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"Functioning of Power Exchanges and Market Monitoring"

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Disclaimer : These are the personal views of the speaker

We shall discuss….

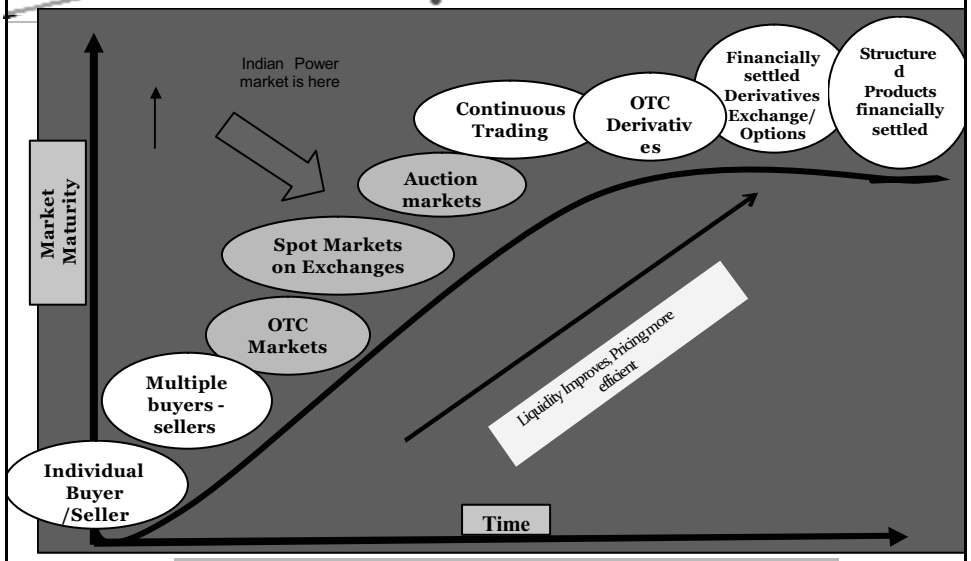
- Markets
- Indian Power markets
- Regulatory Initiatives for market development
- Power Exchanges
- International Power markets

Interesting facts

- Google a electricity trader as huge exposure to electricity prices , data centers are power intensive
- Nuclear plants built at country boundary or coast in France
- Negative price bidding by generators –Must run generators like Nuclear
- Hydro dam valuation – Value of water
  - Is a call option on the asset
  - Cascading assets on same river basin

Markets

Market Development S- Curve



•*In matured markets all these types of markets exist*
•*Interplay between markets improves price discovery*

Why have a Power Market ?

- Markets - Ultimate payment security mechanism -superior to government guarantee
  - Induces price risk ,Reduces liquidity risk
- Risk Mitigation mechanism –from take or pay contracts
  - Liquidity improves valuation of companies as risk reduces
  - Cost of capital reduces as alternative platform to sell available
- Price acts as signal for new investments
  - Merchant Power capacity and private sector investment
- Match short-term surplus with demand variation in a diverse country – optimal asset utilization
- Bring latent generation capacity - captive power plants to market

Why have a power market ?

- Liquidity reduces business risk
- Increases price volatility
- Access to markets - Open Access – Key to competition
  - Alternative to consumers - by using open access
  - Industrial consumers getting access through PX and technology

What are the types of markets

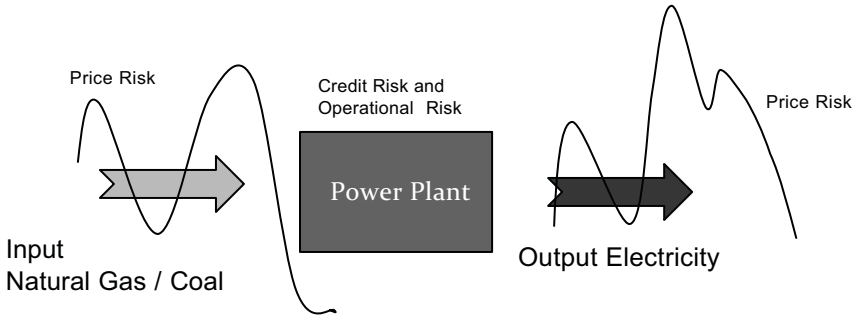
- Time based
  - Spot market -Futures market (Derivatives market)
  - Convergence of spot and future prices
  - Long term contract – surety of supply -no volumetric risk , no price risk or can have floating price
  - Short term – Flexibility vs. Induces Price risk and price volatility
- Asset Class Based
  - Interest Rate ,Credit
  - Capital - Fixed Income (Bond market Government securities) , Equity
  - Commodity –Agri, Metal, Bullion, Energy
  - Currency – Largest markets
  - Real Estate
    - Interest rate is a common link ,If interest rate is high, asset prices fall

What are the types of markets

- **Market Structure based**
- OTC vs Exchange
  - Exchange –Standardized contracts, easier pricing , transparent , price dissemination
  - Exchange / Clearing corp acts Warehouse of risk , does risk management

- **Price discovery based**
- Auction –Open or Closed – Function of liquidity and maturity, e.g. IPO Book Building , single clearing price – Indian power exchanges
- Electronic Continuous Trading on Exchange – Stock Exchanges
  - Open outcry vs Electronic
  - Options still traded on open outcry in many places – easy to market make & liquidity is low
  - Futures trading is highly automated now

Risk Model for a Company

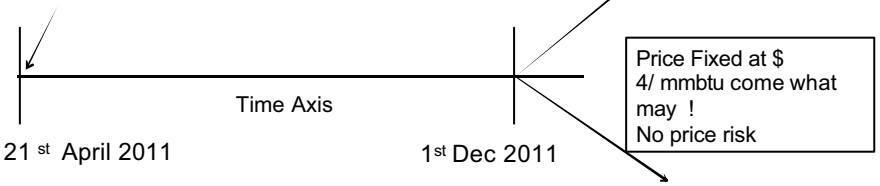


Spread Contract – Crack Spread , Spark Spread Contracts to Hedge
If can pass on the risk to customers no need to hedge
If Competitor gives fixed price , may need to hedge
Long term contracts on both sides – is also a hedge

How a hedge works ?

