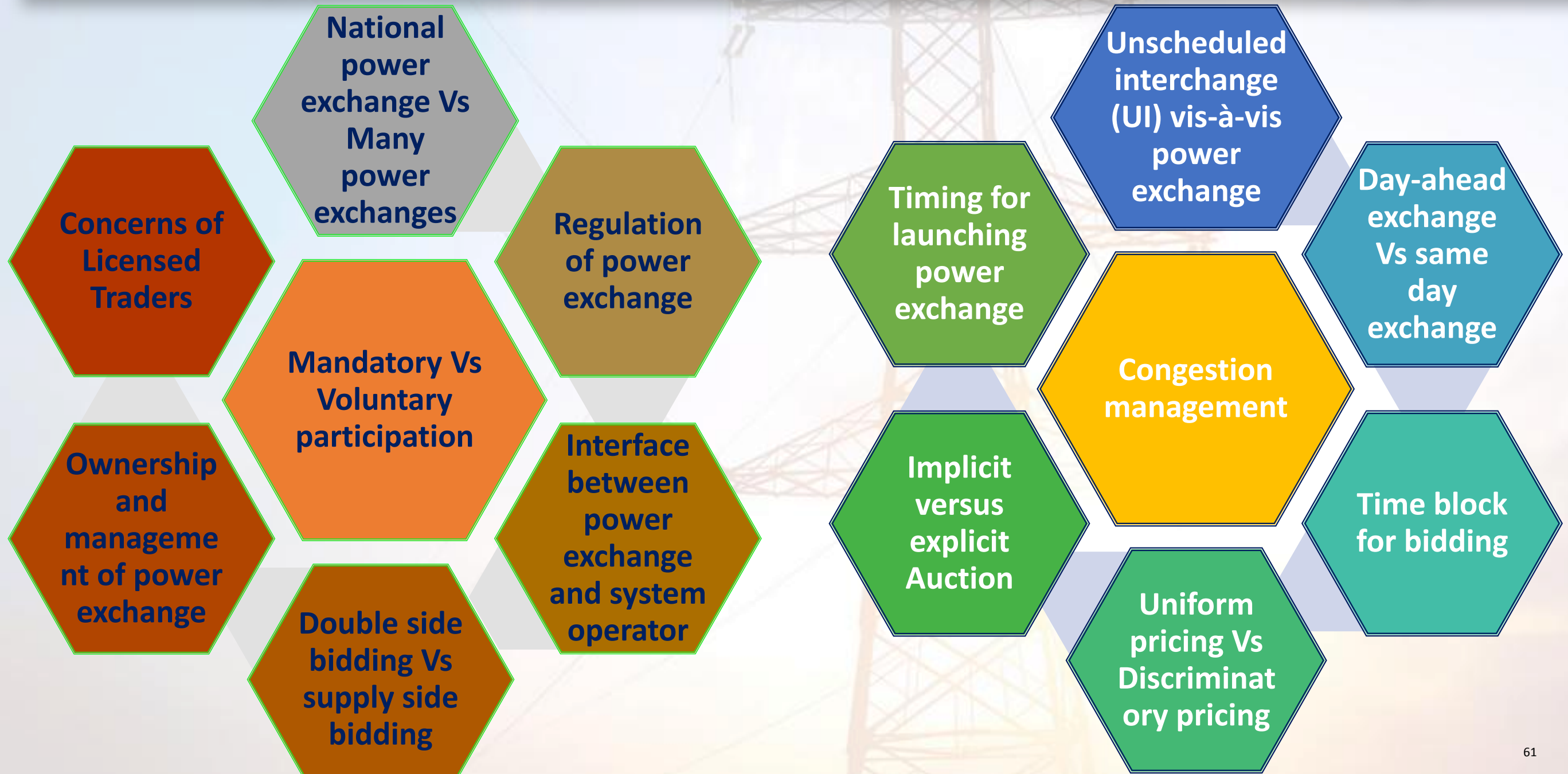
“You can't cross the sea merely by standing and staring at the water.” - Rabindranath Tagore

Thank You

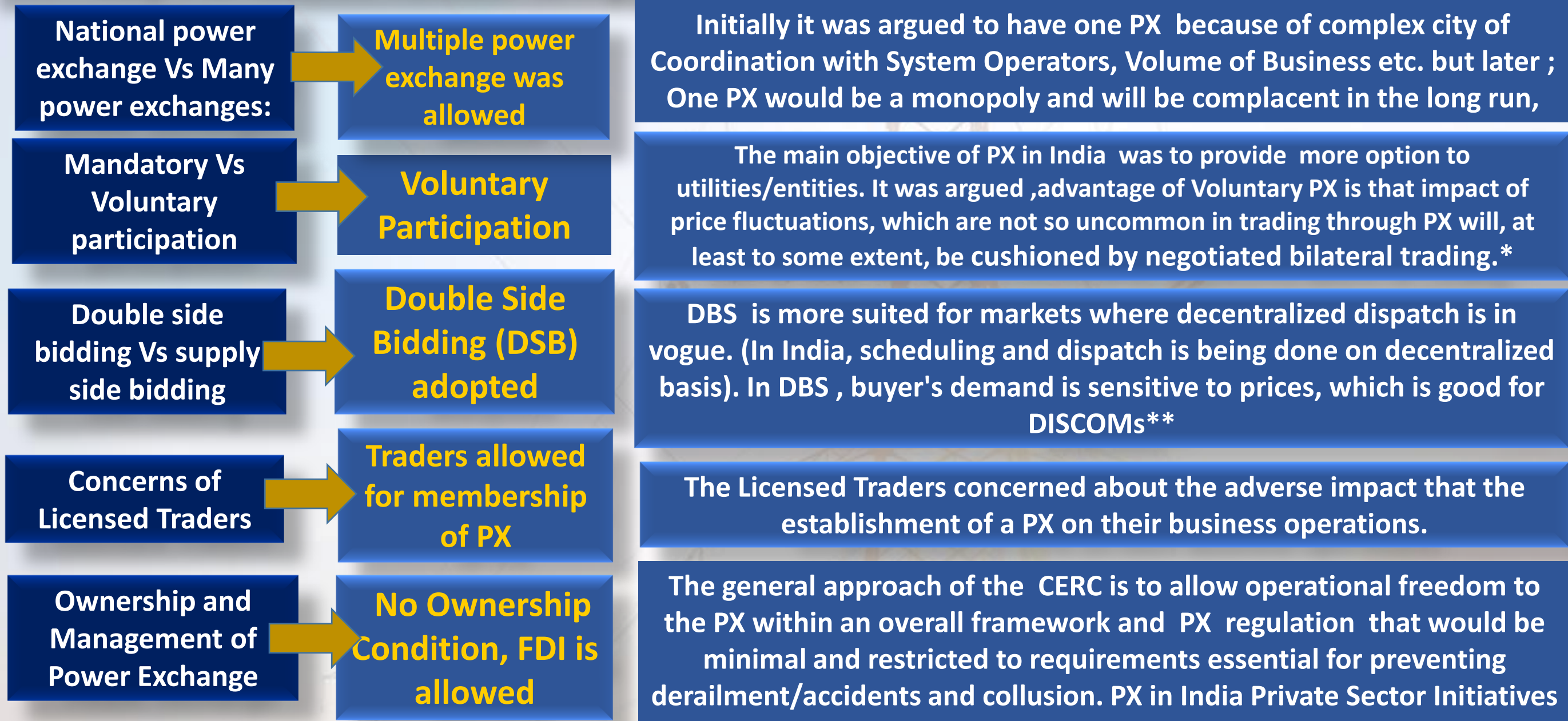
Contact
rajivratnapanda@irade.org
rajivratnapanda@gmail.com



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

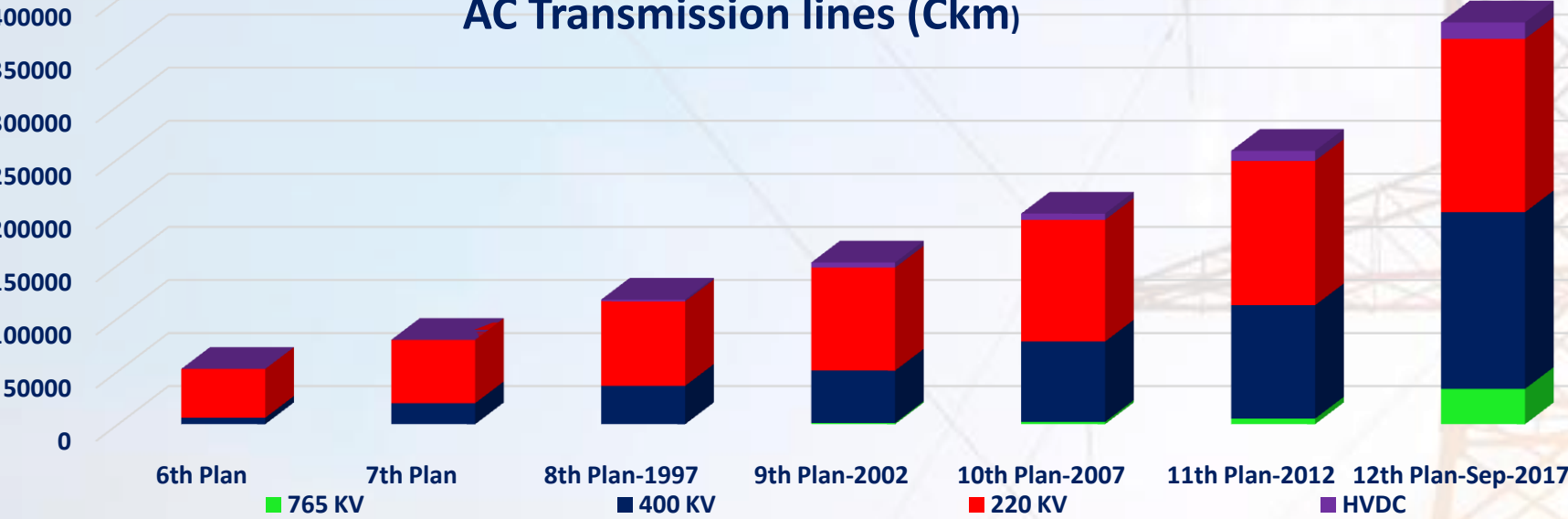
Have we learned something from these for customized adaptation ?

International Experience : Comparison

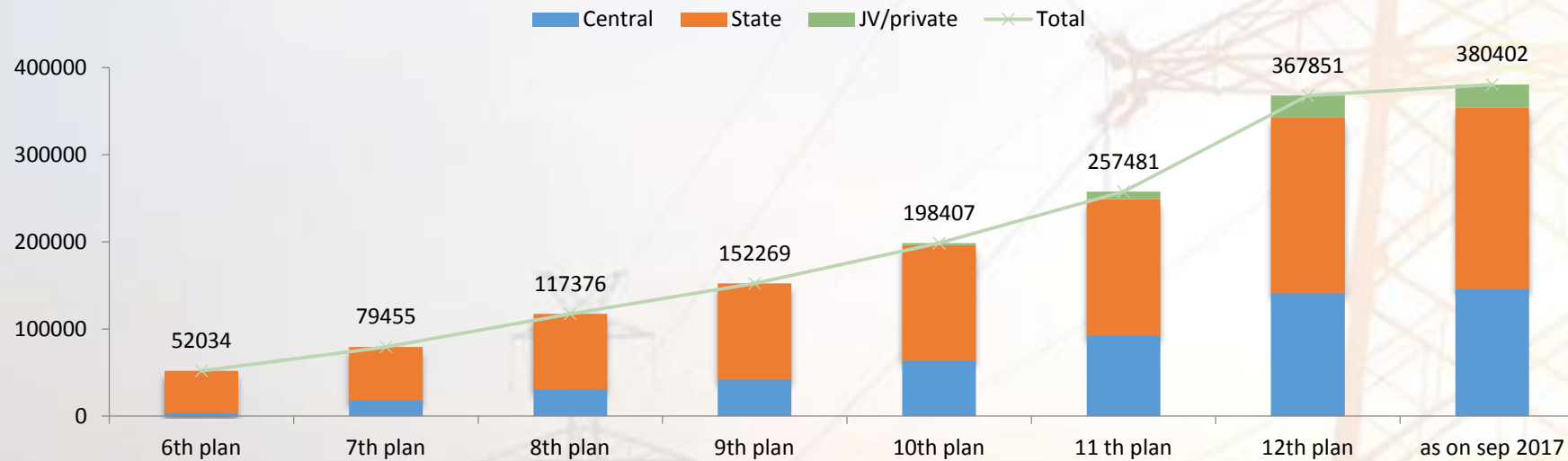
	Nord Pool	PJM	AEMO	India
Participation	● Voluntary for DAM	Compulsory for Real Time	Compulsory for DAM	● Voluntary
Market Offerings	● DA spot, hour-ahead, forward, futures, options	DA spot, real-time balancing, capacity credit markets	DA spot, Short term forwards	● DAM, TAM
Bidding Type	● Double Sided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

