Role of Derivatives in Indian Power Market

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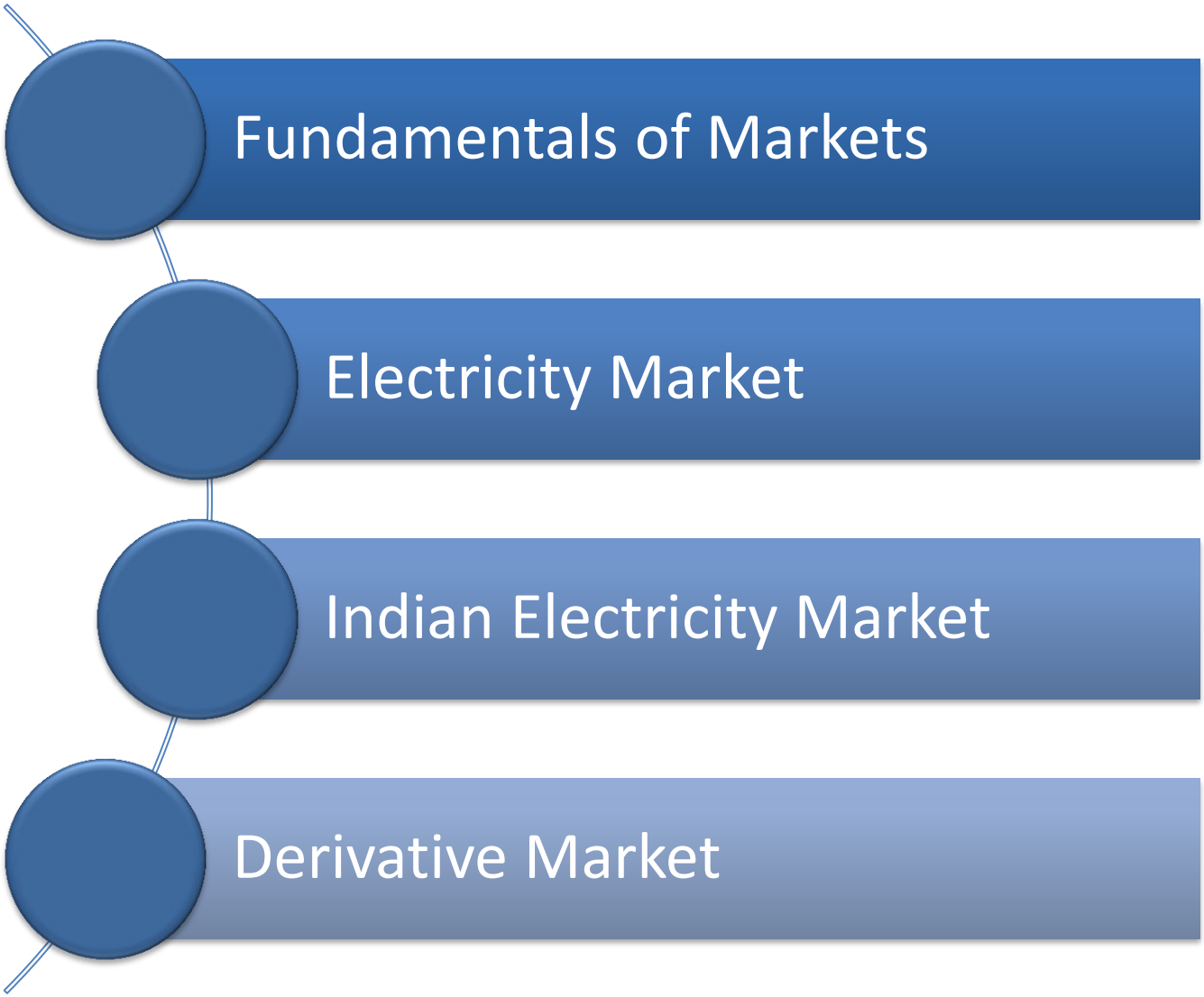
In this presentation…



i. Markets

Market

"Market is a mechanism for matching supply and demand for a commodity through the discovery of an equilibrium price"

Requisites for Creation & Classification of Markets

- Quality
- Quantity
- Price
- Date of Delivery
- Mode of Settlement
- Conditions to Contract

Commodity

"A basic good used in commerce that is interchangeable with other commodities of the same type"

Characteristics

- Product should be essentially uniform across producers
- Often used as inputs in production of other goods and services, i.e. large scale utility
- To be traded on an Exchange, a commodity must meet specified minimum standards, known as Basis Grade

Eg: Grains, Gold, Oil, Natural Gas, Foreign Currencies, Electricity etc.