ABC Buys Natural Gas December 2011 expiry at $ 4 / mmbtu.
This is the Futures contract price

Price increases to $ 5 / mmbtu
Sell financial Contract at $ 5
Profit of $1
Buy In physical Spot at $ 5
Effective Price = 5 - 1 =$ 4



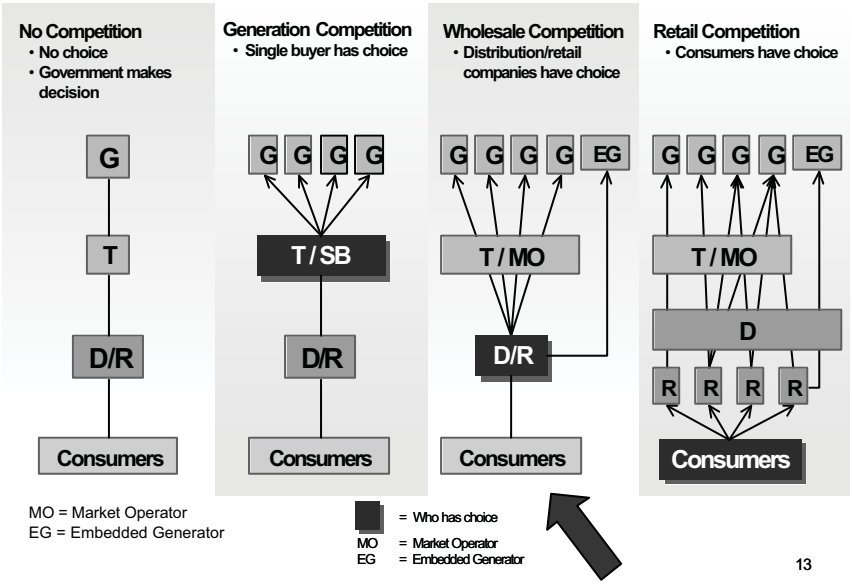
Price Fixed at $ 4/ mmbtu come what may !
No price risk

Price decreases to $ 3/ mmbtu
Sell financial contract at $3
Loss of $1
Buy In physical Spot at $3
Effective Price = 3+ 1 = $4

Both physical and financial position to be looked at together

Indian Power Markets

Evolving Power Industry Structure



MO = Market Operator
EG = Embedded Generator

= Who has choice
MO = Market Operator
EG = Embedded Generator

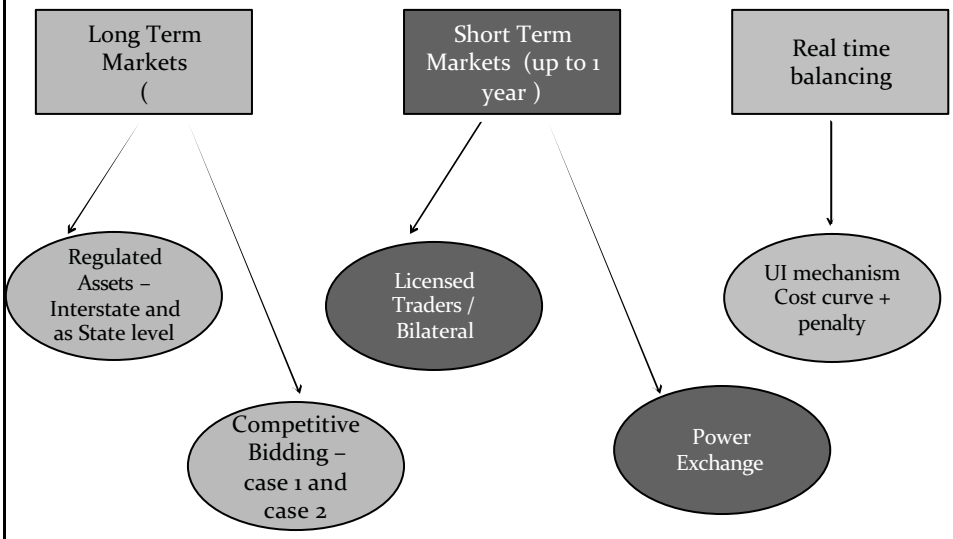
Market related Sections in Electricity Act 2003

- Development of power markets including trading - Section 66
  - NEP suggests 15% of new capacities to be sold outside long-term PPAs
  - NEP stipulates power exchanges
- Generation delicensed –Sec 7
- Trading, Transmission, Distribution are licensed - Sec 14
  - Regulatory oversight only on trading margin ,not on sale price by trader
- Max & Min tariff for a period of 1 yr in periods of shortages – Sec 62 (3)

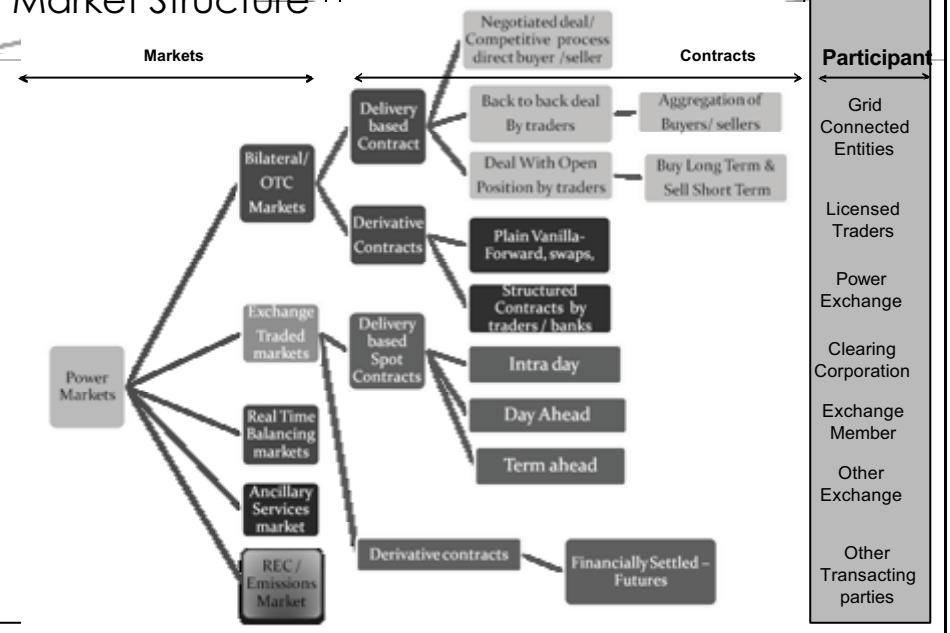
Market related Sections in Electricity Act 2003

- Determination of tariff by(competitive) bidding process based on guidelines issued by GOI – Sec 63
- Preventing market domination- responsibility of Regulators - Sec 60
- Open Access to Generation ,Consumers by Transmission, Distribution cos -Sec 38, 40, 42
  - Cornerstone of the act
  - Bring competition
  - Similar to FERC order 888 , 889 in 1996
    - Access to line on payment of charges
    - Allow transmission to recover stranded cost through energy customers
    - All info in open market – OASIS Open access same time information system
    - NLDC, RLDC similar function , information asymmetry reduction