Growth in Transmission Capacity

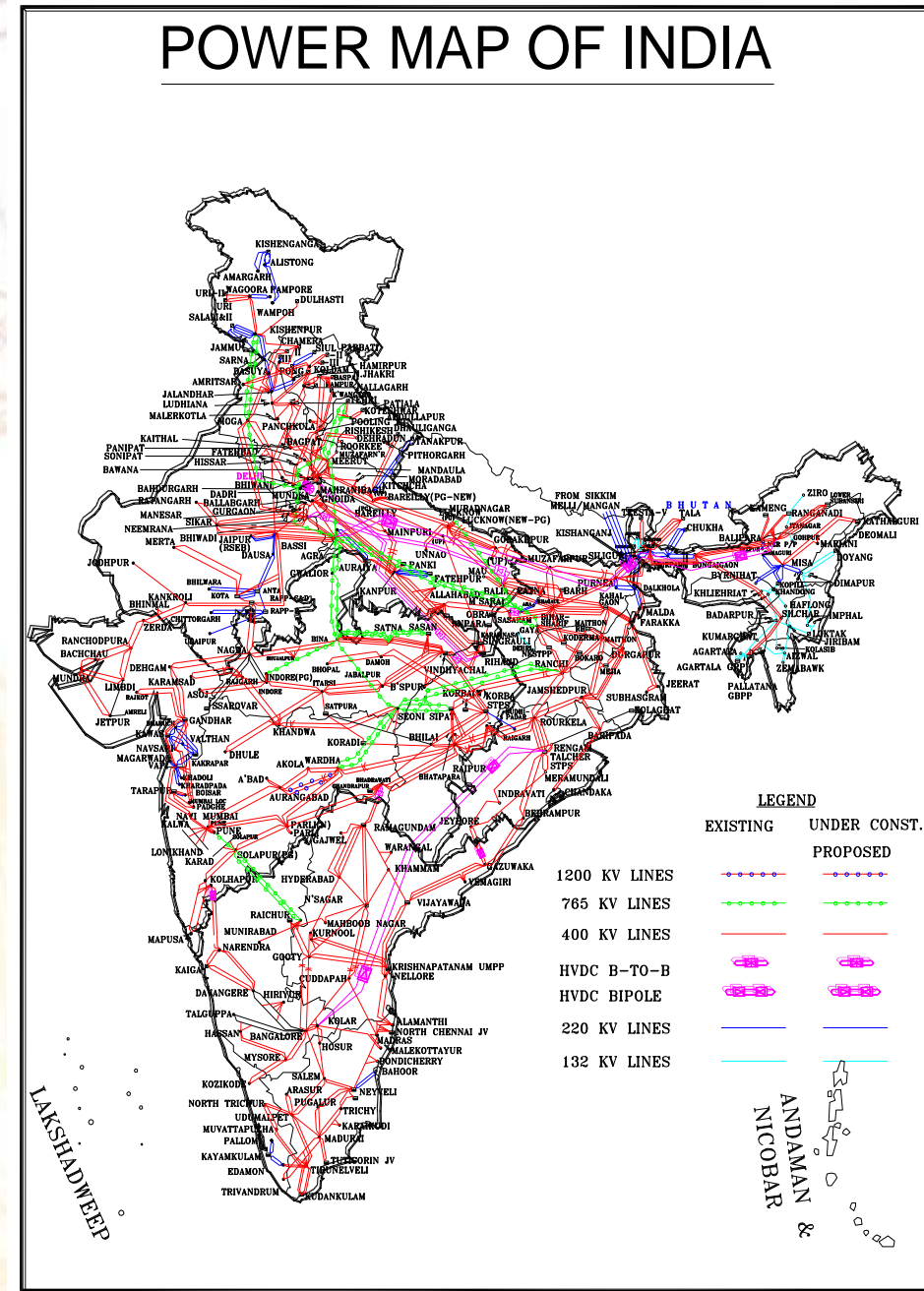
Growth in Transmission AC Transmission lines (Ckm)



Growth in Transmission Capacity



POWER MAP OF INDIA





South Asia Power System- Technical Info-Gap Analysis

	Voltage		Frequency	
	Normal	Emergency		
Bangladesh	Normal: $\pm 5\%$	Emergency: $\pm 10\%$	49 Hz to 51 Hz	
Bhutan	Normal: $\pm 5\%$	Alert: $\pm 10\%$	Normal: 49.5 Hz to 50.5 Hz	Alert: 49 Hz to 51 Hz but above Normal range.
India	Normal: $\pm 5\%$ for 400 kV, 765 kV, $\pm 10\%$ for 220 kV & below.	$\pm 10\%$ for 220 kV & below.	49.9 Hz to 50.05 Hz	
Nepal	Normal: $\pm 5\%$	Emergency: $\pm 10\%$	48.75 – 51.25 Hz	
Pakistan	Normal: 8% and -5% .	Emergency: $\pm 10\%$	49.8 Hz to 50.2 Hz(Frequency sensitive mode)	49.5-50.5 (Tolerance Frequency band) 49.4-50.5(Load shedding threshold and contingency frequency band)
Sri Lanka	Normal: $\pm 5\%$ for 132 kV, $\pm 10\%$ for 220 kV.	Emergency: $\pm 10\%$	49.5 Hz to 50.5 Hz	

Acceptable Voltage Deviations are similar but the permitted frequency deviation is different- Need to harmonize for synchronous interconnection

Except India, grid codes of all other SA nations specify the same voltage variation limits for both planning and operation stages.(For India :refer CEA's manual on transmission planning).

For (India) Planning studies +/-2% 765kV; +/-3% 400 kV; +/-5% to 7% for below 220 kV



South Asia Open Access – Overview

Country	Transmission Unbundling	ISO	Independent Regulator	OA Policies	OA Regulations	Pricing framework	Operational Framework - CBET
Afghanistan	No	No	No	No	No	No	No
Bangladesh	Partial	No	BERC	No	No	No	Partial
Bhutan	Partial	No	BEA	No	No	No	No
India	Yes	No	CERC/ SERC	Yes	Yes	Yes	Yes
Maldives	No	No	MEA	No	No	No	No
Nepal	No	No	ETFC*	No	No	No	No
Pakistan	Yes	No	NEPRA	No	No	No	No
Sri Lanka	No	No	PUCSL	No	No	No	No

* Only for Retail Tariff Determination





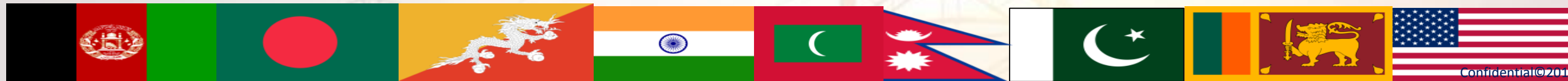
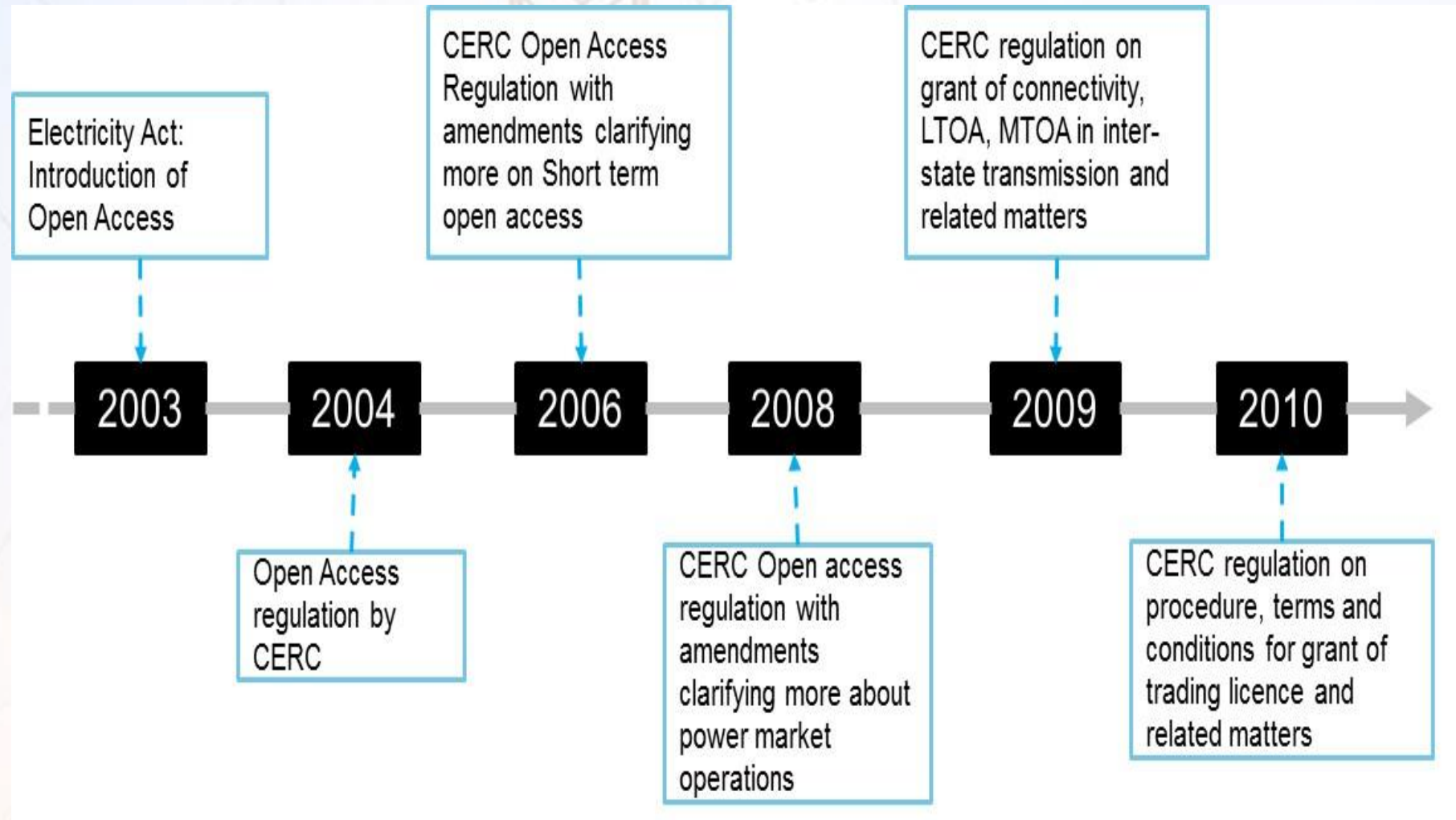
USAID
FROM THE AMERICAN PEOPLE



Open Access framework in India has evolved over time

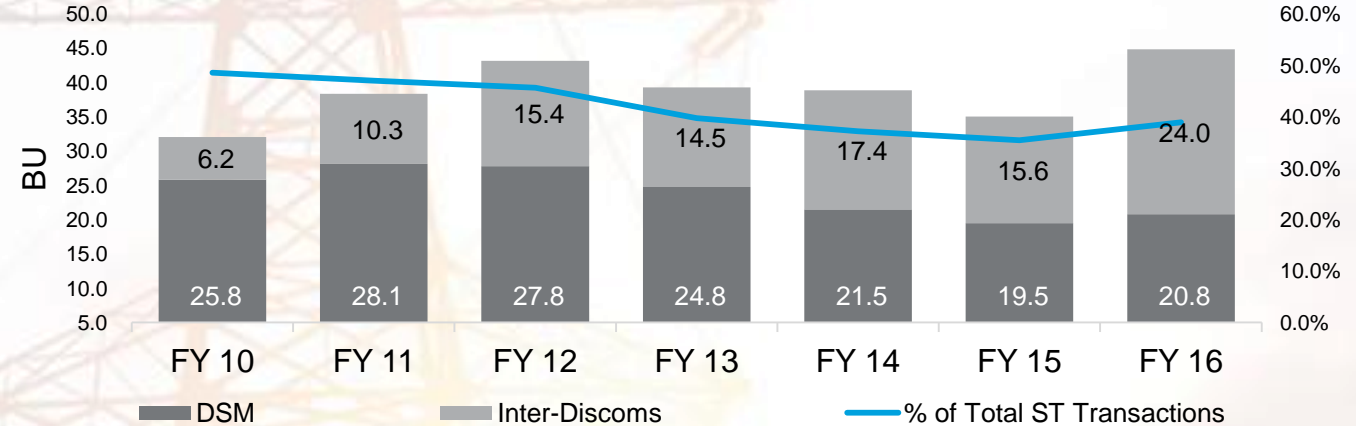
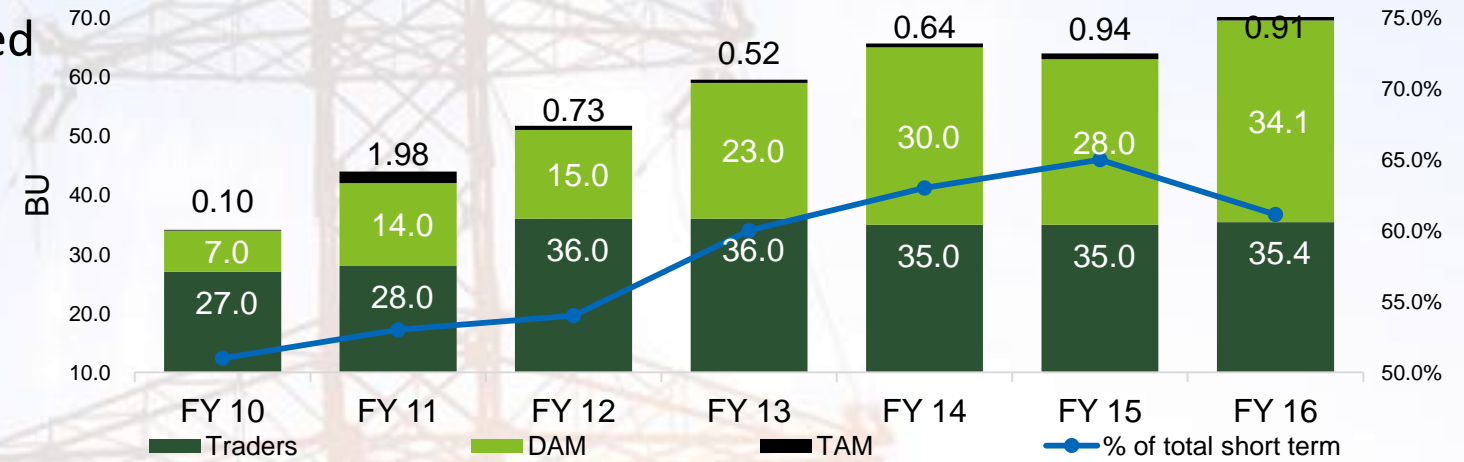
"non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulation specified by the Appropriate Commission"

