

Creating a Futures Market for Electricity in India: Way Forward

Akhilesh Awasthy
Director (M.O. & I.T.)

IIT Kanpur
26-28 Apr 2017

What is a Derivative ??

The foundation of all derivatives market is the underlying market, which could be

- Asset
- Interest rate
- Index

“A derivative is a financial instrument whose value depends on the value of other basic underlying variables” ...John c hull

The derivatives market performs a number of economic functions. They help in:

- Transferring risks
- Discovery of Future prices
- Catalysing entrepreneurial activity
- Increasing saving and investments in long run

Evolution of Derivatives

- In the 17th century, in Japan, trade of rice evolved to the stage where receipts for future delivery were traded with a high degree of standardization. In 1730, the market got official recognition as “Dojima Rice Market” thus regarded as first futures market
- The first futures markets in the western hemisphere were developed in the United States in Chicago. These markets had started as spot markets and gradually evolved into futures trading. The Chicago Board of Trade (CBOT) which opened in 1848, is the largest futures market in the world

Derivatives Market in India

- Functioning in India since 19th century through establishment of Cotton Trade Association in 1875
- Instrument got Momentum after the liberalization process of RBI in 1991
- In July 1999, Derivatives trading commenced in India
- Exchange Traded Derivatives introduced in Jun 2000 in NSE & BSE
- On 2nd July, 2001 NSE became the first Exchange to introduce options on Individual

Salient features of Derivative Markets

- A contract which derives its value from price of an underlying commodity
- All financial contracts are derivative contracts
- Can involve a degree of optionality
- Difficult to “**Value**”
 - as published forward curves do not really represent the types of prices covered by contracts

Participants in Derivative Market

- **Hedgers** use futures or options markets to reduce or eliminate the risk associated with price of an asset
- **Speculators** use futures and options contracts to get extra leverage in predicting on future movements in the price of an asset
- **Arbitrageurs** are in business to take advantage of a discrepancy between prices in the two different markets

Types of Derivatives Contracts

- **OTC** (Over-the-Counter) derivatives are those which are privately traded between two parties and involves no exchange or intermediary
- **ETD** (Exchange-traded-Derivatives) is a market where individuals trade standardized contracts that have been defined by the exchange

Physical Markets

+

Financial Markets

Spot

Immediate Delivery

Derivatives

Risk Mgmt. tools for product/time/place

- **Forwards** (P/F)
- **Futures** (P/F)
- **Swaps** (F)
- **Options** (F)

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

* P = Physical settlement, F= Financial settlement

Common Derivatives

1) Forwards

- Physical or Financial



2) Futures

- Essentially Financial



3) Swaps

- Financials



4) Options

- Physical or Financial



1) Forwards

- A forward contract is an OTC agreement between two parties to exchange an underlying asset:
 - for an agreed upon price (the forward price or the delivery price)
 - at a given point in time in the future (the expiry date or maturity date)
- Forward transaction can be looked at as a purchase with deferred delivery and deferred payment
- As per textbook definition, forward price at maturity converges to the spot price. In practice the convergence is complicated due to market frictions and imperfections, and in deciding the reference spot price
- By signing a forward contract, one can lock in a price *ex ante* for buying or selling a commodity. Whether one gains or loses from signing the contract depends on the spot price at expiry

2) Futures

- Futures are Forwards traded on organized Exchanges
- Like a forward contract, a futures contract is a binding agreement between a seller and a buyer to make and to take delivery of the underlying commodity at a specified future date with agreed upon payment terms
- Unlike forward contracts:
 - Futures contracts are standardized and exchange-traded
 - Default/Credit risk is borne by the Exchange Clearing house
 - Traders are allowed to reverse ('offset') their positions, so that physical delivery is rare
 - Value is marked-to-market daily
 - Different execution details also lead to pricing differences

Forwards vs Futures

Forwards	Futures
Traded between private parties	Traded in competitive arena
Self-regulating	Regulated by authority (like Exchange)
Tailor made contracts	Standardized contracts
Usually one specified delivery date. Range of dates is also possible.	Range of delivery dates
Settlement on the due date	Settlement on daily basis
Delivery or final cash settlement usually occurs	Delivery is rare, usually parties offset their position before maturity
Some credit risk	Virtually no credit risk
Margins are not required	Margins are usually required

3) Swaps

- Swap is the exchange of two streams of cash flows: one of them is based on a fixed (predetermined) price and the other on a floating (variable) price
- Can also be looked at as baskets of forwards that are traded as one package
- Mostly financially settled; also physically settled
- Swap transaction requires specification of:
 - the underlying commodity
 - the notional quantity (volume)
 - the fixed price
 - the published price benchmark for floating price (say Spot DAM)
 - the settlement date(s); and
 - cash flow dates