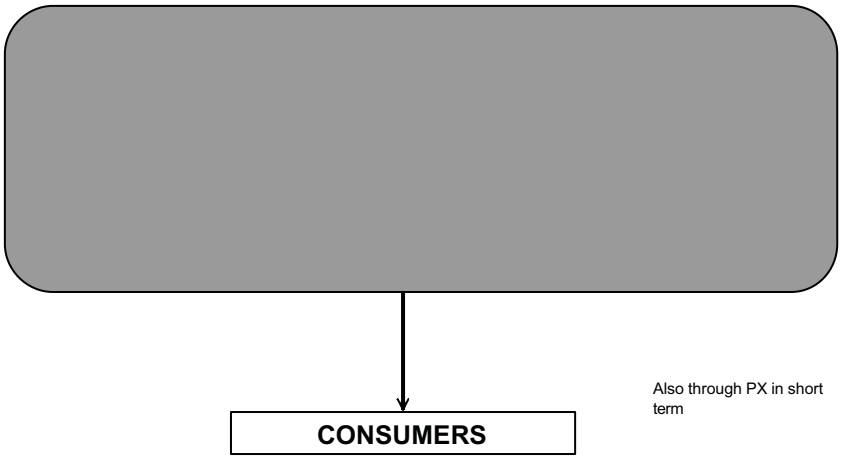
Power Market Structure in India



Market Structure



Market Structure: Medium and long term power procurement



Also through PX in short term

Some Features of Short Term Power Markets

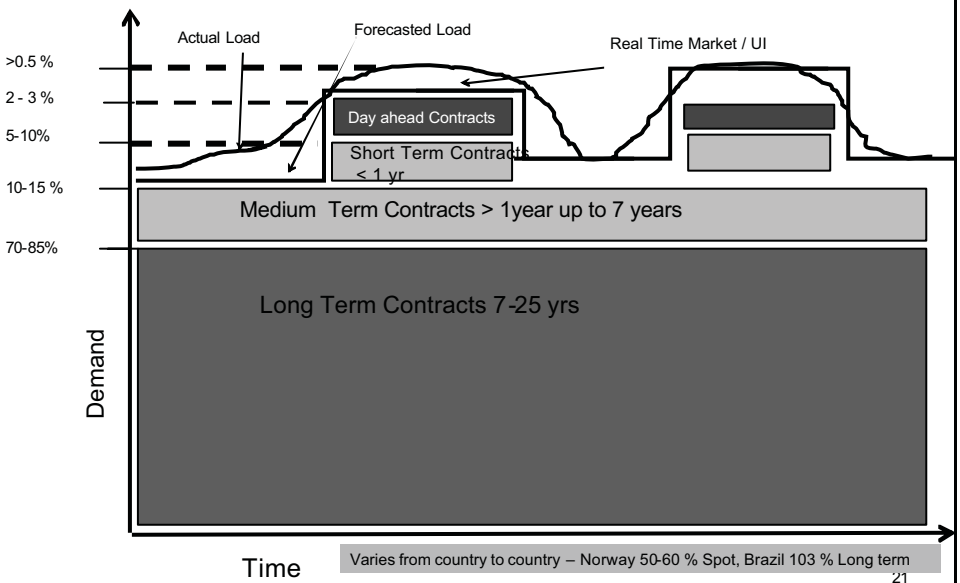
- Trading licensees (44) – Top 5 control 80 % of market
  - HHI Index to monitor market power
  - Traders also facilitating investments in new capacities
  - New smaller category created to penetrate market
- Two Power exchanges - electronic platform for day ahead markets , week ahead markets ,intra day (Similar to Nordpool)
  - Assured payment security and risk management
  - Prices Dissemination across country
  - Reduce information asymmetry
  - Provide equal bargaining power to all players in a supply deficit environment

How DISCOMs Procure Power

- Long-term regulated Cost-Plus PPA
- Long Term Competitive bidding based price PPA
- Medium term contracts > 1 year to up to 7 years through PPA
- Short term contracts for 1 year
- Short-term seasonal contracts (non-standard contracts through Traders or directly)
- Term ahead contracts (through PX)
- Day ahead contracts (through Open Access/PX)
- Real time market Unscheduled Interchange

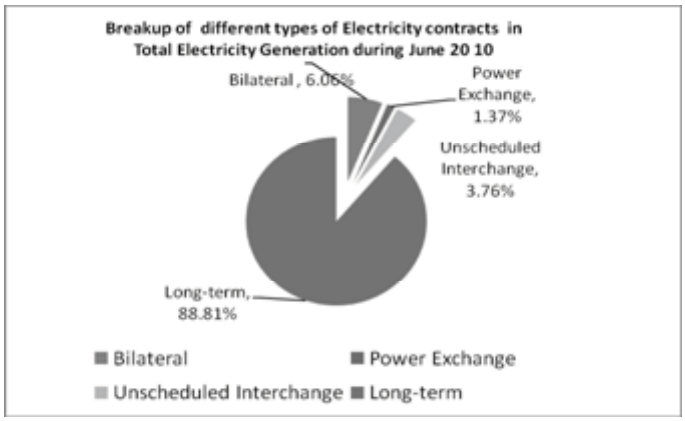
These are the various contracts in the market

DISCOM Portfolio



Varies from country to country – Norway 50-60 % Spot, Brazil 103 % Long term

Market Breakup



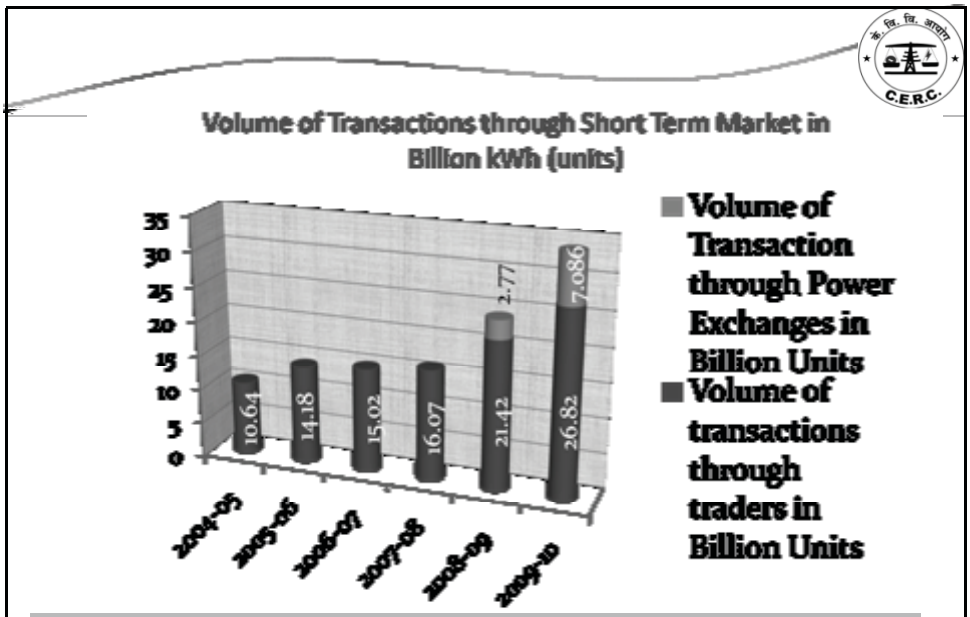
Short term market turnover is only 6-7% of total generation ,PX volume is 1 % of total generation