Section 2(47) of Indian Electricity Act 2003



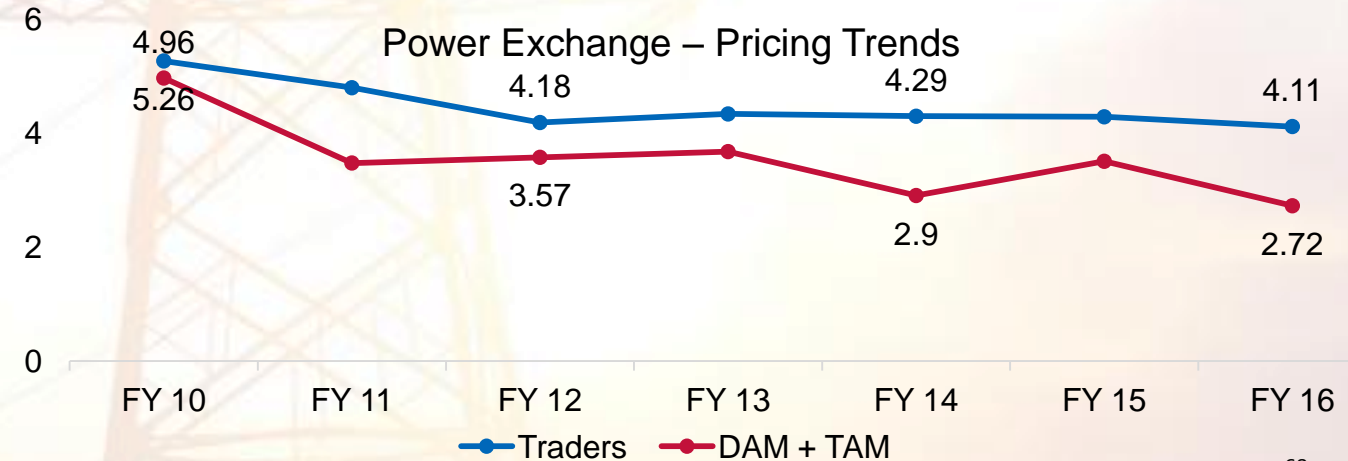
Short Term Electricity Trades

- 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



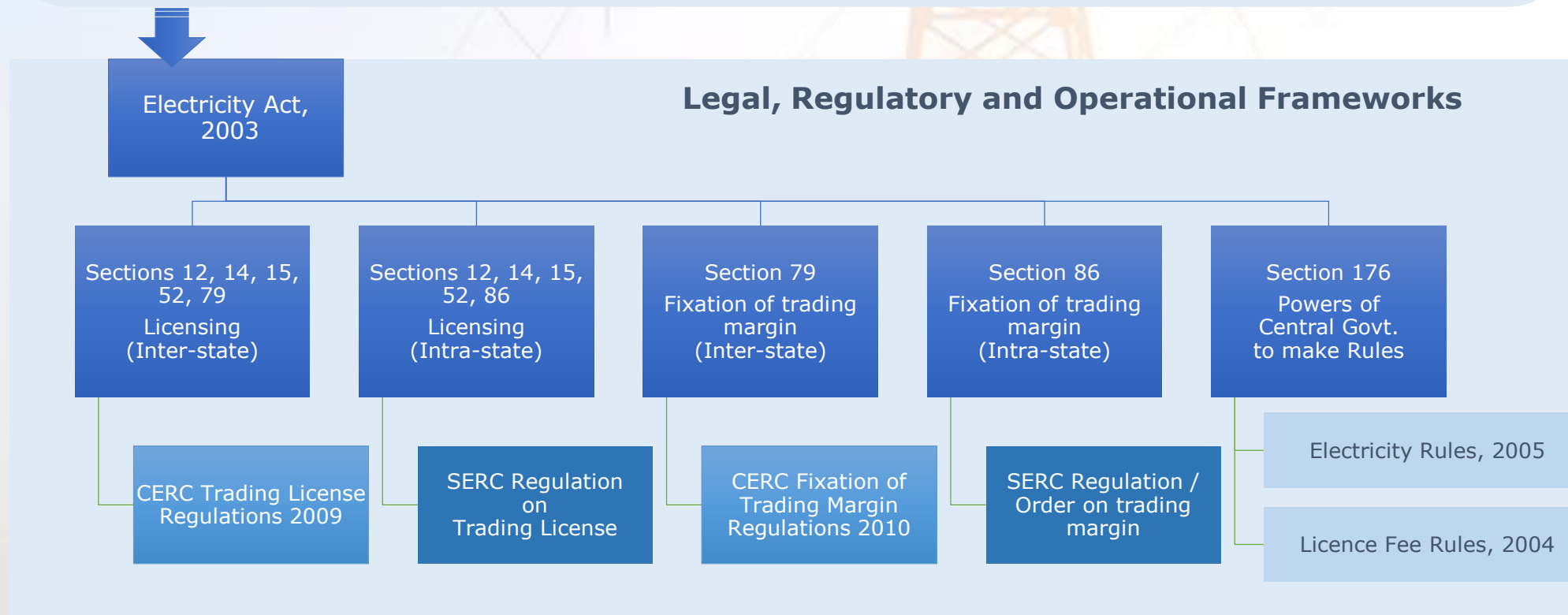
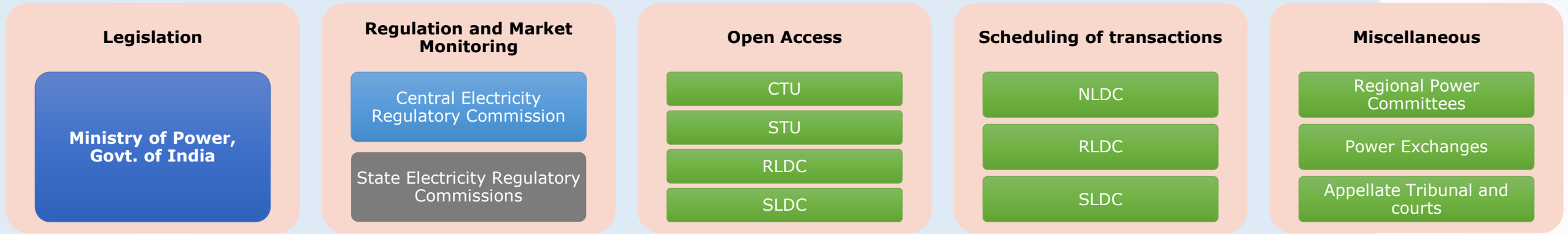
In monetary terms, short-term market size was Rs 24,096 crore, which was 4% less than in the year 2014-15

Traders versus Power Exchange

Parameters	Bilateral Trades	Power Exchange
Contract Tenure & Scheduling	Intra-day and from 1 day up to 1 year on Firm Bilateral Scheduling	Intra-day, 1 day-ahead & up to 7 days under Collective Scheduling
Contracted Tariff & Market Risk	Fixed with no variation linked to market / fuel	Transparent Price Discovery - Depending up on market conditions; Volatile & Risky
Requirement / Usefulness	Management of Surplus/Deficit on Firm Basis	Balancing Mechanism for Day-Ahead Surplus/Deficit
Billing & Payment	Weekly billing; Payment within 7 days up to 30 Days	Advance Payment with Daily Billing
Credit Available	14 days up to 37 days	No Credit; Advance Payment
Rescheduling & Surrender	Allowed on 2 days notice	Not Allowed

Framework of trading license regime in India

Institutional Framework



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

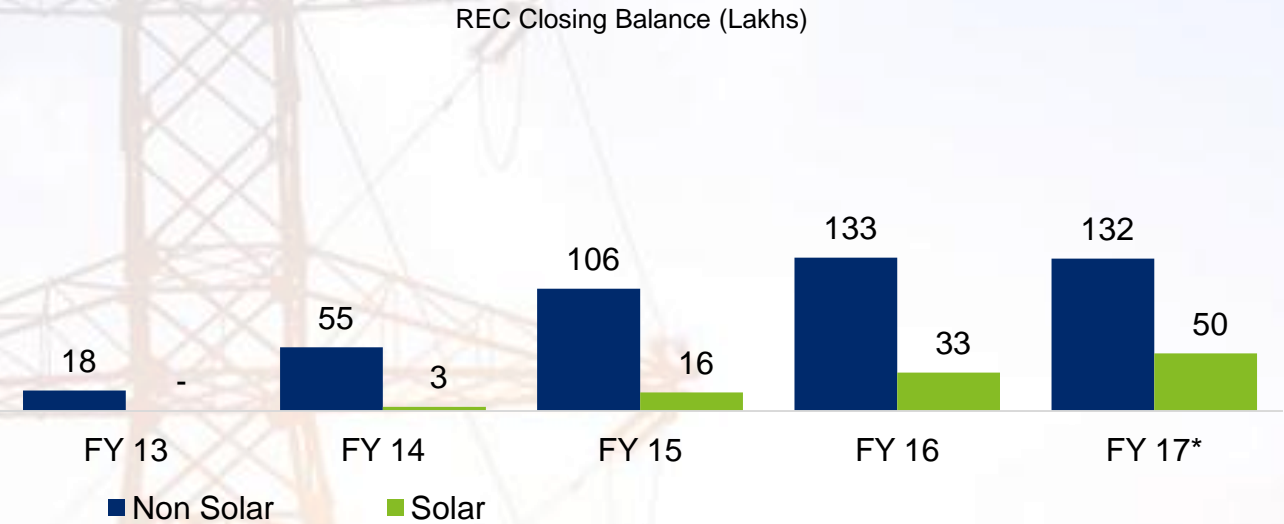
Market clearing volume of Non-Solar RECs transacted in FY 2016

- 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

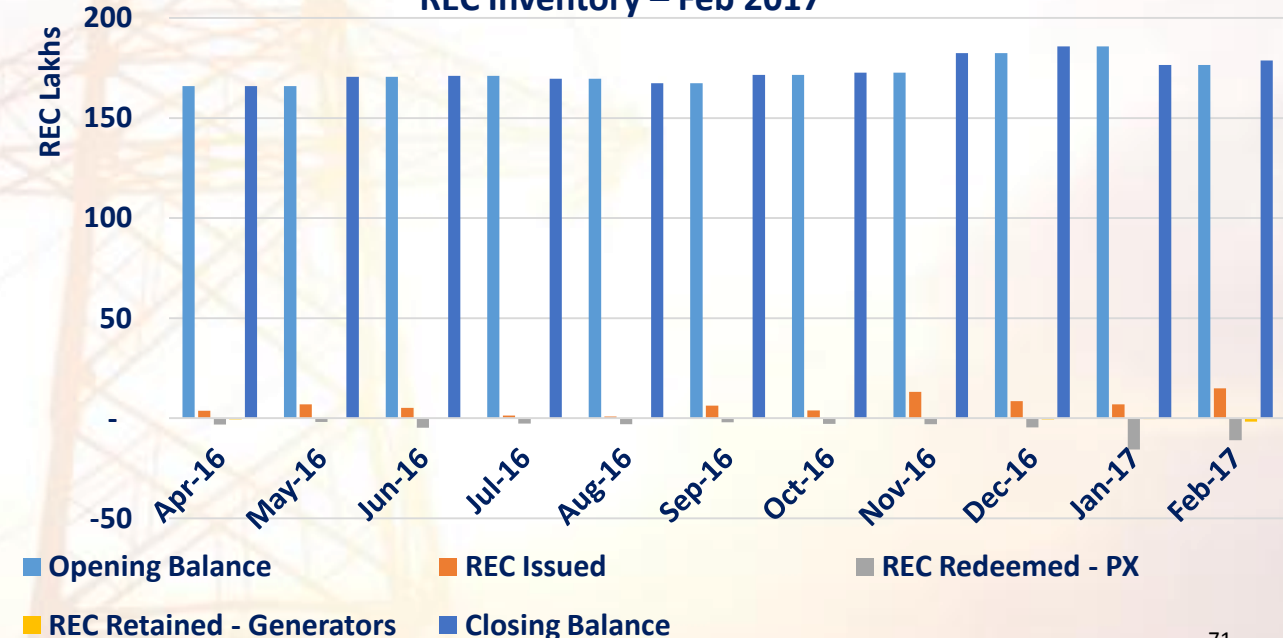
REC Inventory - FY 2017

- Opening Balance (Apr 2016): 165,91,968
- Closing Balance (Feb, 2017): 178,79,467