Complete Market Products

Physical Markets + **Financial Markets**

Spot
Immediate Delivery

+

Forward
Delivery at some point in future

Derivatives
Risk Mgmt. tools for product/time/place

- Futures
- Options
- CfD

Commodity Exchanges first evolved to facilitate agri-markets or ‘mandi’ through electronic platforms

ii. Electricity Markets

Electricity, a unique commodity

Flow (Non storable)	Laws of Physics	Interdependencies	Speed of Light
Imbalances	**Congestion Management**	**Ancillary Services**	**Scheduling & Dispatch**
Because of complications in Production & Delivery systems, mismatches will always exist in supply & consumption as against contracted Power. System Operator manages these imbalances	This commodity Travels as per laws of physics which are unique to itself. We cant Tell electricity where to go or not to overload a route/line. One transaction of electricity can affect any or all other transactions for delivery.	Production & Consumption of electricity is dependent on ancillary services which make the transmission system Work, such as Operating Reserves, Reactive Power, etc.	SO Schedules Contracts in advance and mingles energy in real-time by Dispatching Generation to meet demand

Can Electricity Markets be designed to meet standard economic theory?

- Electricity is a flow, rather than a stock
- Cannot be metered perfectly
- Storing potential energy is expensive
- Stochastic 'retail demand' is too costly to moderate via spot prices and devices for continuous control and metering
- Flows on transmission lines are constrained continuously by operational limits and environmental factors. Imbalances can injure or destabilize transmission links, electrical systems require continuous balancing of demand and supply
- Ramping rates of generators are limited

Electricity Markets are inherently incomplete and imperfectly competitive

Property rights of Electricity Commodity?

- Electricity is a flow, means that a property right cannot be assigned by title. No one owns electricity per se
- Qualified wholesale market participants obtain 'privileges' to inject or withdraw power from the grid at specific locations
- These Privileges encompass obligations to comply with technical rules and procedures for settling accounts based on metered injections and withdrawals

All Rights are reciprocal and are derived from Contracts

Limitations in Metering & Control

Consequent market imperfections

- Owing to limitations in Metering & Control of electricity, compromise adopted universally is that for most retail customers the timing and quantity of power used is priced imperfectly (flat tariffs) w.r.t wholesale tariffs
- Hence, Consumers (especially retail) have 'unrestricted right' with few exceptions, to draw electricity from the grid
- This requires strenuous efforts on the
  - supply side to provide energy,
  - transmission to meet expected demand, and
  - supplemented by reserves to meet contingencies

Electricity Market Design

Electricity markets are designed to match supply and demand, taking into consideration the technical limitations, elasticities and delivery requirements

- Design is influenced by not only Economic, Engineering considerations but also by Historical, Political and Social Considerations. These factors make every country unique.
- If the spot electricity markets were complete and perfect then all forward markets could be organized around financial contracts pegged against spot prices
- The efficiency of Spot Markets to facilitate intertemporal effects as startup costs and ramping constraints, and spatial effects such as constraints on transmission lines decides the level of dependence on Forward Markets

Transformation of Vertically Integrated to Liberalised Markets

- From early 80s to late 90s, the process of privatisation of state enterprises and liberalisation of markets was underway in infrastructure industries (Telecom, Water, Gas, Electricity, Transport, etc)

For Electricity, this shift was justified

by

diminished economies of scale in Generation

to

expose cross-subsidies and to improve efficiency via better pricing and incentives for greater variety of products and services