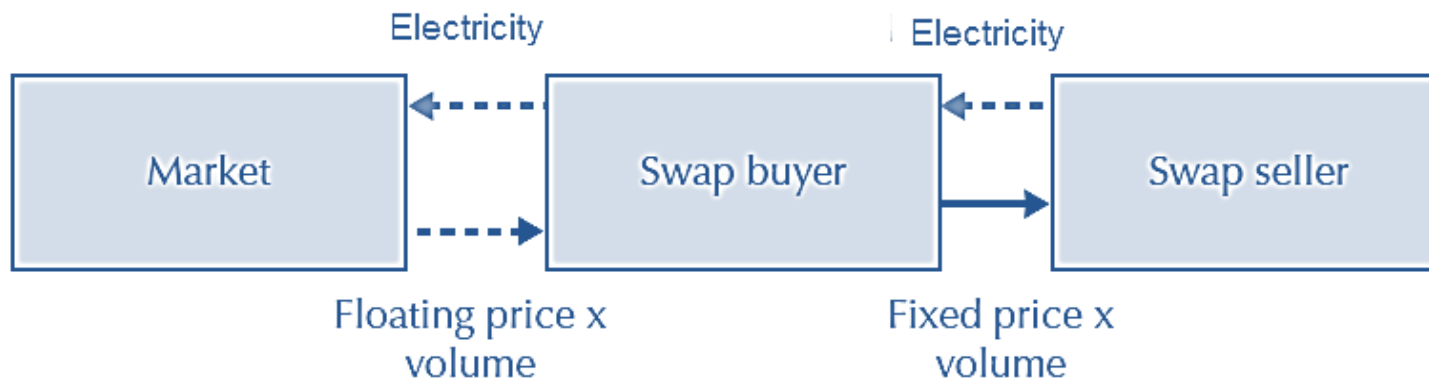
Financial swap

Floating price x
notional volume



Fixed price x
notional volume

Physical swap

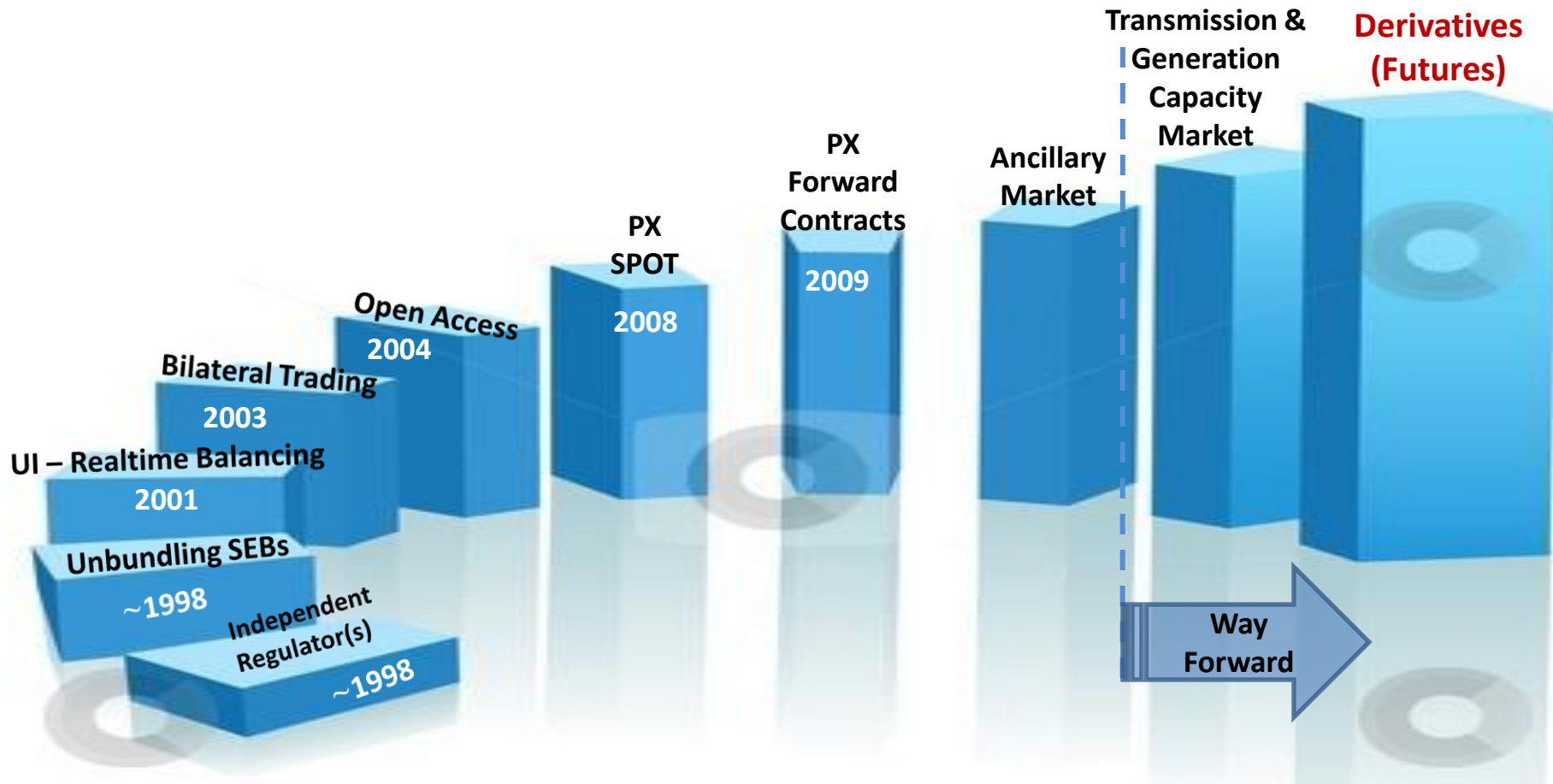


4) Options

- Option gives the option holder the right/option, but no obligation, to buy or sell a security/commodity to the option writer/seller at (or up to) a given time in the future (the expiry date or maturity date) for a pre-specified price (the strike price or exercise price)
- A **call option** gives the holder the right to buy a security/commodity at a predetermined price
- A **put option** gives the holder the right to sell a security/commodity at a predetermined price
- Options are both Exchange traded or OTC traded
- In many traditional OTC, Options are embedded in the contracts that often are not even explicitly identified as options. They typically arise from flexibilities and conditionality included in energy related contracts. Any flexibility in terms of volume, price, place of delivery or time of delivery can be restated as option contract

- Classified as European, American and Asian style:
 - European option can be exercised only on its expiry date
 - American option can be exercised at any time before the expiry date
 - Asian option's payoff depends on average price of underlying asset over a period of time
- Relative to Strike Price, Option contract can be:
 - At the Money (ATM)
 - In-the Money (ITM)
 - Out-of-the Money (OTM)
- In case of futures/forwards, contract is either held for delivery or liquidity, but option contracts may be held for liquidity, delivery or expire worthlessly
- Option contracts are tradable, the holders have the flexibility to sell the contract in secondary market

Indian Electricity Market Milestones & Way Forward



- Electricity is an unusual commodity that can not be stored
- A typical contract allows one side to receive a specified number of MWh for a specified price at a specified location for a specified period of time

Why Electricity Derivatives? Hedging?

- Deregulation and competition in wholesale markets in the past two decades has resulted in lower market driven prices, but also greater price volatility