REC Closing Balance (Lakhs)



REC Inventory – Feb 2017



India Power Market Design

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

Power Exchange Market Products-- Term Ahead Market (TAM)

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

– Key features

- Trading of Region specific contracts
- Firm Delivery: Contracts under Term Ahead Market can be used to ensure delivery of electricity for a few days in advance
- Delivery Blocks:
 - Round the Clock (RTC)
 - Day
 - Night
 - Peak
 - Hourly
- Risk Management by collection of margins as specified in the Bye-Laws, Rules and Business Rules of the Exchange

Power Exchange Market Products - Day Ahead Contingency (DAC)

- Day-Ahead Contingency auction for all the 24 hours, subdivided into hourly contracts.
- Allows Sell bids region wise for the first hour of trade followed by Buy bids
- Buyers allowed to see price and the region of the Seller but the seller identity will not be revealed. Buyer can bid for any region that is feasible for him.
- Auction mechanism is used with Differential pricing
- Bids matched are included in the day-ahead schedules
 - Buy trades settled at or below the quoted price and Sell trades are settled at or above the quoted price
 - There is complete anonymity of the bids between members
 - There is a Bilateral contract between Buyers and Sellers.
 - Financial settlement and clearing is done by the exchange.
- DAC market comes under the Bilateral Transactions.
- Scheduling procedure is handled by Nodal RLDC (Buyers region RLDC) in case of DAC
- Congestion management through curtailment or re-routing of trade as per the instructions of Nodal RLDC or SLDC

Power Exchange Market Products - Intra-Day

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

Salient Features of Intra-Day Product:

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

Renewable Energy Certificate (REC)

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

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

Cross Border Electricity Trade Investments: Risk

Why Cross-border Electricity Trade Investment are Risky

- Project risks in general tend to be high with out a comprehensive Policy, Regulatory framework for **large CBET project development.**
- Cross-border element greatly amplifies the risks due to **geopolitical, economic and trade related factors.**
- Even projects that appear to have feasible , rationale, economical **in practice struggle to get it financed and built.**
- Project risks in general tend to be high in **countries without wide experience on large project development.**



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



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



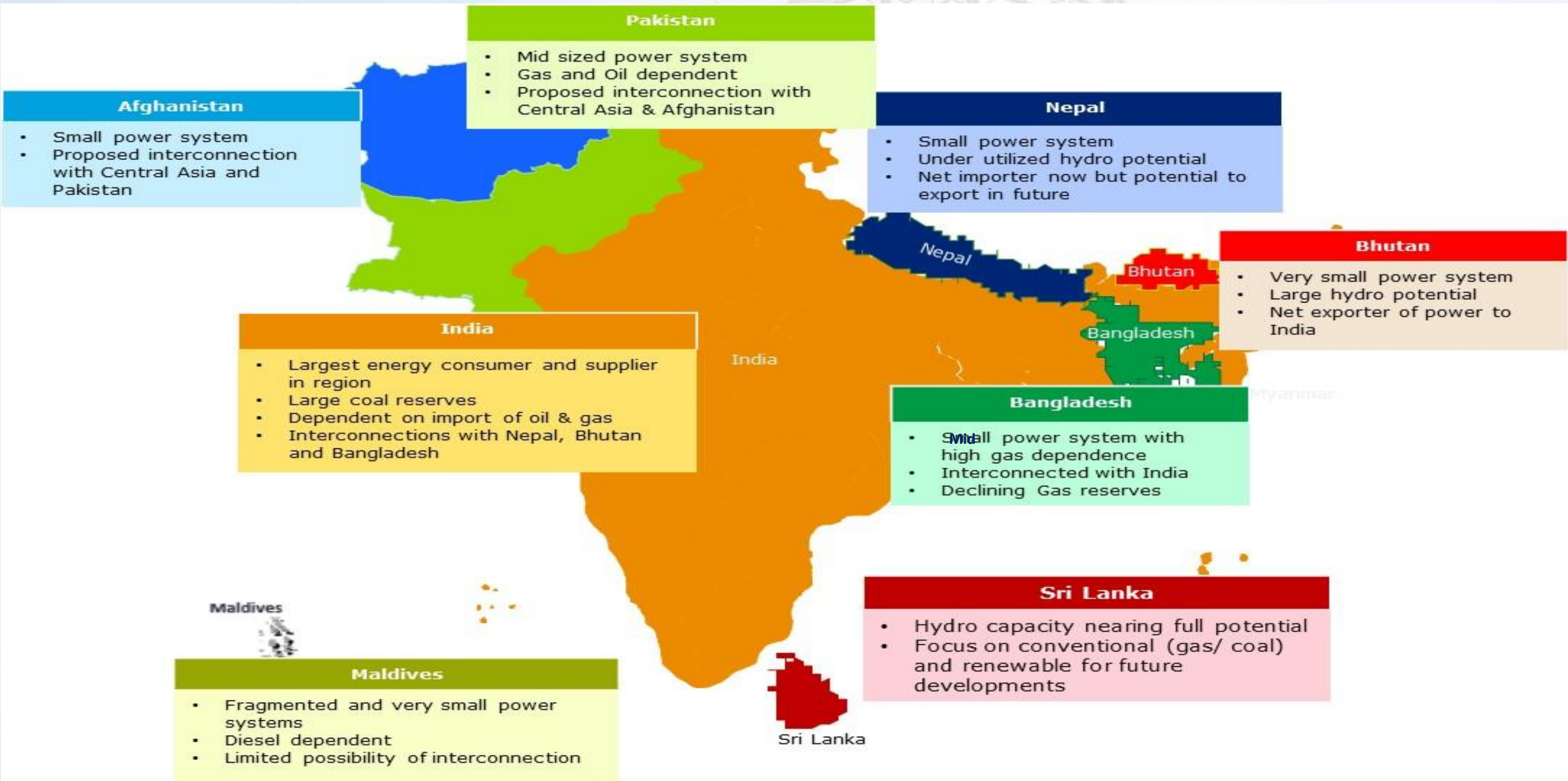
Economic: What happens if the economic assumptions on the project changes? What is the protection available to buyers and sellers ?



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



Infrastructure: What happens if the infrastructure to transfer the energy is not built or is not available when needed ?



South Asia Regional Power Market Development for CBET

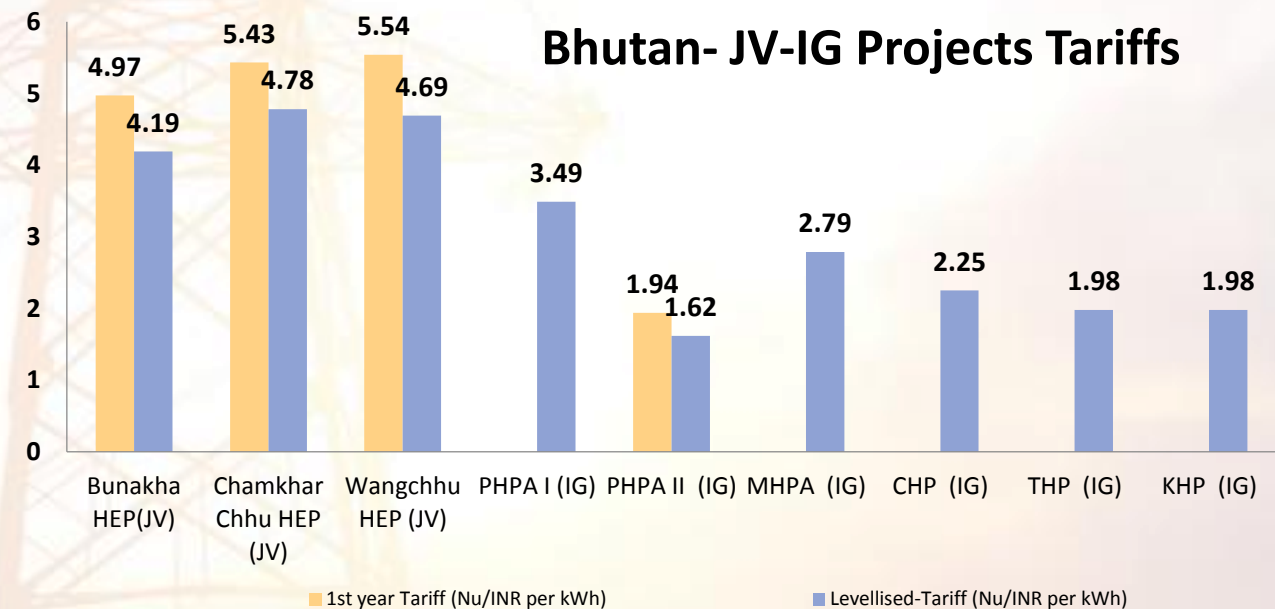
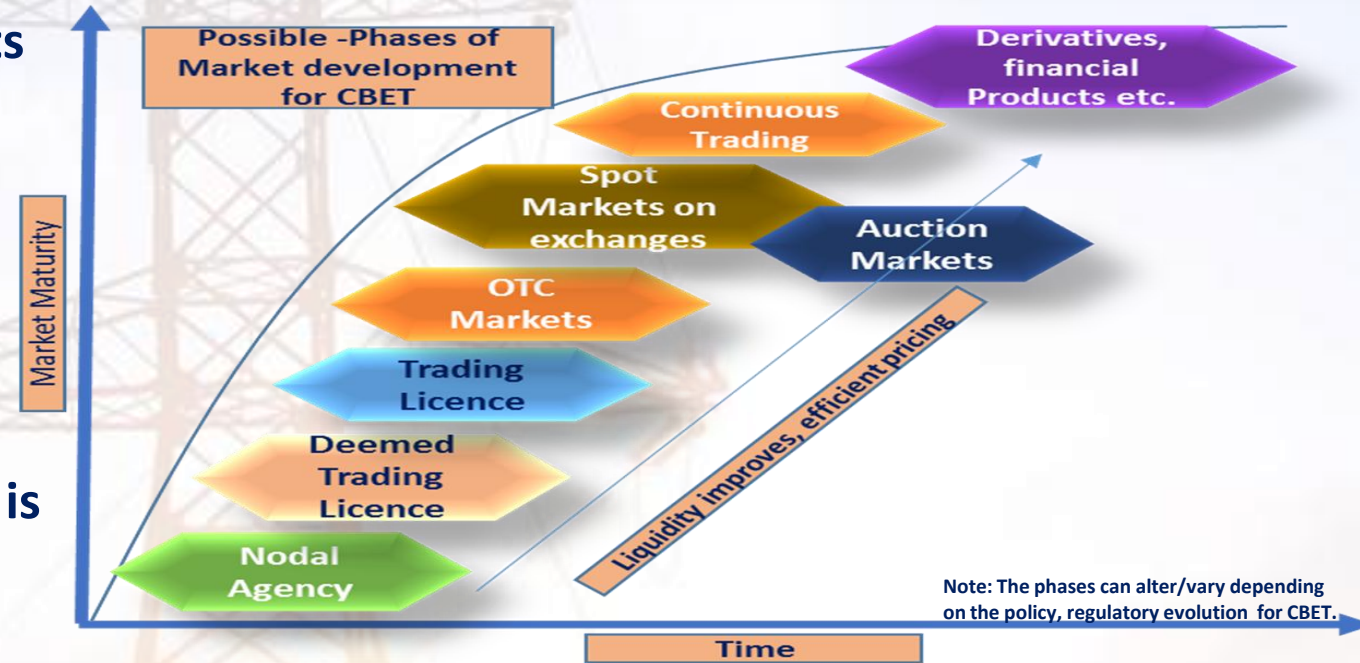
• Currently most of the Cross Border Electricity Trade projects are backed by government and rightly so as it brings confidence.