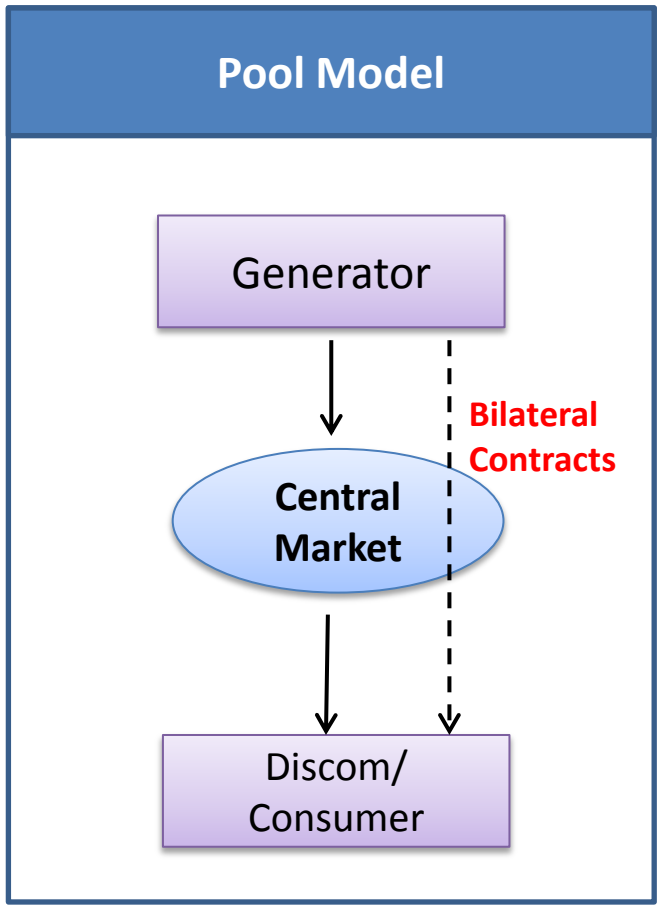
as

privatization and liberalization seen as necessary to overcome organizational inertia, and to attract private investment to serve rapidly growing demand arising from economic expansion

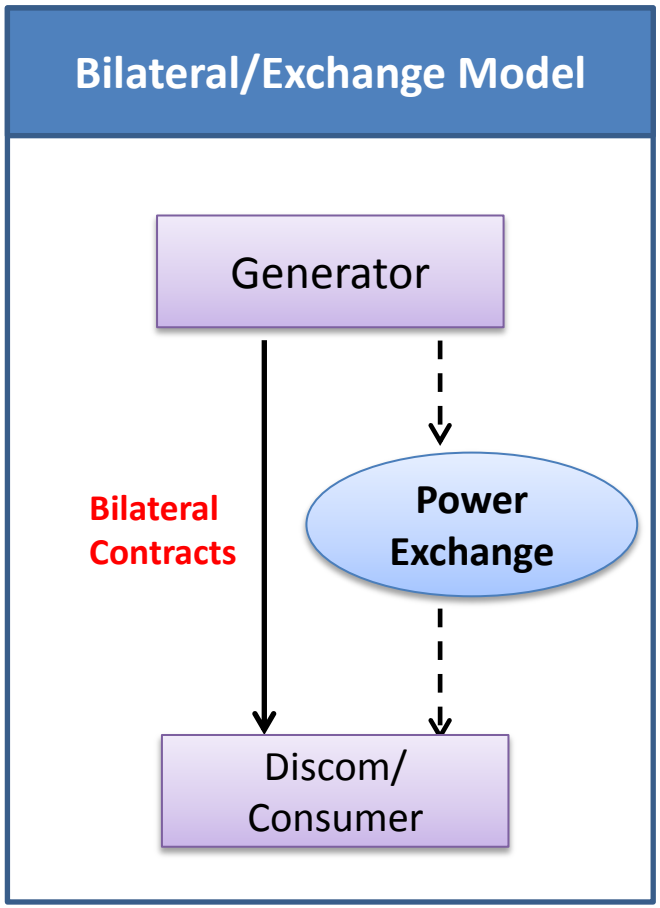
through

separation of the public good embodied in the infrastructure network, such as electricity or gas transmission and rail lines, from the associated commodity or service