Short Term Market Size

Year	Transactions through Traders		Transactions through Power Exchanges		Size of Market through Traders (Rs. Crore)	Size of Market for Exchanges (Rs. Crore)	Total Size of Short Term Market Excluding UI, Bilateral Through DISCOMs , and Input from Bhutan (Rs. Crore)
	Volume in Billion Units*	Weighted Average Price (Rs/kWh)	Volume in Billion Units	Weighted Average Price (Rs/kWh)			
2004-05	**10.64**	**2.41**	**-**	**-**	**2564**		**2564**
2005-06	**14.18**	**3.23**	**-**	**-**	**4580**		**4580**
2006-07	**15.02**	**4.51**	**-**	**-**	**6774**		**6774**
2007-08	**16.07**	**5.6**	**-**	**-**	**8999**		**8999**
2008-09	**21.42**	**7.31**	**2.77**	**7.49**	**15658**	**2075**	**17733**
2009-10	**26.82**	**5.26**	**7.086**	**4.99**	**14107**	**3536**	**17643**
2010-11**	**29.17**	**4.92**	**11.55**	**3.47**	**14335**	**4009**	**18300**

**** = Excludes imports from Bhutan and banking volumes***
***** = Upto Dec 2010***

Short Term market size is large ,although in % term it looks small (5%)
In absolute terms is large 18300 Cr



Short term volumes are increasing ,Traders market is 3 times PX in volume terms – Fewer transactions but monthly contracts with large volume

Price trend in Short Term markets

- Weighted Average power price have been declining over last 3 years
- Average Price through Traders higher than transaction in Power Exchange

Short Term Price Range (Jan – Dec 2010)

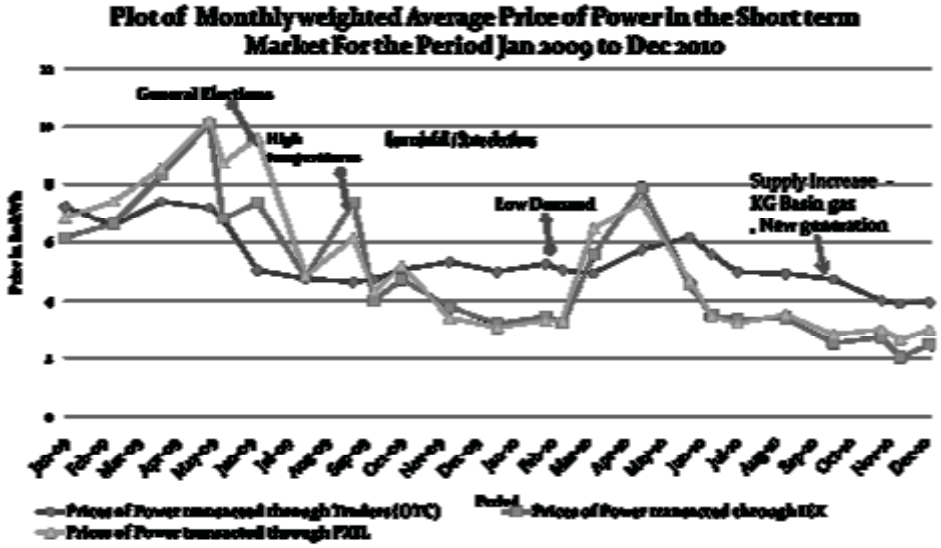
Power Price	Traders	Power Exchange
Maximum (Rs/ Kwh)	10.57	13.9
Minimum (Rs / Kwh)	1.84	0.10
Weighted Average	4.98	3.47

Average prices lower in PX than license traders but more volatile – reflects immediate demand supply, better bargaining power
Prices have risen to Rs 14/ Kwh & gown down to Rs 0.10 / Kwh as well in PX as the mechanism reflects market information quicker

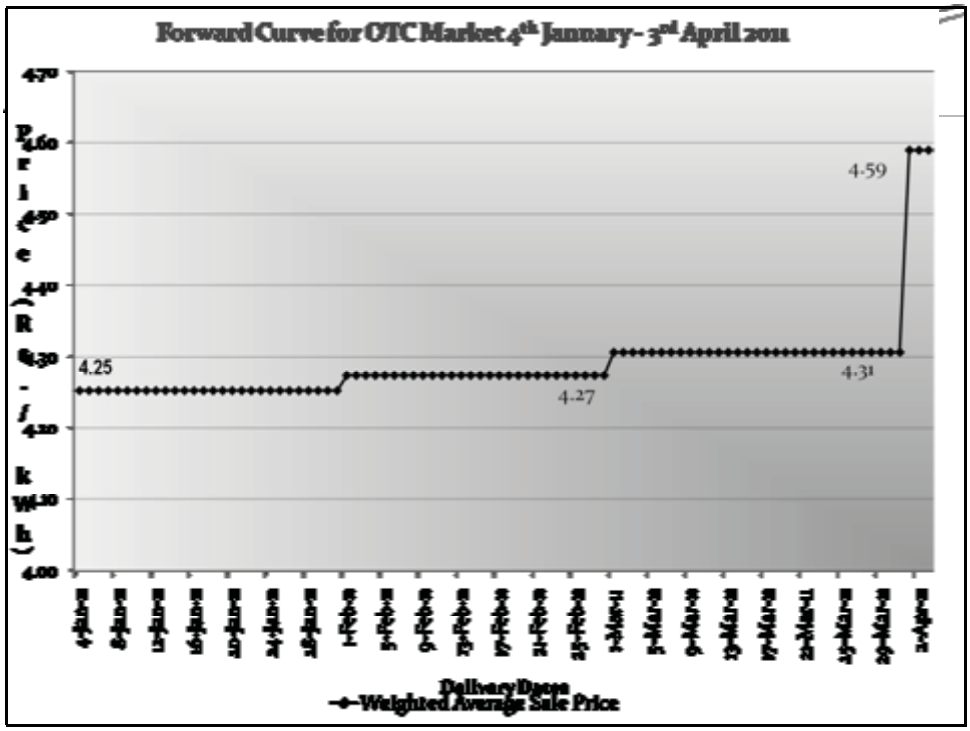
International Electricity Prices

Wholesale Exchange	Country	Units	Delivery	Base Price	Peak Price
Nordpool	Norway	Euro/ MWH	May-10	49	51
		Rs/ MWH		2806.72	2921.28
APX	UK	Pound/ MWH	May-10	54	61
		Rs/ MWH		3600.72	4067.48
EEX	Germany	Euro/ MWH	May-10	50	54
		Rs/ MWH		2864	3093.12
EEX	France	Euro/ MWH	May-10	50	57
		Rs/ MWH		2864	3264.96
PJM	US East Coast	$/MWH	May-10	38	44
		Rs/ MWH		1715.32	1986.16
Market Monitoring Report	India		Avg of	Power Exchange	Electricity Trader
		Rs/ MWH	2009	5730	6410