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

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

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

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

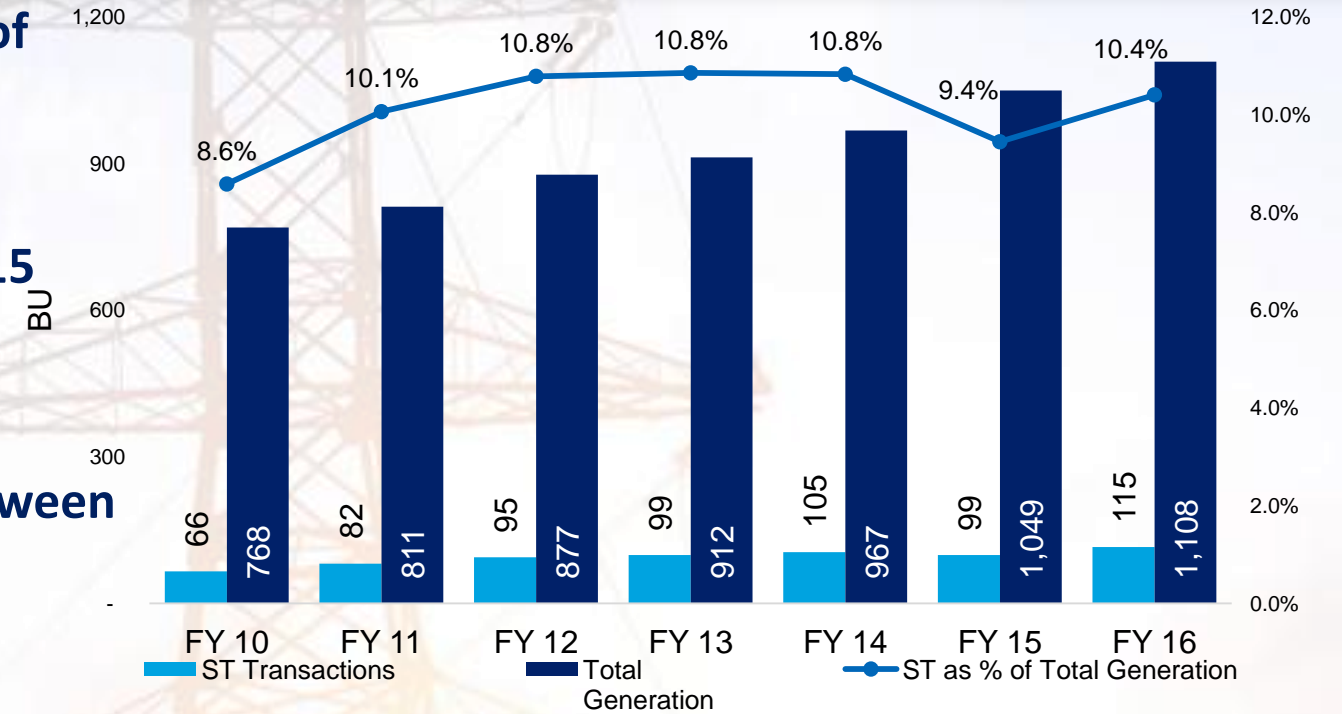


	Bhutan-India	India-Bangladesh	India-Nepal
Principle of determination	The tariff for both Tala and Dagachhu PPAs was determined on a negotiated basis	The tariff for NVVNL PPA is as per CERC regulations (agreed based on negotiation). On the other hand, tariff for PTC PPA was determined through competitive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

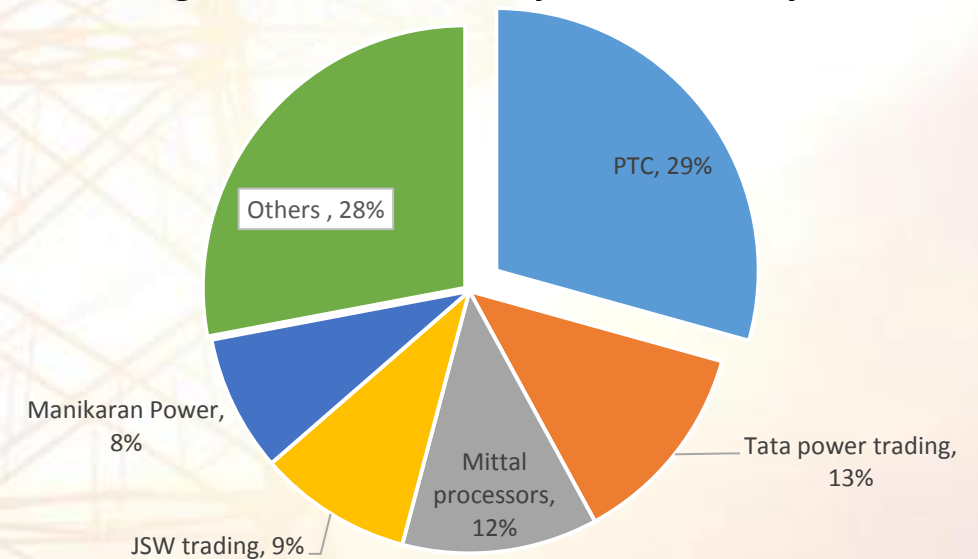
Source: Compiled from various sources. Note- Tariff for 1st year for IG projects of PHPA, MHPA, CHP, THP, KHP are not Available

Power Trading Profile

- ST power market size in FY 2016 was 115.23 BU or 10.4% of total power procured
- This was about 16% higher than market in the year 2014-15 (98.99 BU)
- Short Term Overall volume has grown at **CAGR of 27%** between FY 2008 and FY 2016
- The growth in FY 16 (16.24 BU) mainly on account of **positive growth in transactions through power exchanges (5.60 BU)** and by direct bilateral transactions between the DISCOMs (8.47 BU)
- The top 5 trading licensees together contribute 72% of the overall trading market volume.
- The top 10 trading licensees together contribute 92% of the overall trading market volume



Percentage share of Electricity Transacted by Traders in 2015-16



DAM Time Line



DAM and TAM Trading Timeline at IEX



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

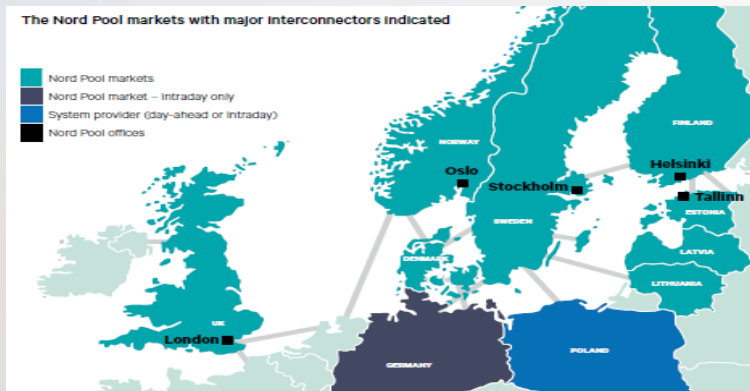
IEX: It was promoted by Financial Technologies (India) Limited and PTC India Limited. Other key shareholders include Lanco Infratech Limited, Tata Power Company Limited, Jindal Power Limited, Reliance Infrastructure Limited, Adani Enterprises Limited, Rural Electrification Corporation Limited and Infrastructure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

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



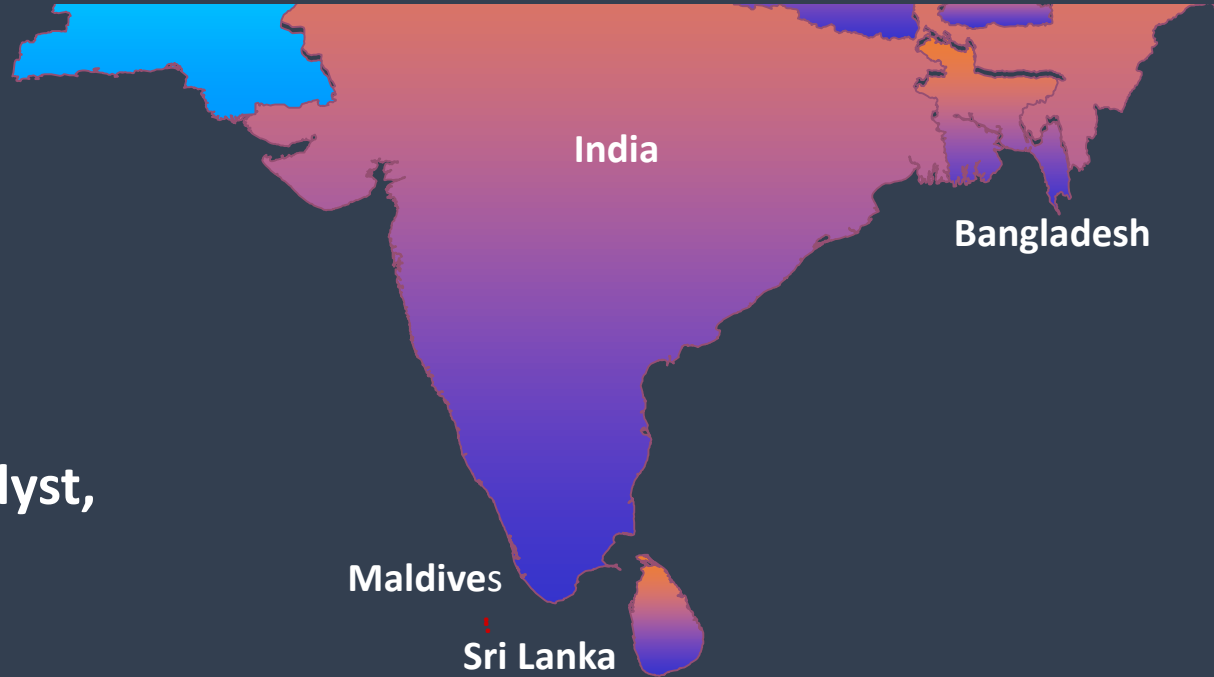
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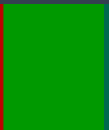


Annexure-II

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



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



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



Content

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

Aspiration Behind the Regional Integration

Technical and Operational Benefits:

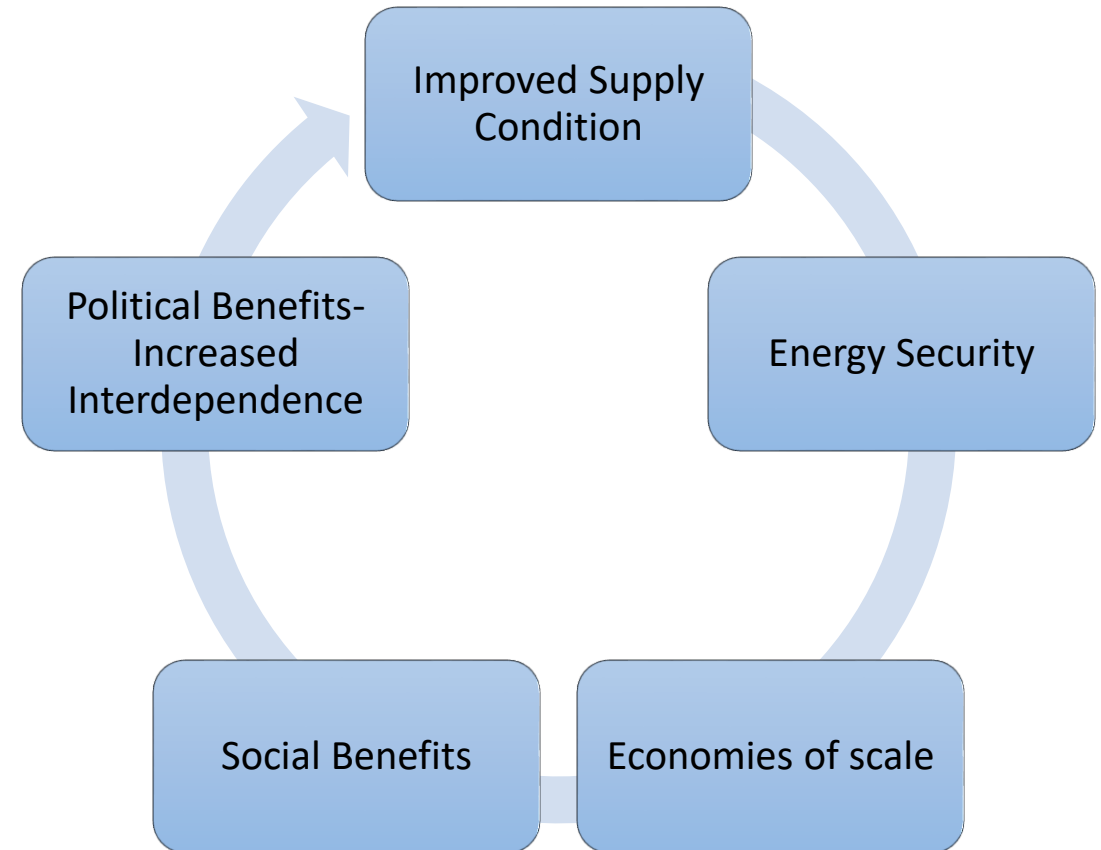
- ❖ Optimal Use of Regional Resources and System Operation
- ❖ Economies of scale in the development of regional resources
- ❖ Improved energy security and reliability of respective power systems
- ❖ Optimized transmission network
- ❖ Reduce environmental impact
- ❖ Reduce fossil fuel imports

Economic and Financial Benefits:

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

Environmental Benefits:

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

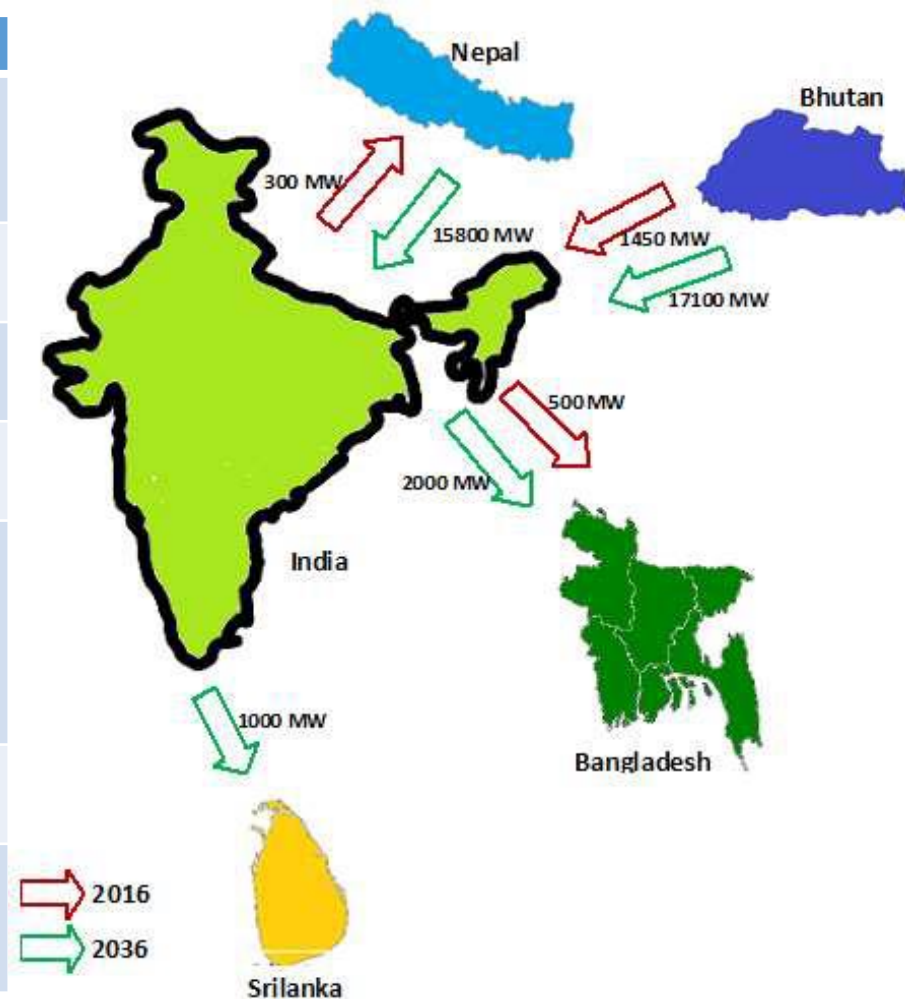


SOUTH ASIA- BRIEF OVERVIEW

System Operation and Settlement Mechanism

Existing and Future envisaged Power trade in South

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



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



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Key Policy developments in Cross Border Trading