Pool vs Exchange Model

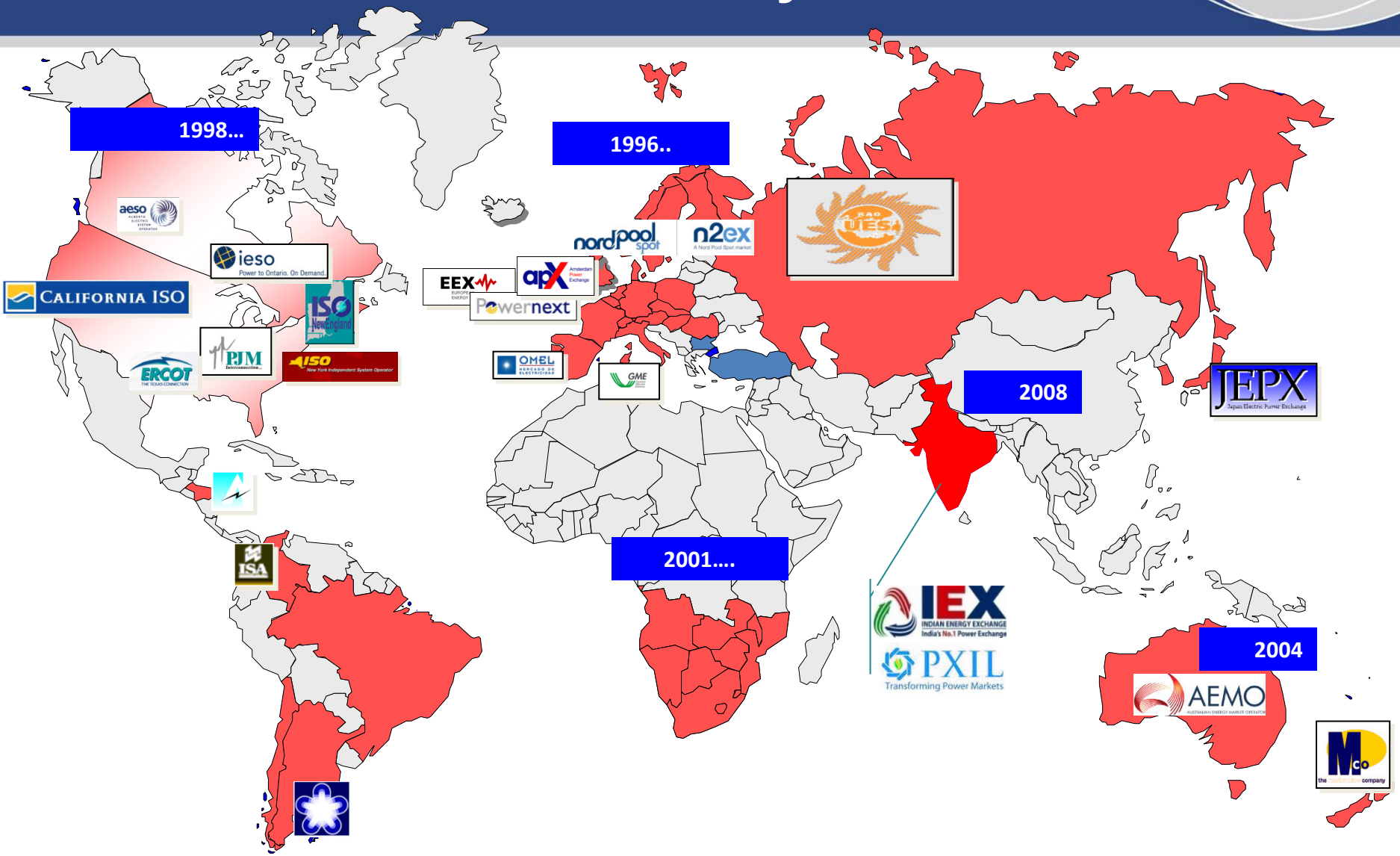


Centralised Dispatch



Decentralised Dispatch

Global Evolution of Electricity Markets



iii. Indian Electricity Markets

Introducing Competition

Electricity Market

Production Function	Transportation Function	Merchant Function
• Generation	• Transmission • Distribution	• Wholesaling (Supply) • Retailing (Demand)

Natural Monopolies

Step-1: Introduce competition in Supply side so as to decrease electricity prices. (Demand side competition doesn't result in reduction of prices unless production is competitive)

Step-2: Introduce competition in Demand Side so as to pass the gains in supply side directly to consumers

Pre requisites for a competitive market

Unbundling of Utilities	• Separation of Vertically integrated utilities, transmission should be separated from generation & supply
Multi Buyer Model	• Choice to consumers to buy from any generator or third party • Choice to generator to sell to any buyer
System operator	• Independent System Operator: To maintain grid security and reliability, transmission allocation
Open Access	• Open Access in Transmission & Distribution Network
Imbalance Settlement Mechanism	• Deviation or Imbalance settlement mechanism to ensure discipline • Balance Responsible Party (Control Areas)
Trading	• Recognizing trading as a distinct activity
Autonomous Regulator	• To overlook the working of the Market

Indian Power Market Products…Missing Blocks

Medium Term 3 months- 5years	➢OTC Licensed traders *(40)* ➢Exchanges
Short-Term Intraday - 3 months	OTC Intraday- 3 months Exchanges 1. Intra-day 2. DAM 3. DAC 4. Daily 5. Weekly 6. Monthly 7. Derivatives
Balancing Market Real Time	Unscheduled Interchange/DSM Ancillary Services Demand Response
Transmission > 7 Years	➢*Transmission Licensee* Exchanges ➢Financial Transmission Rights ➢Physical Transmission Rights