Short Term power prices in India higher than other markets , in PPP terms prices will be even higher



Short Term power prices are showing a declining trend . Decline higher for PX than OTC



Short Term vs Long term Contract

- ST- Acts as a payment security mechanism in case of default in long term contracts
- ST- Generation resource optimization and helps transfer power from surplus to deficit region in a geographically seasonally diverse country like India
- Is short term market a procurement market or a balancing market?
- Utilities to decided their own expectation of the market prices and demand projections.
- In long term contracts , utilities are stuck to a technology
- Long term contracts help to bring certainty of cash flow and are necessary for making projects bankable
- Long term contract can be done only if , contacts on fuel side can be done else risk not mitigated , chance of contract reneging

Short Term vs Long term Contract

- Utilities can enter into long term contracts for their future demand projections and in case demand does not grow as per their anticipation can sell any extra supply in the short term market as a part of their portfolio management
- System Operation - Large volume of short term transaction creates congestion in transmission due to unplanned power flow

Capacity Markets

- Generators risk for project financing is taken care of
- Recovers his fixed cost , DSCR, ROE
- How to price capacity – is a real call option
  - Buyer asks for electricity to be scheduled whenever the day ahead price is higher than the variable cost of this generators
- Fuel cost is a pass through to DISCOM
- Fuel cost is 60 % of total power cost
- Can be an alternative to Power Derivatives ?

Competitive bidding – CERC reco

- All future power procurement / transmission projects through competitive bidding except large storage hyrdo projects / peaking stations post Jan 2011
  - Existing substations, upgrades of lines, urgent projects , HVDC out of competitive bidding
- Our finding - Cost based regulated tariff higher than competitive bidding tariff
- Regulated assets – Tendency to increase equity base through additional captiliasation - pass to consumers higher tariff, variable cost full pass through consumer
- In competitive bidding -Non escalable portion ensures cost not passed to consumer
- States to be encouraged to go for competitive bidding
- Blended coal based competitive bidding should be done

Sec11, Open Access denial – CERC Reco

- Open access is cornerstone of EA2003 to bring competition and choice to genco and discom
- State Govt using Sec 11 to prohibit sale of power outside state by embedded gencos as shortages in state prevail – To be used only in exigencies but being abused
- Done through denial of open access by SLDC
- Leads to breach of contract by gencos with cos outside the state , Increase risk for private investment
- Denial of open access could disrupt market development
- Unfortunately some high courts have stayed CERC orders against such act by state govt
- GOI advised to move Supreme court for vacation of stay order

Free Hydro power sale by States – CERC Reco

- State govt get 12 % free power for hydro projects in their state under Hydro Policy as compensation for use of its resources
  - Can sell this free power to DISCOM, licensed trader or other party as deemed fit in short term
  - If sold in the state transaction under purview of SERC
  - As States are not licensees , these transactions if inter state in nature should be under the purview of CERC
  - As the proportion of free power transaction increases, need to be monitor gains significance as can distort market
  - Trend seen in case of Coal also , abuse of market power ,distort market

Ring fencing of Load Dispatch Centers –CERC Reco

- Non discriminatory open access needed to promote competition
- All consumer and large no of genco still connected to state level networks
- SLDC still under control of state govt controlled DISCOms & state traders or STU – not functioning independently and neutrally
- Unable to protect interest of open access consumer and gencos
- Completely separate management of SLDC from DISCOM or State tarder or STU
- Has been achieved partially in case of NLDC and CTU by creation of subsidiary of CTU

Regulatory Initiatives for Market Development

Regulations CERC

- EA 2003 mandates Commission to formulate regulations in certain areas
- Approximately 25 Regulations notified
  - Tariff Regulation
  - Interstate Transmission regulations
  - Renewable energy regulation
  - Licensing regulations
  - Market Regulations
  - Miscellaneous and procedural regulations
- Last 2 years around 12-15 Regulations published and /or amended
- Model Regulation for SERCs under Forum of Regulators
- 18 Statutory Advice to Central Government

Power Market Regulation

- Market Structure
- Market design and principles
- Power Exchange
  - Approval, Prudential Norms
  - Various Committees for governance
  - Trading systems
  - Risk management and Default settlement
- Market Oversight
  - Market monitoring
  - Reports and analysis

Short Term Open Access Regulations

- Short Term Open Access Regulations facilitated power trading in orderly manner
  - 3 month Advance reservation , first come first serve, power exchange corridor reservation , day basis opened again for traders
- Energy agreements and transmission clearance to be arranged separately
- Open Access charges are reasonable and simple to apply
- Increasing Competition in wholesale market

Long/Medium term Open Access Regulation

- Framework for connectivity medium term (3 months - 3 yrs) and long term access (12 – 25 Yrs) to ISTS ,inter-state transmission , non discriminatory
  - Thermal 500 MW, Hydro 250 MW
- Central gencos and IPP being treated by CTU in same manner for connectivity to interstate grid
  - Bring parity between central gencso and IPP
  - Improves access to markets for all gencos
  - Reduce operational risk for gencos and make projects more bankable
  - In line with NEP/Tariff policy stipulation
  - Based on anticipated transmission needs , expected regional flow s
  - Prior agreement with beneficiaries not a pre-condition for network expansion

Trading License Regulation

- Trading - a licensed activity - Capital adequacy needed as taking risk on behalf of participants
  - Networth , Liquidity criteria
  - Capital intensive players absorb credit risk of DISCOM, risk mitigation for suppliers
- Trading margin imposed by regulator
  - To ensure prices do not increase much
  - Stymies innovation as there is no incentive
- No margin on long term transactions
- Margin on short Trem Transactions
  - 4 paisa margin if power price less than Rs 3/kwh
  - 7 Paisa margin if power price more than Rs 3/kwh

Transmission Pricing Regulation

- ARR of PCGIL same, only how beneficiaries pay it changes
- Point of connection tariff – generation access charge, demand charge , Till now only consumers paid
- STOA lower than long term due to incidental usage ,
  - less incentive to go for long term contracts , free rider allegation
- Hybrid Model-Based on Marginal + Average Participation Method
  - Removes like pan-caking of transmission charges
  - Helps short term power trading , MPP power flows not known
- Bring geographically distant disadvantaged genco equal to other gencos and compete in competitive bids
- In line with vision of tariff policy -Sensitive to direction, distance and quantum, (pay as use)