Inter-Governmental Agreement between Bhutan and India on development of JV Hydropower Projects

SAARC Inter-Governmental Framework Agreement (IGFA) on Energy Cooperation

Ministry of Power, India Guidelines on Cross Border Electricity Trade

Pakistan – Import of electric power regulation

Apr, 2014

Sep, 2014

Nov, 2014

Oct, 2015

Nov, 2016

Feb, 2017

2017

Power Trade Agreement (PTA) between India and Nepal

Sub-Regional Cooperation between Bangladesh, Bhutan, India and Nepal (BBIN)

Center Electricity Regulatory Commission, India draft notification on CBTE

System Operation & Settlement Mechanism: Key Provisions/Clauses

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

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

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

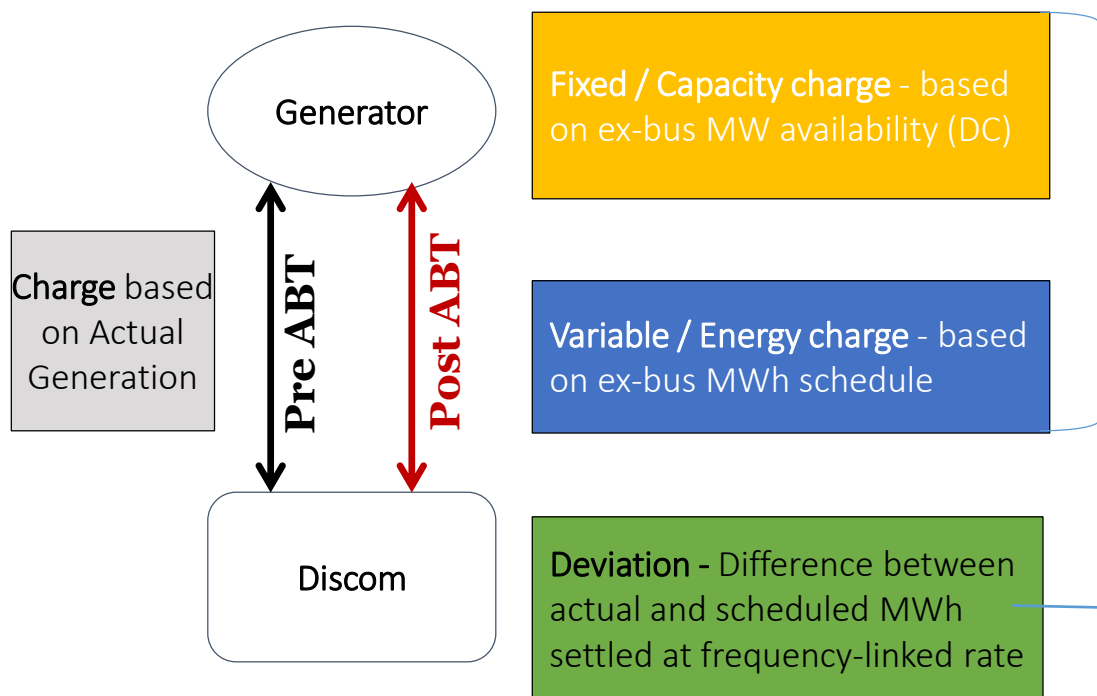
- ✓ a.) Mutually work out a coordinated procedure for secure and reliable operation of the national grids interconnected through cross border transmission interconnection(s) and prepare scheduling, dispatch, energy accounting, settlement and procedures for cross-border power trade and unscheduled interchange.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

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

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

Energy Accounting & Deviation Settlement Mechanism

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



DC - Declared Capacity; ABT - Availability Based Tariff

- **Regional Level:** Regional Power Committee (RPC) issue Regional Energy Account (REA) on a monthly basis containing Availability and Schedule for regional entities (viz. ISGS, State as a whole)
 - **State Level:** SLDC issue State Energy Account (SEA) on a monthly basis containing Availability and Schedule for intra-state entities (viz. SSGS, Discoms)
-
- **Pool Concept:** Paying Entities & Receiving Entities
 - **Regional Level:** RPC issues Weekly Deviation Settlement Account (DSA)
 - **State Level:** SLDC issues DSA (where intra-state ABT is implemented)



Deviation Settlement Mechanism

Drawal /Injection
in time block

Drawal
/Injection =
Schedule

Yes

Charges for Deviation

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

No

No deviation
settlement
required

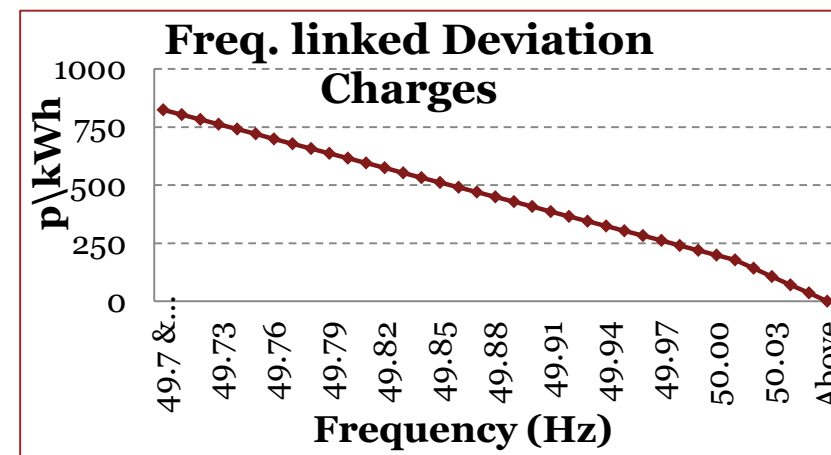
Deviation \leq
12% of Schedule
or 150 MW
(whichever is
lower)*

Deviation
Settlement
Charge

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

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

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





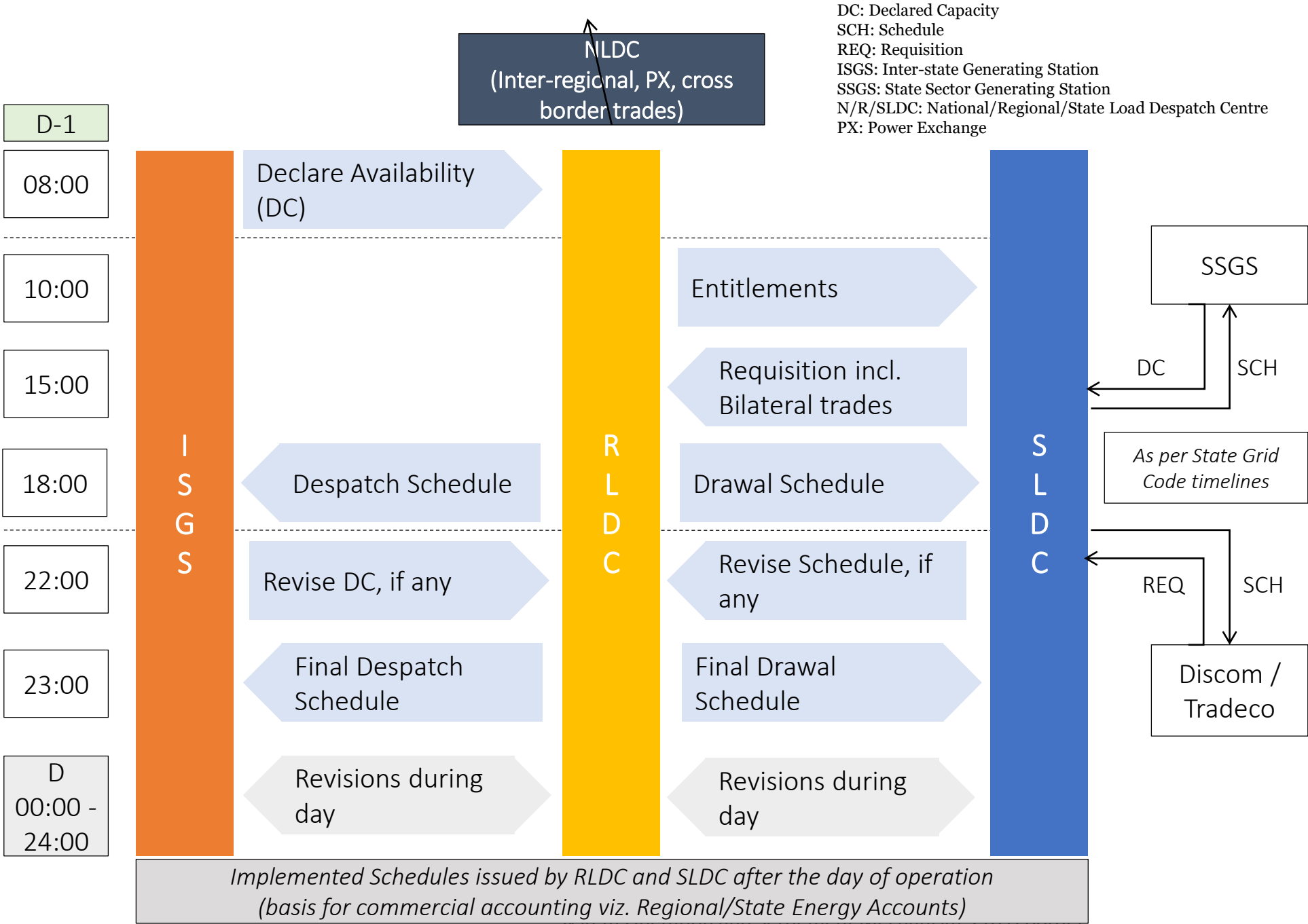
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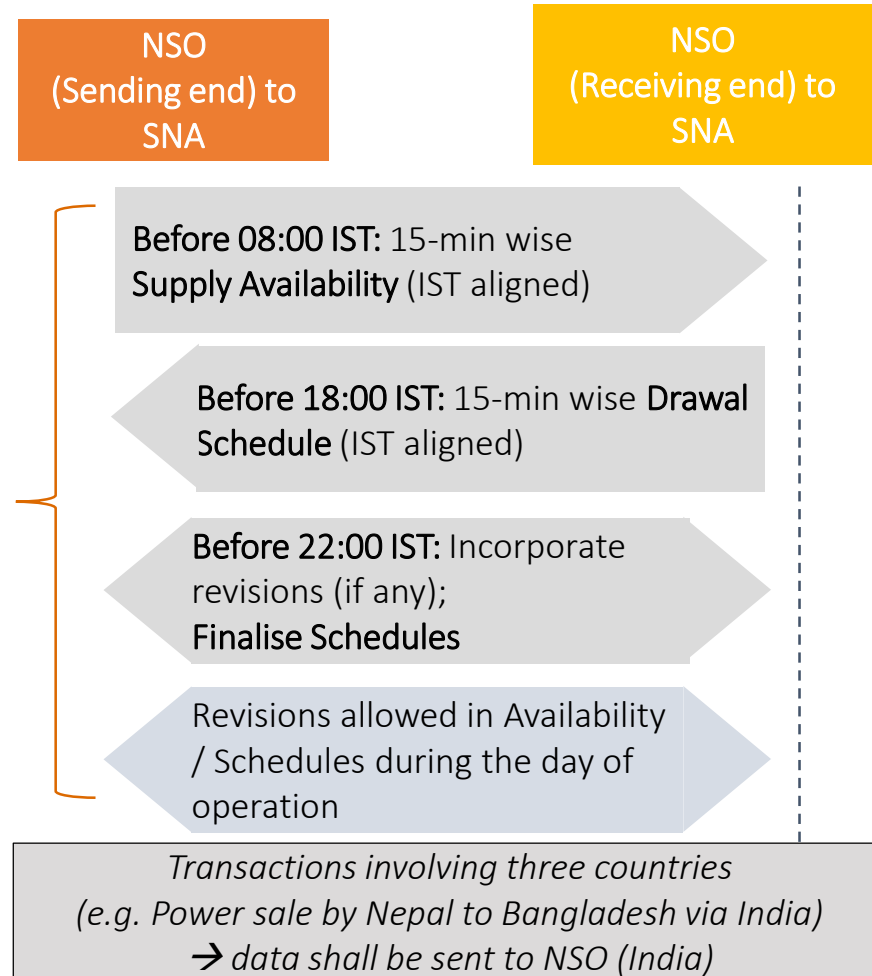
	8 AM	10 AM	12 AM	4 PM	6 PM	10 PM	12 PM	Day of Operation	
INDIA	8.00 AM Generator - DC - RLDC	10.00 AM RLDC - Entitlements - Beneficiaries		3.00 PM SLDC - Requisitions - RLDC	6.00 PM RLDC - Schedule – all entities	10.00 PM Any modification - RLDC	11.00 PM Final schedule - RLDC	12.00 PM Schedules applicable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