Development of Power Market

Advantages of an Organized Power Market

- Market Participants can efficiently manage their portfolios by choosing different products available under long term , medium term and short term duration.
- Provides an exit route for PPAs.
- Efficient Market provides transparency and which may lead to easy financing .
- Markets are driven by the force of economies i.e. demand and supply and hence the prices are derived.
- Market Participants e.g. DISCOMS may reap benefits of real time balancing.
- Typically lower unit pricing compared to standard electricity supply contracts.
- Derivative products may provide an avenue to hedge against spot-price volatility

iv. Derivative Markets

Market Products

Physical Markets + Financial Markets

Spot
Immediate Delivery

Derivatives
Risk Mgmt. tools for product/time/place

- **Forwards** (OTC, Physical or Financial)
- **Futures** (Exchange, Essentially Financial)
- **Swaps or CfD** (OTC, Financials)
- **Options** (OTC/Exchange, Physical or Financial)

Spot market is the only segment where the price of a commodity for physical delivery is discovered

Derivative Markets

- A contract which derives its value from price of an underlying commodity
- All financial contracts are derivative contracts
- Performs economic functions like Transferring risks, Discovery of Future prices, Increasing saving and investments in long run
- Participants in Derivative Market- Hedgers, Speculators, Arbitrageurs
- Could be a combination of spot and/ or published forward/ contract prices
- Difficult to “value”
  - as published forward curves do not really represent the types of prices covered by contracts

1) Forwards (OTC Contracts)

- Obligation to buy or sell a fixed amount of electricity at a pre-specified contract price(the forward price), at certain time in the future (called maturity or expiration time)

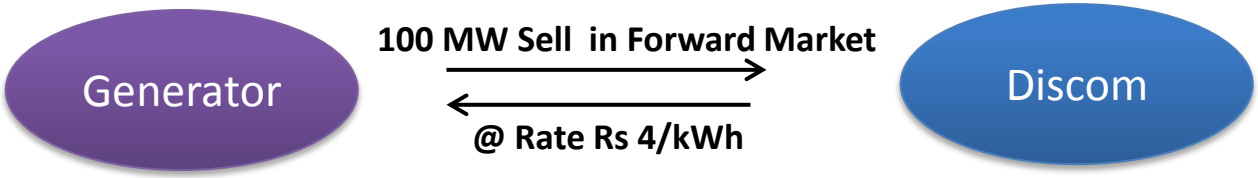
- Electricity forwards are custom tailored supply contracts between a buyer and a seller,
  - Buyer is obligated to take power and Seller is obligated to supply

- Electricity forward prices are:
  - Based on forward (long-term) expectations
  - Stable behavior
  - Long-term forwards have low volatility, short-term forwards may have high volatility
  - Correlation with fuels
  - In India, long term Forwards called ‘PPA’ with >7 year offtake & levelised tariff are in vogue

Risks in Forward Market?

Example

- Forward Contract Entered in Jan'18 for Delivery in June 18



- Two types of Credit Risk

i) Replacement Risk:- Before Start of Delivery if any counterparty defaults. For ex. If Discom defaults on March 18 to take power from the generator, then generator has to enter in a new contract at current market price, which will be generally at low price say @Rs. 3/u with a new counterparty. So Replacement Risk=(4-3)*Contract Volume

ii) Settlement Risk:- If the electricity is delivered but discom defaults to make payment, this creates settlement risk which has generally several times higher risk than replacement risk=4*Contract Volume. In addition to this delay in payment also comes in settlement risk

Credit risk exposure is defined as the sum of the settlement and the replacement risk.

2) Futures

- Traded on organized Exchanges
- Majority of electricity futures contracts are settled by financial payments (cash settlement) rather than physical delivery, which lower the transaction costs.
- Futures contracts are highly standardized:
  - Contract specifications, Trading locations, Transaction requirements, Settlement procedures.
- Main difference between Futures and Forwards is the quantity of power to be delivered.
- Delivery quantity specified in electricity futures contracts is often significantly smaller than that in forward contracts