UI Interchange Regulation

- Heavy overdrawals by some of States - a concern
  - Grid security aspect
  - Depriving other states from their legitimate and planned procurement
- Very high rate for overdrawal at low frequency
  - CEA / CTU - option of isolating a connection for dealing with overdrawal not possible in a meshed grid
- Decoupled overdrawl /underinjection rates from over injection /underdrawal rates
  - Create UI fund to be used for bottleneck removal
- Disincentivises both genco (gets paid low) and discom (pays high) from using UI mechanism regularly
- Volume restriction placed through commercial penalty
- LC to be opened by parties who have defaulted earlier in UI payments
- Will bring more electricity to organized power markets

Regulation on Grant Transmission License

- Transmission Plan by CEA- Certain projects identified by Empowered Committee developed through Competitive Bidding
- Other projects by CTU under regulated asset mode – 25 year period license , tariff after that bas eon regulation then
- Genco also gets transmission license for a development of dedicated line which becomes a part of interstate grid
- License for 25 yrs period , can be renewed 2 years before
- Competitive Tariff quoted for 35 year period
  - After 25 yrs get tariff as has been quoted for the particular year of operation
  - After 35 yrs , tariff based on ROE on equity invested in project or equity as 30 % of Gross block ,other norms as per tariff period block when tariff is due to expire

Regulation on Peaking tariff – Under consideration

- Peak Shortage likely to continue for many years
- Special policy support required to set up peaking plants
- Full recovery of fixed cost to be assured through regulated peaking tariff
  - Open cycle gas , IC/ reciprocating engine , pumped hydro storage
- Base load stations or hydro stations cannot get differential peak – non peak tariff
- Hydro in any case are declaring capacity during peak hours and recovering full fixed cost form that declared capacity
- Will reduce over investment in the base load and hence reduce consumers burden

Standard of performance for Transmission Licensee

- Is a regulated monopoly business with assured rate of return
- SOP required for efficient performance by licensee
- IEGC and CEA (grid standards regulation 2010) are there
- Compensation for affected party if fail to meet SOP
  - Line Availability- monthwise and element wise(AC line, Var compensator, series compensator, sub station bay)
  - Restoration time, in case of failure of line and transformer – different in different terrain ,
  - Frequency of failure
- Not more than Transmission Charge, within a specified period

Market Monitoring

- Focus is more on Short Term market presently
  - Started creating a forward curve as no futures market there
- Start monitoring long term , medium contracts also
  - 92 % of market is long term
  - State market difficult to monitor centrally
  - Forward looking and not post facto only
- Look at open positions of traders -is a metric to monitor risk ,not just prices – when price going down
- Financial health of gencos companies who have large number of contracts – when sale price fixed and fuel cost increasing
- Contract reneging phenomena – is it increasing ?
  - especially as contract period is 25 yrs
- Physical /Economic withholding of assets
- Generators cost curve monitor ? PJM , California do this

Other discussion points

- Should merchant power plant be always available in shortage condition?
  - Should they declare capacity daily?
  - Is generator a public utility ?
  - Has no assured return , why commit availability?
- What should be the mix of short term and log term markets ?
  - Share of short term purchase in portfolio low but rising
  - Is upto 15- 30 % of total portfolio (Rel Infra- JVVN) , Avg 5 %
- How to equitably allocate corridor between license trader and power exchange to increase social welfare ?

Regulators role

- Regulator to think from systemic risk point of view
- As market size increase , market integrity to be maintained
- Role of regulator will be as watchdog of market
- Regulators role transformation from tariff fixation to market oversight

Power Exchange

Power Exchange

- Multiple power exchange model
- Voluntary participation
- For profit organizations- Market operator
- Co ordinate with system operator
- Two Power Exchanges operational , 3rd in principle approval
- Electronic platforms
- Transparent price discovery and anonymous bidding
- Equal bargaining power to buyer and seller
  - In a supply deficit market
- Helped in introducing open access at ground level
- Technology has acted as a great leveler
  - Large participation , different from other markets where only wholesaler participates

Power Exchange

- Standardized products
- High Liquidity
  - Pricing improves
- Standardized risk management
- Electronic price dissemination
  - Quick and nation wide
  - Reduces information asymmetry

Products on Exchange

? **Day-Ahead Market**
  ? Double sided closed bid auction with uniform pricing

? **Term-Ahead Market**
  - Intra-day, Day-Ahead Contingency
  - Daily
  - Weekly
  - Monthly (awaiting approval)

? **RE Certificates Market**
  - Commenced since November,2010
  - Sellers :RE generators sell certificates
  - Buyers: Obligated entities purchase certificates to fulfill RPO
  - National market for RE

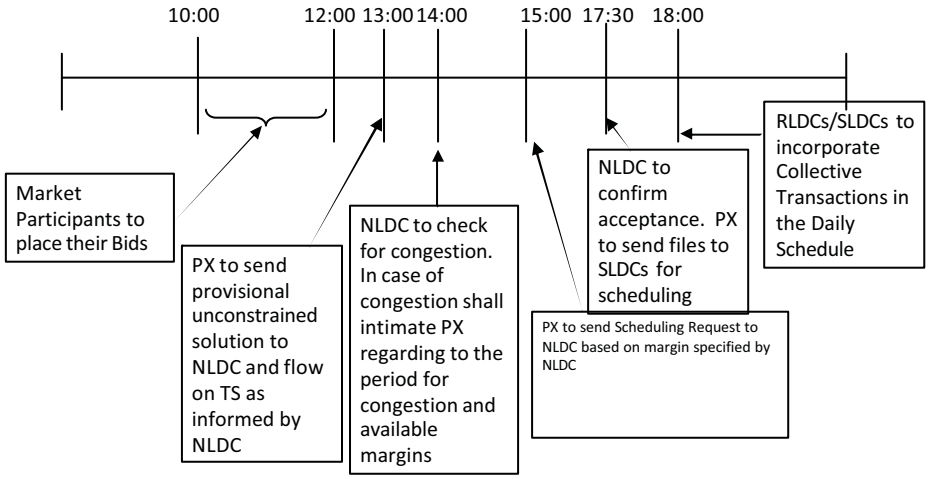
DAM Product Description

- **Order Types:**
  - Hourly or Portfolio Orders
    - Min 1 hour
    - Different Price-Quantity Pairs
    - Partial Execution Possible
  - Block Orders
    - Consecutive hours during the same day
      - Customized block bid allowed
- **Firm commitment to purchase or sell**
- **Order Characteristics**
  - SLDC Clearance should be = 1 MW
  - Minimum Order quantity can be less than 1 MW
  - Minimum volume step: 0.1 MW
  - Minimum price step: Rs 1 per MWh (0.1p/kWh)