- Renewable integration results in further high price volatility
- Spot price volatility in the electricity market can cause significant risk to wholesale market participants. While generators face a risk of low prices having an impact on earnings, DISCOMS/consumers face a complementary risk that prices may rise to high levels
- Market participants commonly manage their exposure to volatility by entering financial contracts that lock in firm prices for the electricity they intend to produce or buy in the future
- Derivatives can be OTC or Exchange traded

Continued..

- Electricity business has too many variables
- Long term PPAs are inherently risky wherein risks are generally transferred to one party
- No body can forecast for such a long period (say 25 years)
- Error in judgement can be too costly to sustain
- No easy exits available
- International trend is to avoid very long term contracts
- Introduce capacity market along with energy market to resolve missing money problem

Electricity Forwards

- Electricity forward contracts represent the obligation to buy or sell a fixed amount of electricity at a pre-specified contract price, known as the forward price, at a certain time in the future (called maturity/expiration time)
- Generator (IPPs) are natural sellers (short-side) while utility companies (DISCOMS) often appear as the buyers (long-side)
- Electricity forward contracts are the primary instruments used in electricity price risk management

Financially settled Electricity Forwards

- These are settled through financial payments based on certain market price index at maturity
- Ex- Contract for Differences in the UK and Australian Power Markets

Physically settled Electricity Forwards

- Electricity forwards with short maturity are often physical contracts
- Ex- DEEP market in India and energy balancing market (CAISO) in US

Ex: Electricity Forward Contract

Forward Contract Terms	
Price	Rs 4000/ MWh
Quantum	10 MW RTC
Maturity/ Delivery	1 st calendar day of immediate month
Underlying	Spot DAM market
Transaction day/date	15 th calendar day of preceding delivery month