- Pros

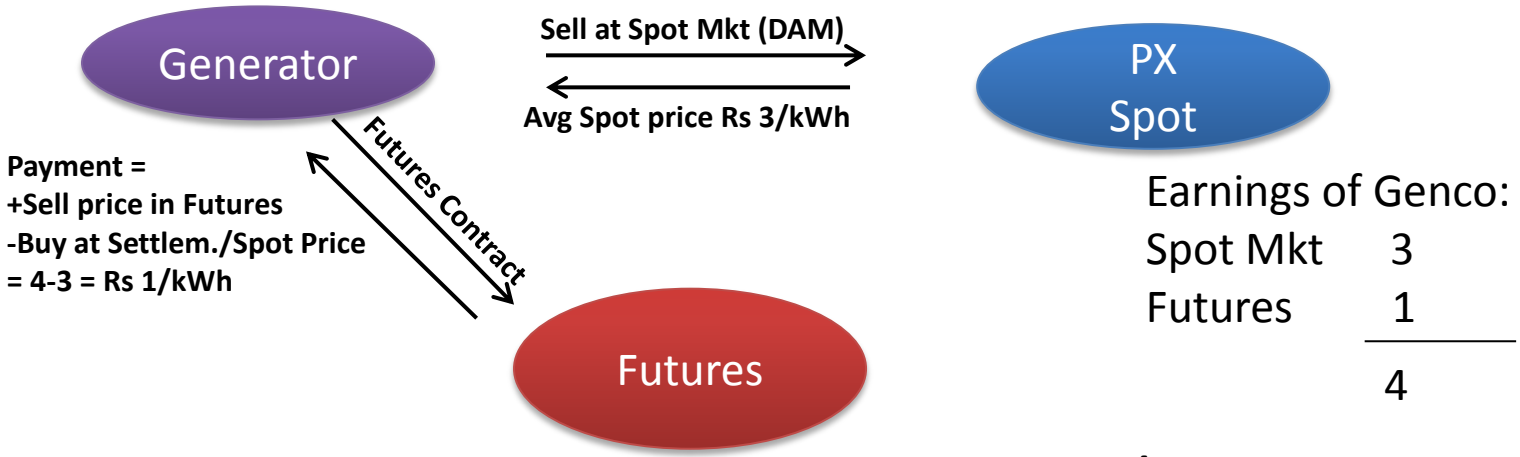
  Market consensus; Price transparency

  Trading liquidity; Reduced transaction and monitoring costs
- Cons

  Only Standardized Contracts tradable, no customization possible.

Hedging with Futures

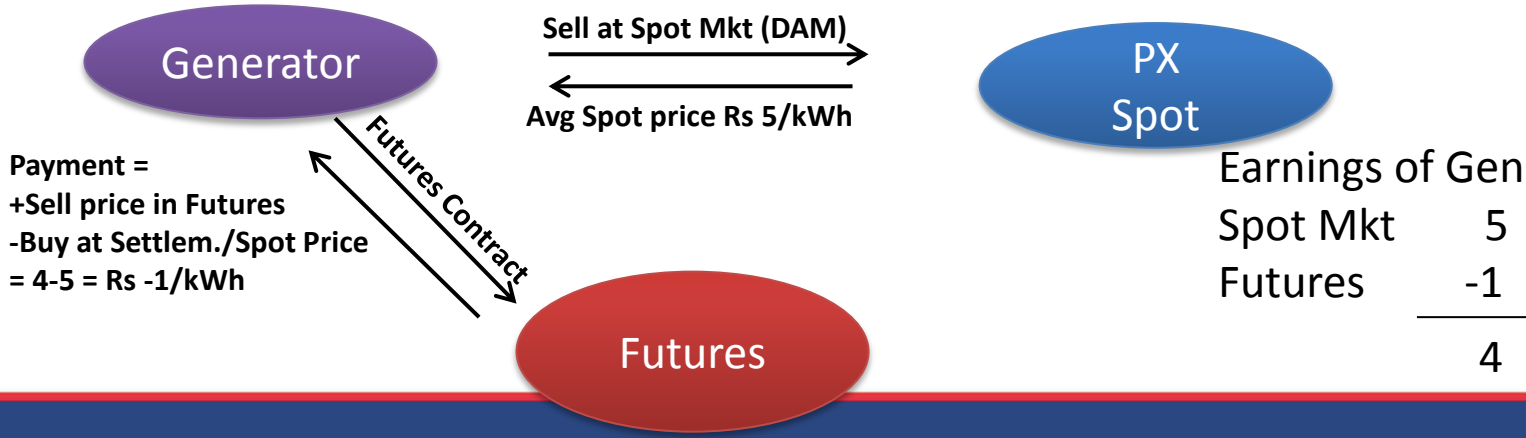
- Generator hedges 100 MW load in Futures Market
- Generator Sells Futures Contract at a future price in Jan '18 @ Rs 4/kWh which settles at spot market price
- Scenario 1:- Avg. spot market price during delivery period is say **Rs 3/kWh**



Earnings of Genco:

Spot Mkt	3
Futures	1
	4

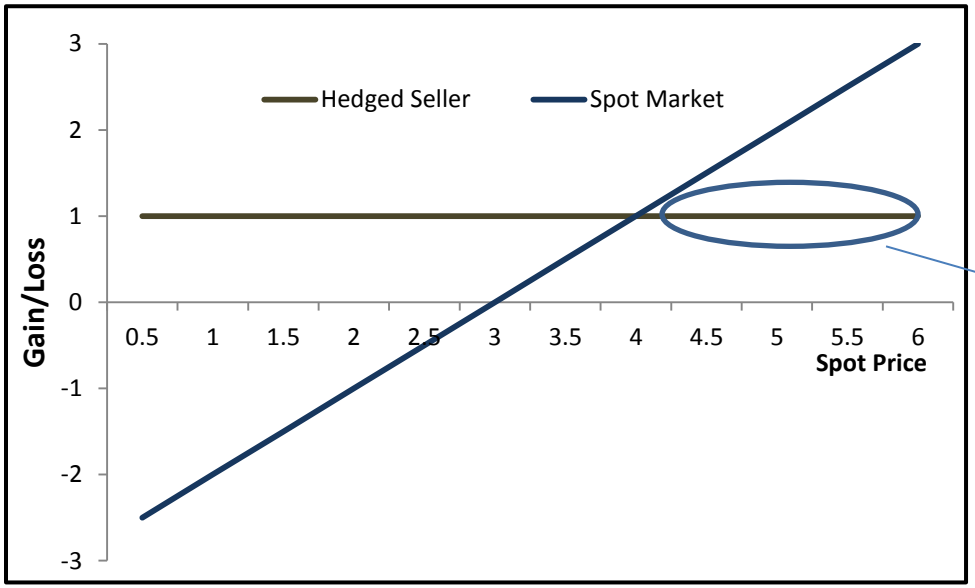
- Scenario 2:- Avg. spot market price during delivery period say **Rs 5/kWh**



Earnings of Genco:

Spot Mkt	5
Futures	-1
	4

Situation of Seller at various Spot Price



High Profit Zone

When Spot Price is low then Futures seems profitable for seller since it hedges price risk but at higher spot price the seller is getting same price. There is no prospect for greater profit. Solution is **Option Contracts!!**

The Seller through a put option—is provided a way to have higher profits at high spot prices while still being protected against low prices by paying an insurance premium.

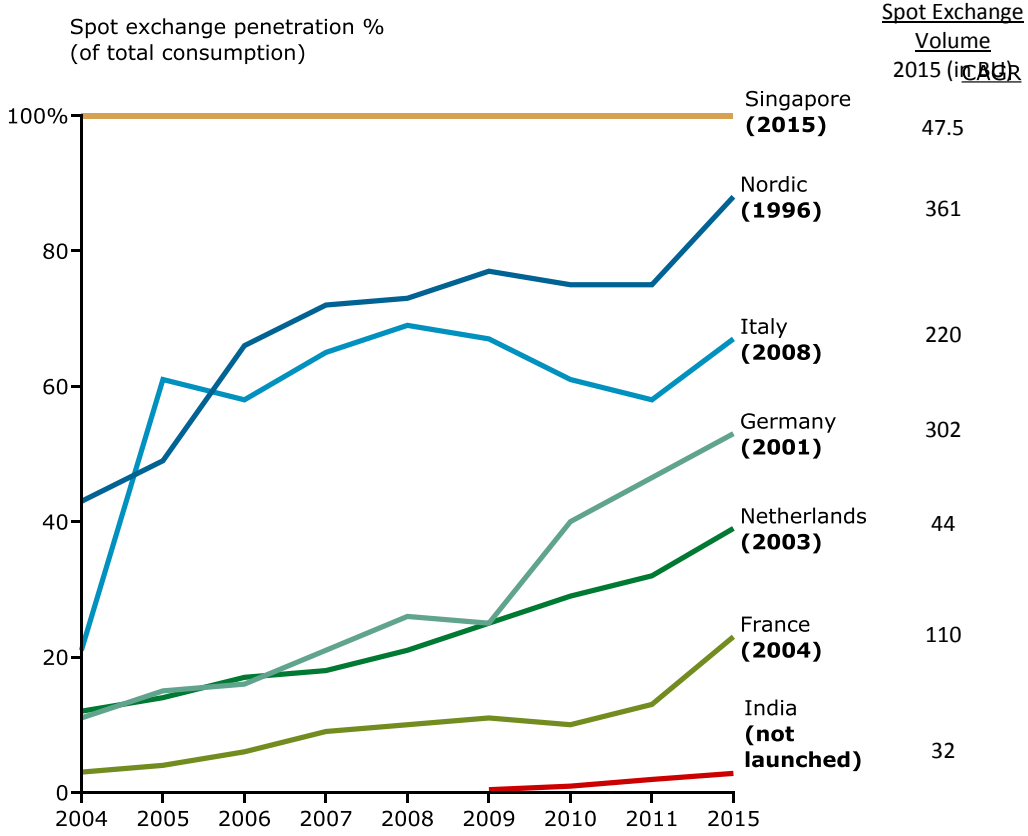
Issues in Present Indian Wholesale Market Design