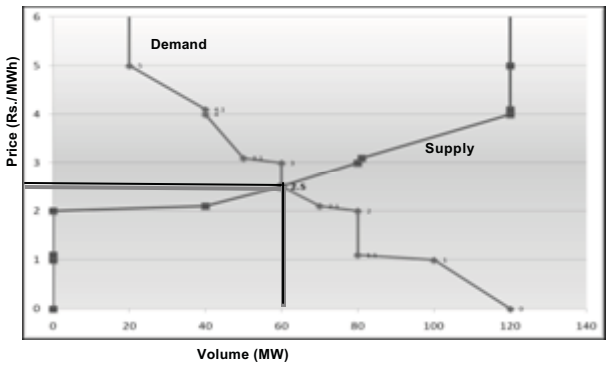
DAM Product Description

- **Trading Availability**
  - Every Calendar Day
- **Order Entry / revise /cancel**
  - Entry of orders on D-1 from 10:00 hrs to 12:00 hrs related to Delivery Day (D day)
- **Contract**
  - Clearing Price : Area Clearance Price
  - Cleared Volume
  - Total Contract Value: Cleared Volume multiplied by ACP
  - Final settlement adjusted for any force majeure deviations
- **Delivery Point**
  - Periphery of Regional Transmission System in which the grid-connected entity, is located

Time Line for scheduling of Collective Transaction

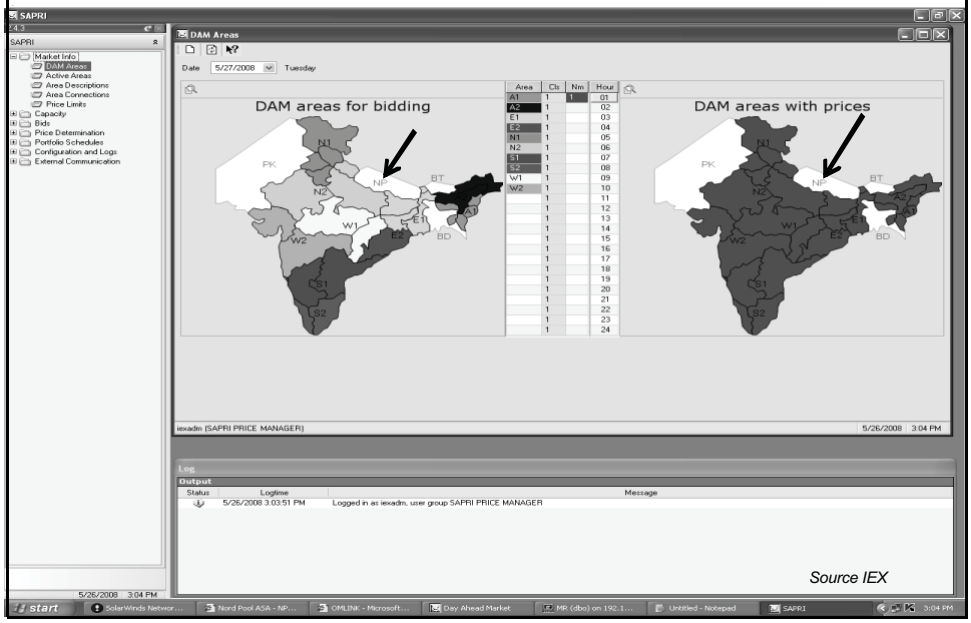


Match demand and supply



?Market splitting for congestion management
?Social welfare maximization

BID AREAS



Collective transaction:

TREATMENT OF LOSSES

- Inter-state transmission losses to be applied separately on buyers and sellers.
- To compensate for losses in the system, the sellers shall inject extra power into the system in addition to the contracted power.
- To compensate for losses, the buyers shall draw less power than contracted.
- Intra-state transmission losses should also be taken care of in the schedules by respective SLDCs.

Treatment of Losses

- **Both Buyers and Sellers to absorb losses**
  - **Buyer**
    - *draw less than Contracted Power*
    (Contracted Power – losses)
  - **Seller**
    - *inject more than Contracted Power*
    (Contracted Power + Losses)

- Average Transmission Losses of the Region where the Entity is geographically located

International Power Market Models

Pennsylvania New Jersey Maryland(PJM)

- RTO and market operator, Non profit organization
- 13 US states with 700 members
  - Gencos, Discom, Trading Cos, Large Eng users ,captives
    - Capital intensive cos- Aluminum, steel , Cement
- Is a centralized dispatch model – Security constrained Economic desptach/ merit order despatch by RTO
- Reliability Pricing model
  - Capacity Auction market upto 3 years ahead – One Base Residual Auction
  - All gencos in PJM region have to bid , demand side management can also bid
  - Demand curves are posted before hand for genco to see and bids
  - 3 Incremnetal auctions – Every year incremental capacity auctioned to fine tune requirement
  - All load serving entities have to forecast peak demand and procure capacity through self supply, bilateral contracts , remaining through PJM capacity auctions
  - Long term price signal for new genco investment

PJM RPM Model

PJM

- Energy market
- Energy price is the LMP of the Hub/ Zone one is connected to
  - Locational Marginal Price - marginal power price+ transmission congestion + marginal loss
  - May vary based on generator dispatched and congestion in network
  - Day ahead forward (both buyers and sellers)
  - Day ahead Scheduled Reserve market – 30 minute , offer based for gencos, after PJM forecast of day ahead market
  - Operating reserves - offer based price for gencos
  - Real time balancing- 5 minute based on grid condition

- Financial Transmission rights
  - Hedge transmission congestion price risk
  - Price risk = LMP Genco- LMP Discom
  - Ancillary Services – synchronized reserves , black /brown start etc

Financial Electricity Derivatives in US

- Commodity Exchanges –
  - New York Mercantile Exchange (NYMEX)
  - Intercontinental Exchange (ICE)
  - Derivative contracts settled on PJM spot day ahead prices
  - Not liquid , ICE more liquid than NYMEX
  - Large number of contracts
  - Each ISO, Zone , peak -off peak, daily - month
- US gas market much more liquid – Henry hub gas price is benchmark price in US
  - Pipeline network dense
  - Old commodity , used for heating homes in winter

Contract Specs Monthly | Contract Specs Daily

US Regulators

- Both FERC and CFTC have a role in derivative market
- MoU between them for information sharing on energy trading & maintain confidentially of proprietary trades - under Energy Policy Act 2005
- FERC/ state regulator looks at physical market – ISO
- CFTC looks at derivative market & exchanges

Synthetics in Power Markets

- Spark Spread- Dark and Clean
  - Long Coal or Gas And Short Electricity
- Price of Gas + Profit of Carbon credit emission vs. Price of Coal
- Paper power plant
  - Energy Trading Cos, Energy Hedge Funds
  - Financial Institution like Morgan Stanley / Goldman Sachs also hold physical assets
  - For asset based trading – has become the core commodity business , derivative after financial crisis are less preferred
  - Trade prices at strategic gas pipeline hubs – Arbitrage

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Trading Techniques

- DISCOM portfolio similar to Asset Liability Matching in bank
  - Long term contract with long term , medium term with medium , spot with spot.
  - In case of retail competition becomes a bigger challenge
    - Portfolio churn
    - Floating and fixed rates to be matched in the portfolio
- Dirty hedge to cover most of risk
  - Basis Risk exists
  - Change into actual hedge when get a good price

Trading Techniques

- In day ahead uniform price auction – Price of marginal fuel determines the electricity price – Natural gas.
- Revenue of a coal based generator as MPP is then linked to gas prices and not coal
- Coal generators is exposed to coal price on revenue side, needs to hedge natural gas and not coal !!