- Seller and Buyer of the forward contract have locked in the price of Rs 4000/MWh based on foreseeable expectation , ahead of delivery
- On reaching closer to delivery date, if the spot price (DAM) is Rs 3000/MWh for the specified delivery period, then the seller of the forward contract is at gain of Rs 1000/MWh and Buyer is at loss
- If delivery is mandated only through spot market, the parties to forward contract trades electricity for physical delivery @ Rs 3000/MWh in spot market, and in addition buyer of the forward contract pays Rs 1000/MWh to seller of the forward contract making the transaction whole

Prices: Electricity Forwards

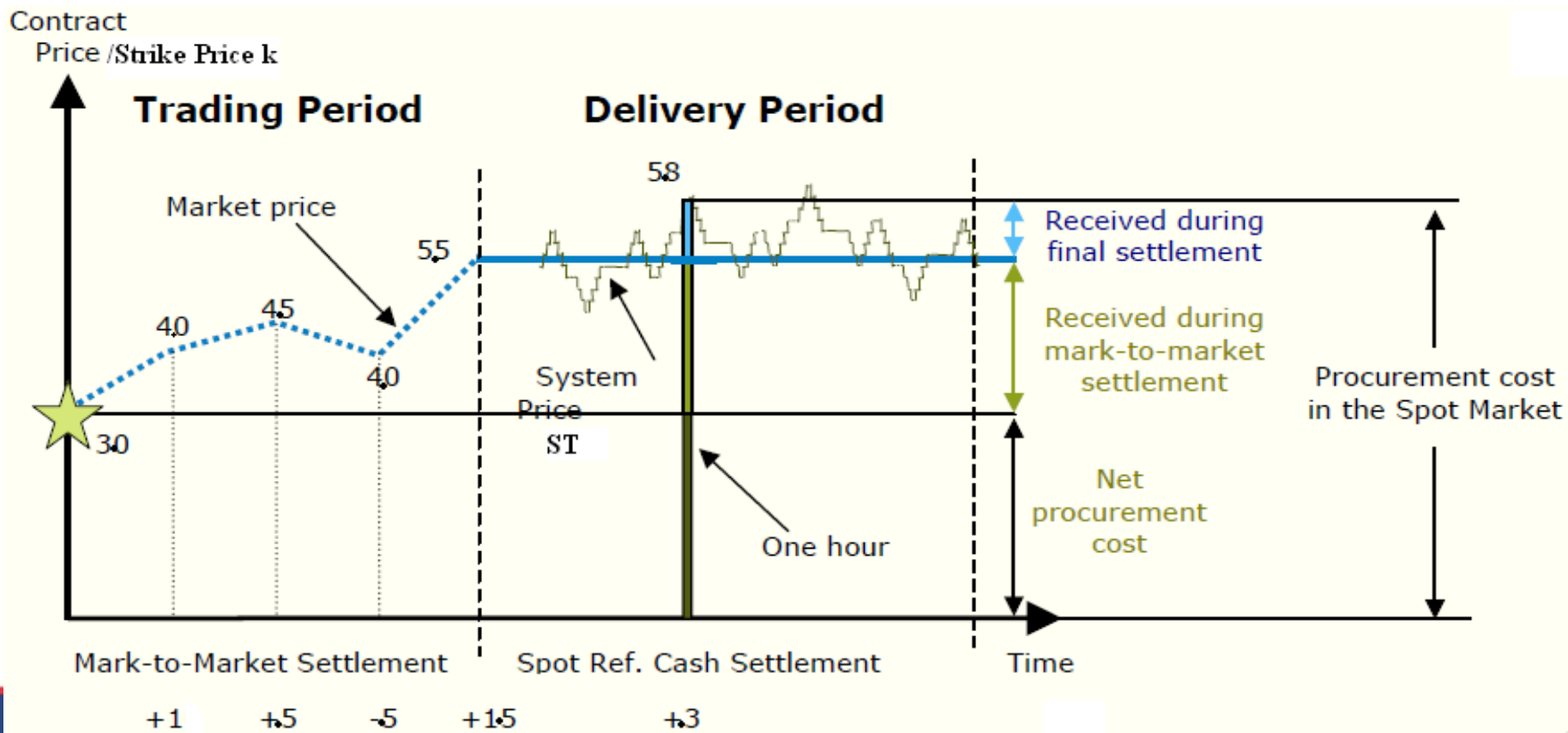
- The primary use of a forward contract is to lock in the price at which one buys or sells a particular good in the future (i.e. to manage price risk)
- If the price of the underlying asset rises, then the party who has bought the forward contract gains while the party who has sold the forward contract loses
- Electricity forward prices are:
 - Based on forward (long-term) expectations
 - Stable behavior
 - Correlation with fuels
 - Long-term forwards have low volatility, short-term forwards may have high volatility