- **Spot prices** in DAM have dropped to the **lowest** due to over supply, as against OTC Short Term and Long term contracts, over the past one year. But Prices in a spot market tend to change quickly due to demand, supply situations and transmission constrained.
- In spite of low prices in DAM, **share of Long Term** market **remained unchanged** from periods of shortage i.e. FY 2010
- Buyers, especially **Discoms are under severe financial stress**, are tied up in Long Term Forward Contracts (PPAs) with **inability to exit** the costly physical contracts to avail cheap power
- **Arbitrage** between 'Forward' market and 'Spot' market is **nonexistent**
- **Forward markets** are **not liquid**, owing to segregated auctions with limited participation
- Discoms have **no liquid alternative market**, forcing them to rely on 25 year Long Term PPAs for resource adequacy. Coupled with this is the **impossibility to forecast demand for 25 years ahead** and payment rigidity of capacity charges

Key learnings from Global Benchmarking

- **Derivatives offer a compelling value proposition** to all stakeholders in the power sector
  - End-consumers: Higher efficiency in price discovery→ **lower growth in tariffs** (e.g. real rate of growth in power tariffs **declined by 4-6 percentage points** since derivatives launch in countries including Italy, Netherlands and Spain)
  - Buyers: **Hedging mechanism** against price volatility in spot markets (e.g. base and peak spot prices in France saw volatility reducing to 25% and 40% post derivatives launch, versus 36-87% and 50-155% previously)
  - Sellers: **Lower offtake risk** (diversified avenues for supply, beyond locked-in contracts; key inputs into **investment decisions** for generators, by providing locked-in prices for longer-term- up to 6 years)
  - Government/Regulatory bodies: **Higher transparency in power pricing**, especially as OTC trades come online; higher efficiency of spot markets with prices trending towards marginal costs of generation

Across all advanced countries, Power exchanges are an integral part of the overall power sector, aided by Electricity Derivatives



	Singapore	Nordics	Italy	Germany	Netherl-ands	France	India
Launch yr. of spot exchange	2003	1993	2004	2001	1999	2001	2008

POWER SECTOR LIBERALIZATION LED TO CREATION OF EXCHANGE MARKETPLACE

Singapore

- Launch of spot exchange (2003) -> move from cost plus to **market based** pricing; **Mandatory participation** on exchange
- Imported natural gas based generation share increased from 20% (1999) to **95%** (2015); market-linked gas price led to **price volatility**
- Launch of **electricity derivatives** in 2015 to hedge against volatility

Nordics

- Liberalization of power sector (1990-95)
  - Unbundling of generation and transmission
- Launch of spot exchange in 1993 (Norway), common market established by 1993-2000
- **50%+** hydro based generation
  - **Supply fluctuation** leads to **high seasonal price variance**
  - Led to early launch of derivatives in **1996**

Germany

- Market **liberalized in 1998** -> territorial monopolies removed, generation/retail opened for competition
- **~50%** coal/gas/nuclear based generation -> relatively stable supply
- Spot & derivatives launched simultaneously in 2001

France

- Generation concentrated with top player **(>90% share)**; **60%+** nuclear generation with stable supply
- Power retail completely liberalized
- Launch of spot & derivatives exchange in 2001-04, however penetration has been low **(20-25%)**

Note: Figures in bracket imply launch year of electricity derivatives

Derivative Markets, examples

Exchange	Product	Country	Type	Settlement
EEX	Futures Options	Germany, Austria, France, Italy, Spain, Netherlands, Belgium	Base load Peak load Off-peak load	Day ahead Spot Market of EPEx Spot
NASDAQ OMX Commodities Exchange	Futures	UK, Scandinavia and Baltic countries	Base load Peak load	Day ahead Spot Market of Nordpool Spot
NYMEX	Futures	Respective ISO/RTOs of USA	Peak load Off-peak load	Respective Spot prices
ICE Futures US	Futures	Respective ISO/RTOs of USA	Peak load Off-peak load	Respective Spot prices

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