California Crisis

- 1998- 2001,
- Utilities went bankrupt
  - Wholesale electricity prices went up 500 %
  - Retail prices were fixed by regulators
- Unregulated Gencos stopped selling power to utilities
- State had to interfere to avoid blackouts , state fund had to be used to buy power
- Later Had to enter into long term contracts at that point at high prices , retail consumers will be burdens with this for years
- Late 2001 , wholesale prices crashed due to economic recession and reduction in natural gas prices

California Crisis

- Three regulated private vertically integrated monopolies (IOUs)
  - owned and operated generation, transmission and distribution facilities
  - provides electricity to all consumers in their exclusive franchise areas
- Pressure from industrial consumers to reduce electricity prices
  - were among the highest in U.S. and much higher than neighboring states
- Generation was deregulated and unbundled
  - Utilities divested their thermal generating assets/ sell power in the market and buy form market
- Retail competition was introduced , but few moved to new the new suppliers, they remained in regulated tariff
- Power was to be procured through PX in day ahead market
- Utilities were exposed to price volatility
- Derivatives was introduced to hedge price risk

California Crisis

- California Power Exchange was set up where day ahead contracts were traded – 80 % market share
- CAISO to handle scheduling ,balancing and ancillary service
- New plant difficult to set up in California due to environmental concerns
- Buying power form other states
- Generators started withholding assets
- Trader like Enron took position in derivative markets and squeezed physical market to make windfall profits
- Market design and regulatory decisions was flawed

Nordpool

- Nordic Countries - Norwary, Denmark, Finland , Sweden
- Large power cos - State owned
  - Market power mitigation through Unbundling vs integrated market
  - Market Coupling
- Generation competition , Transmission regulated monopoly, Discom network regulated monopoly , retail competition (many retailers)
- In US -Discom is regulated monopoly in most states

- Market Design
- Day Ahead Spot market – Elspot- demand and supply in full Nordic region –
  - Energy + Transmission Capacity right
  - Double sided closed bid Auction
  - Run By Nordpool Spot
  - 750 MU daily vs 40 MU in India

Nordpool

- Balancing Market – Elbas- Intra day upto 1 hour before delivery – Continuous market
- Financial Futures market – Upto 4 years ahead
  - Run By NASDAQ OMX Commodities
  - Also run UK power derivatives
  - Is a derivatives exchange
  - Continuous trading
    - Participants can also do long term physical bilateral if they want = Spot physical + Financial Futures
    - Provides flexibility and exit whereas bilateral 'take or pay'

Nordpool

- Contract for Difference(CFD)
  - Basis risk between Financial contract (settled on unconstrained system spot price) and Bid area hedged with this
- Nordpool day ahead prices which are daily demand and supply prices - Is the benchmark price
  - All market prices bilateral retail reflect this
- TSO Dispatch based on market bids of participants
- Integrated Nordic markets
  - No border tariff
  - Explicit transmission charges (postage stamp)
- Short term market is 60 % of market
- Separate Nordpool Clearing to clear all contracts

Comparison

PJM	Nordpool
Centralized security Constrained economic Dispatch	Market based dispatch
LMP=Nodal Marginal price	Pool Price = Marginal price
Marginal Transmission Loss in LMP	Transmission charge – Postage stamp
Capacity Market	Through Financial futures
Discom -Regulated monopoly	Retailer – retail competition
Explicit transmission right auction	Implicit Transmission auction
Derivatives Not Liquid , many contracts - LMP	Derivatives liquid – Pool price
	CFD

Brazil

- Short term market failed in 2001 economic crisis
  - Energy prices crashed as demand reduced , leading to huge loss to gencos
- Short term market not provide sufficient investment signals- Timing of investment not clear as prices show volatility
- Short Term market does not lead to DISCOM efficient procurement
- Have an balance between central planning and market
  - How much capacity required estimated through planning
  - Investment made through competitive bidding to make it efficient

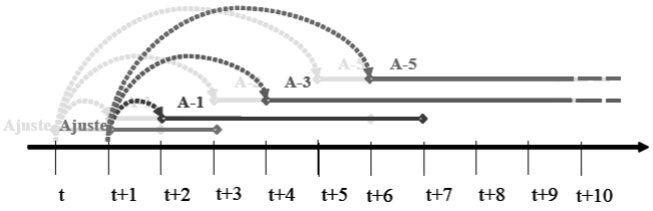
Capacity Markets – New Energy

- Two auctions to contract new capacity are carried out every year, for new entrance to come in operation in five (hydro) and three years (thermal)
  - To take care of load uncertainty
- Long-term energy contracts offered- allows auction winners enough time to build plants and to have project finance
  - 15y energy contracts and energy call options for thermals
  - 30y energy forward contracts for hydros
- Contracts are standardized, fuel price indexation for thermals (similar to Indian case 1, 2)
- Criterion for contracting in auctions is the smallest tariff ($/MWh)
- Done by govt and all Discoms have to project demand and bid

Energy markets- Existing Energy

- 1 Year before delivery
- Contract for 5 yrs to 15 yrs forward contracts. These are financial contracts
- Existing gencos participate
- Multiple buyer and seller model
  - Each genco signs contracts with multiple Discoms
  - Diversification and liquidity
  - Small discom do not loose out
  - Economies of scale ensure good price discovery
- DISCOM - Penalty if underestimate , above 103 % cannot pass on in ARR
- Dispatch based on SDDP stochastic dual dynamic programming (generation and transmission optimization simultaneously) and System marginal price found which is the spot price

Contracts



- New energy
  - Auction A-5 (5 years ahead of delivery/ Contracts from 15 to 30 years)
  - Auction **A-3** (3 years ahead of delivery/ Contracts from 15 to 30 years)
- Existing energy
  - Auction **A-1** (1 year ahead of delivery/ Contracts from 5 to 15 years)
  - **Adjustment** Auction (4 months ahead of delivery/ Contracts from 1 to 2 years)

Source : PSR

Thanks for your Patience