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



Scheduling & Deviation Settlement for existing CBET transactions

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



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

Deviation settlement mechanism may consider for CBET transactions

Scenario-A: Dedicated transmission interconnection

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

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

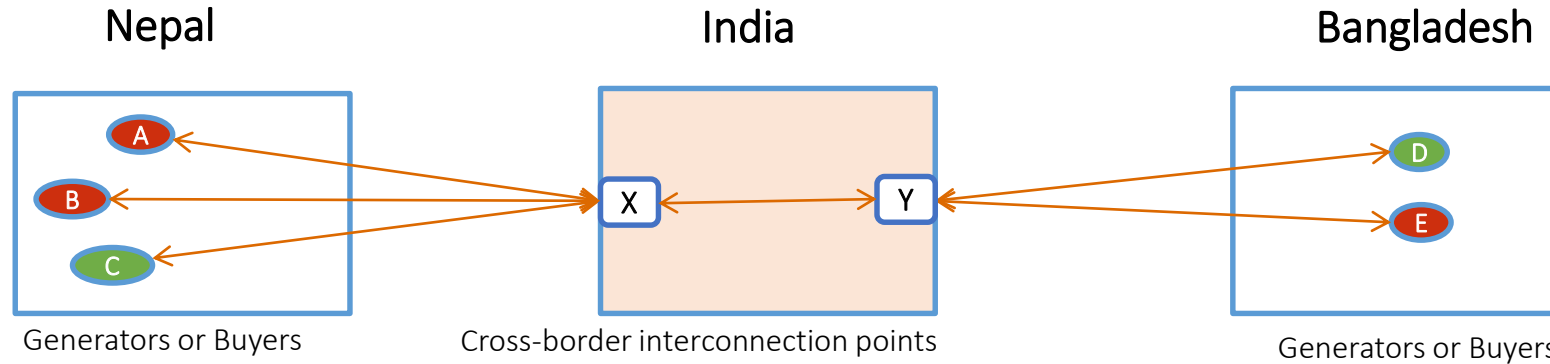
- Deviation to be apportioned to individual generators and buyers based on in-kind & pre-agreed principle

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

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

• Key considerations

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

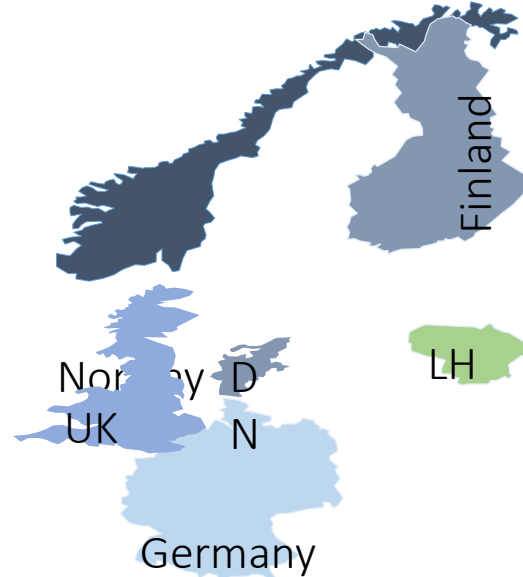


Contract	Schedule at Generator / Buyer end	Schedule at Nepal boundary (Loss: 5%)	Schedule at X (POC Injection / Drawal Loss: 1.5%)	Schedule at Y (POC Injection / Drawal Loss: 2%)	Schedule at Buyer / Generator end (Loss: 4%)
A (Generator) - D (Buyer)	100.0 MW	95.0 MW	93.6 MW	91.7 MW	88.0 MW
B (Generator)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

GLOBAL BEST PRACTICES FOR CREATION OF REGIONAL POWER EXCHANGE

Evolution

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



Products

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

Currencies for settlement

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

Ownership

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

Governance

- Governance includes Board of Directors and Customer Advisory Board

Regulator

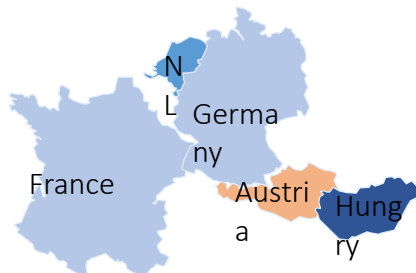
- Nord Pool Spot AS is licensed by Norwegian Water Resources and Energy Directorate (NVE) and by Norwegian Ministry of Petroleum and Energy

Structural features:

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

Evolution

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



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

Salient features:

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

Products

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

Currencies for settlement

- EUR

Ownership

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

Governance

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

Evolution

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



Products

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

Currencies for settlement

- EUR

Salient features

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

Ownership

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

Governance

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

Regulator

- CNE (Spain) & ERSE (Portugal)

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

System Operation and Settlement Mechanism, Cross Border

Power Market in South Asia

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



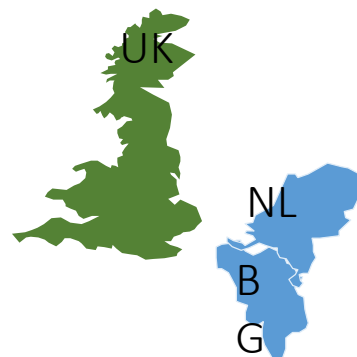
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Evolution

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



Salient features

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

Products

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

Currencies for settlement

- EUR & GBP

Ownership

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

Governance

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

Regulator

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

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

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

Integrated Europe – evolving market structure:

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

• **Creation of ENTSO**

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

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

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

• **Price coupling of regions (PCR)**

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

Evolution

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

Salient features:

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



Products

- DAM, IDM & FPM (Forward Physical Market)

Settlement currency

- USD or ZAR

Governance

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

Key takeaways

Evolution history

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

Ownership

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

Governance Structures

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

Products

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

Settlement

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

WHY POWER EXCHANGES IN SOUTH ASIA??



Regional Complementarities

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

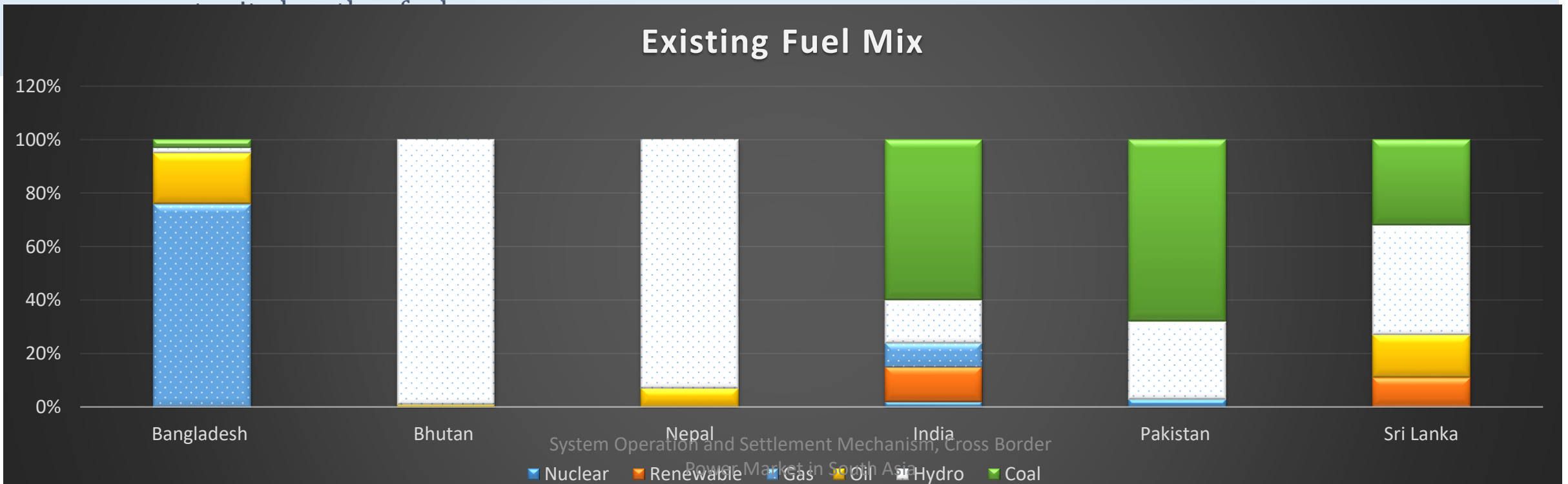
Country	Coal (Million tons)	Oil (Million barrels)	Natural Gas (Trillion cubic feet)	Biomass (Million tons)	Hydropower (GW)	Wind (MW)	Solar Power (Kwh/Sq m per day)
Bangladesh	884	12	8	0.08	0.33	Limited	3.8-6.5
Bhutan	2	-	-	26.6	30	4,825	2.5-5
Nepal	-	-	-	27.04	83	3,000	4.0-7.0
India	90,085	5700	39	139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

System Operation and Settlement Mechanism, Cross Border

Power Market in South Asia

Regional Complementarities

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



Regional Complementarities- Monthly and Hourly

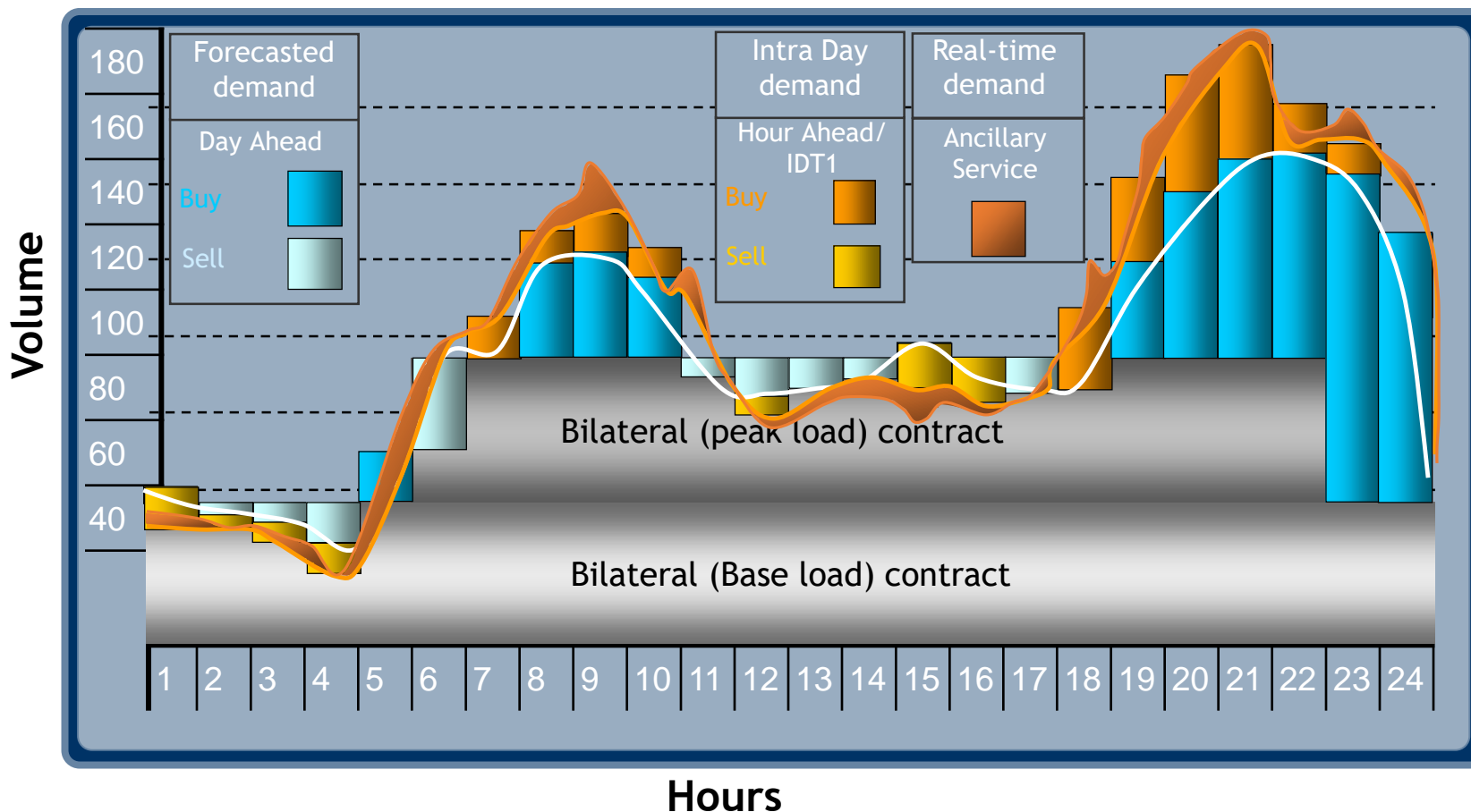
	January	February	March	April	May	June	July	August	September	October	November	December
Bangladesh	Green	Green	Blue	Red	Red	Red	Blue	Blue	Blue	Blue	Green	Green
India - North East	Blue	Green	Blue	Green	Green	Blue	Red	Red	Blue	Red	Red	Blue
Bhutan	Red	Red	Blue	Blue	Blue	Green	Green	Green	Green	Blue	Blue	Red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

Countries	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bangladesh- April	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light
Bhutan - April	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light
India- April	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light
Nepal- April	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light
Pakistan-April	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light
Sri Lanka- April	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light	Light

Color Coding	Range	
Lightest	Min	Min+ (Max-Min)*20%
Light	Min+ (Max-Min)*20%	Min+ (Max-Min)*40%
Medium-Light	Min+ (Max-Min)*40%	Min+ (Max-Min)*60%
Medium	Min+ (Max-Min)*60%	Min+ (Max-Min)*80%
Dark	Min+ (Max-Min)*80%	Max



Optimal Management of daily Demand Supply Position



- The DAM spot with 15-minute dispatch is inherently more compatible than bilateral for closer to the real time needs for balancing the demand supply gaps
- Optimal management of daily / seasonal variations in demand or supply - buy/sell the surplus / deficits

Need and Evolution of Power Exchanges in India

Long & Medium Term Market

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

Short Term Market

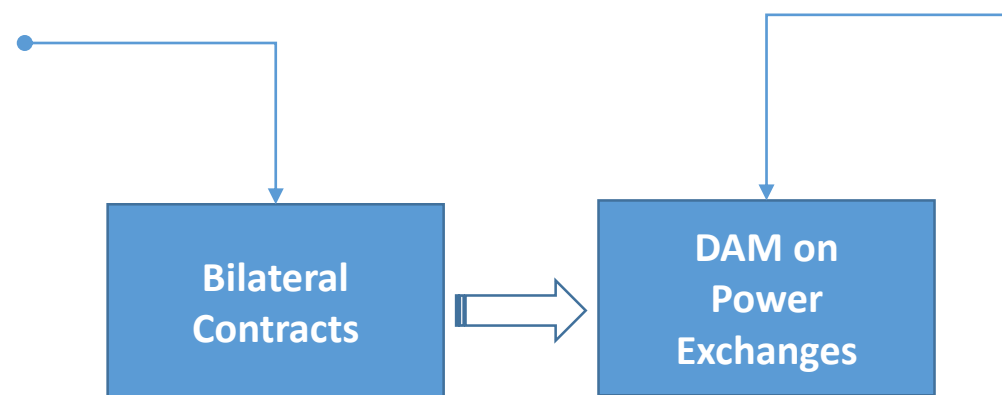
- Similarly, Short-term Markets have the following limitations:
 - Don't permit correction of positions taken by players in long and short term market closer to real time
 - Non-standard and firm nature of contracts
 - Arrangement of separate transmission access – explicit transmission allocation / auction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

Power Exchange

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

Benefits of a DAM through a Power Exchange

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



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

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

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

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

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

Perceived Challenges

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

Key issues and apprehension??

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

Existing proposed provision: Trading through the Power Exchanges

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

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

Regional Power Exchange- Mock Exercise

- A trading platform mimicking a regional Energy Exchange for the SA Region.
- The mock exchange will provide an answer to various key questions, related to feasibility and desirability and possible volume in the regional market, the impact of regional market on domestic energy markets.
- The mock exercise results will provide the desired inputs for the decision makers in selecting a suitable option for market design. This will also give clarity about the identity of the buyers and sellers in such a Regional Exchange.
- Additionally, the mock exercise will also develop/provide:
 - Develop a draft set of market design and rules of a SA regional electricity market.
 - Prepare a detailed report based on the analysis of the pilot market data to ascertain the desirability and the feasibility of a SARPEX, and
 - To build the capacity of relevant officials from the SA countries on the functions of a power exchange which is critical irrespective to the option finally selected.



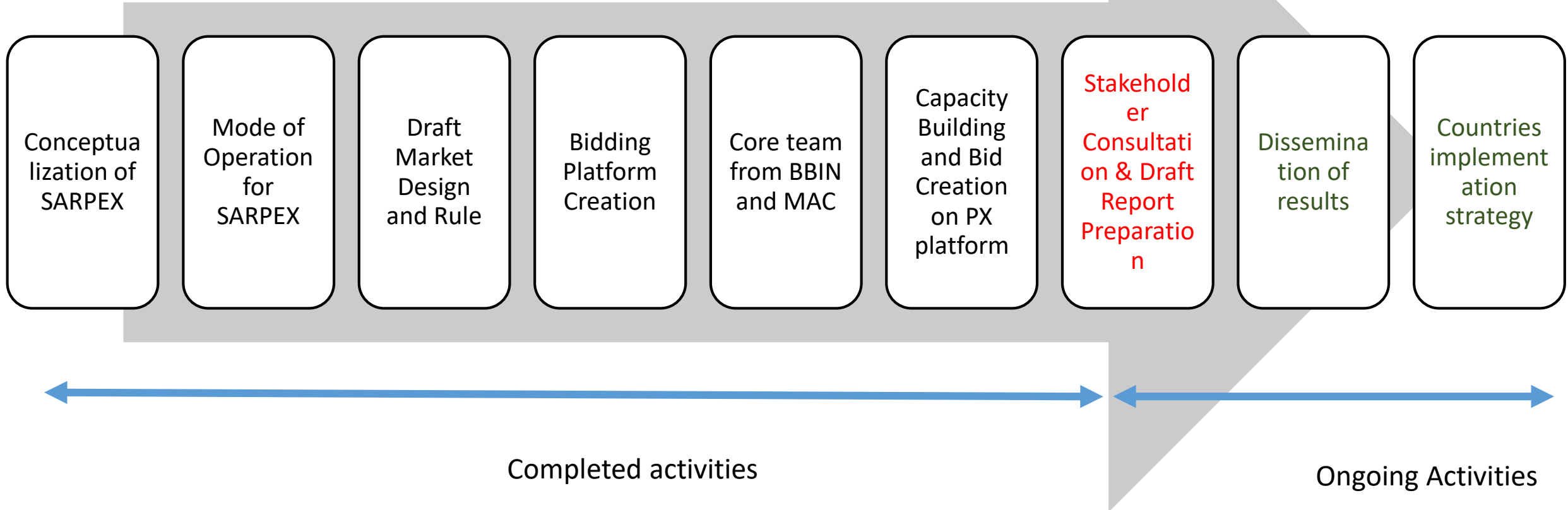
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IRADe Action for Development

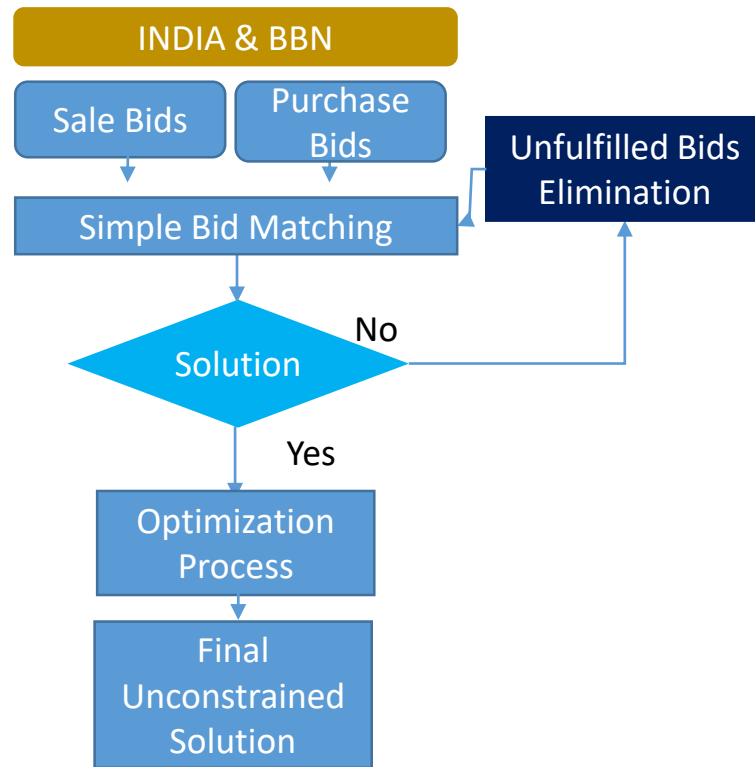
SARPEX- Mock Exercise activities



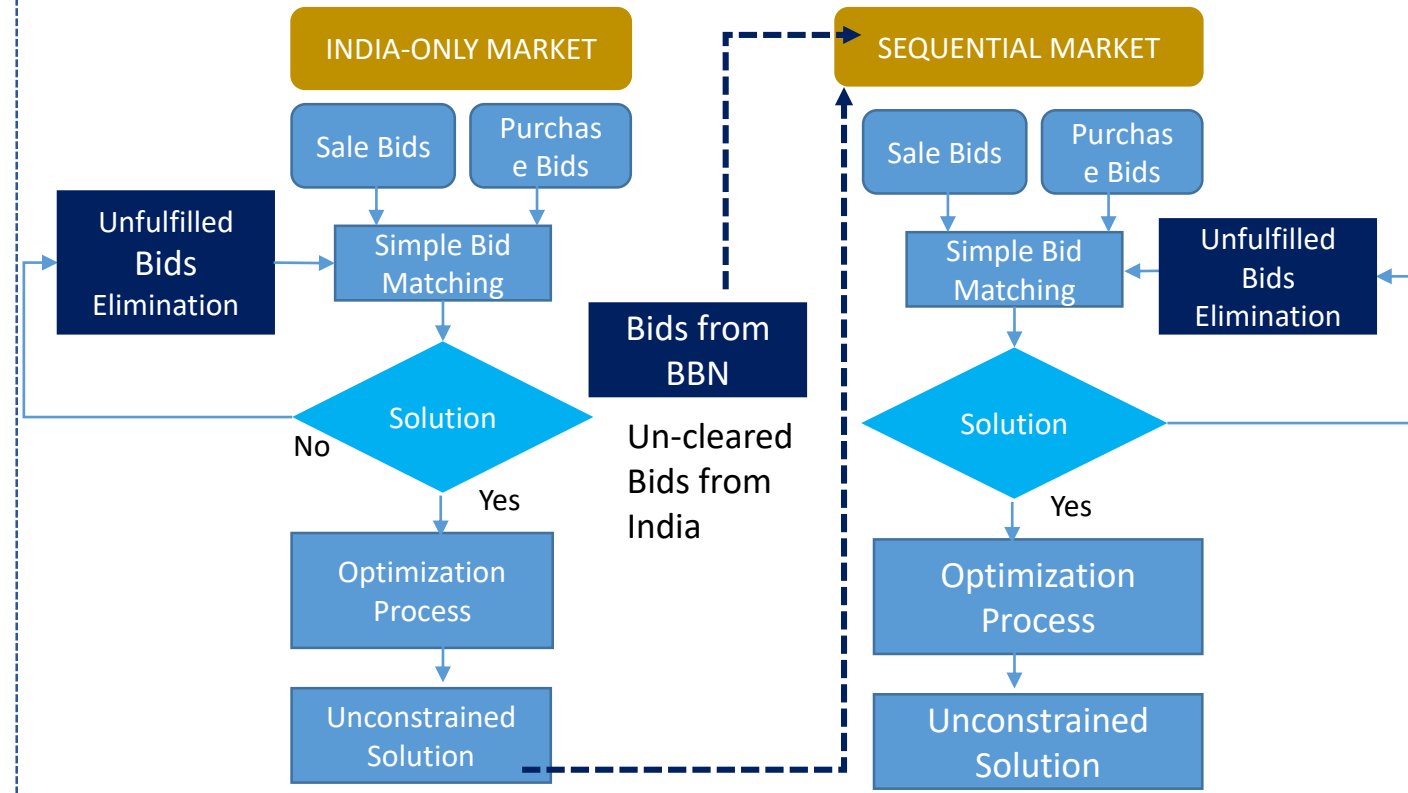
SARPEX's CLEARING ALGORITHM

SEQUENTIAL MODE

UNIFIED MODE – 15 MINUTE DAM INTERVAL



SEQUENTIAL MODE – 15 MINUTE INTERVAL DAM





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SARPEX TEAM



Market Advisory Committee

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

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

Core Team from BBN

Implementation Team - USAID, IRADe and KPMG

Task Force-3 Members

Market Advisory Committee & Mentors

Key Relevant Stakeholder from BBIN



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IRADe



System Operation and Settlement of Power Market in South Asia

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LEARNINGS FROM NORD POOL REGION: Power Market

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Transmission Service Agreement for Cross-Border Electricity Trade

Model

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

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

Working Paper:

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

September, 2016

USAID SARI/EI IRADe Action for Development

SOUTH ASIA REGIONAL ENERGY INTEGRATION

Roadmap for South Asian Regional Power Exchange (SARPEX)

USAID SARI/EI IRADe Action for Development

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

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

Model

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

Task Force-3 Report

USAID SARI/EI IRADe Action for Development

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

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

South Asian Countries Power Pricing Mechanism & Recommendation for CBET

USAID SARI/EI IRADe Action for Development



SARI/EI



Thanks

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

<http://mocksarpex.eu.ai>