Electricity Futures

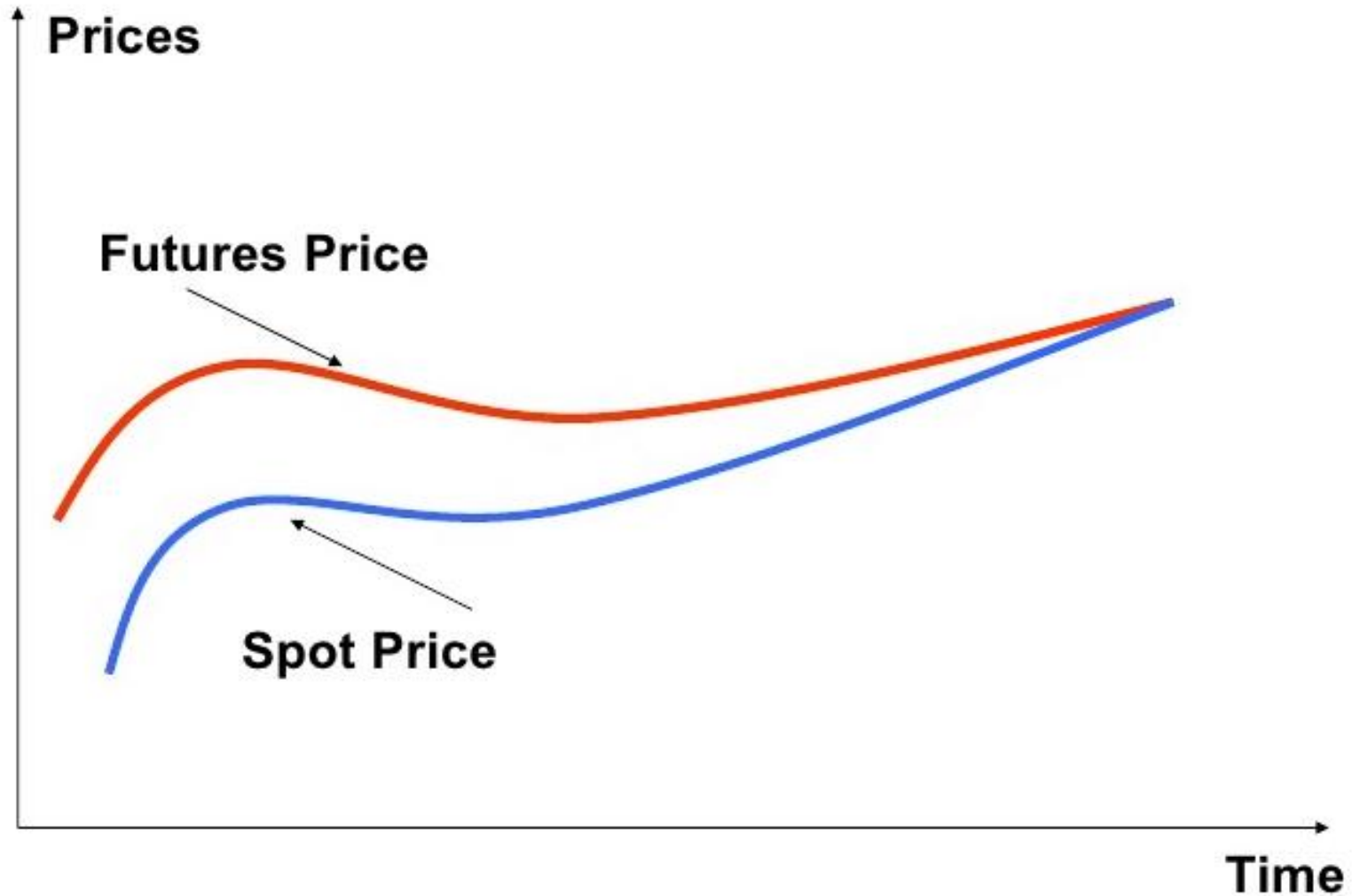
- Electricity futures contracts have the same payoff structure as electricity forwards. However, they are highly standardized in contract specifications, trading locations, transaction requirements and settlement procedures
- First traded on the NYMEX in March, 1996
- The majority of electricity futures contracts are settled by financial payments rather than physical delivery

Operation of Futures Market

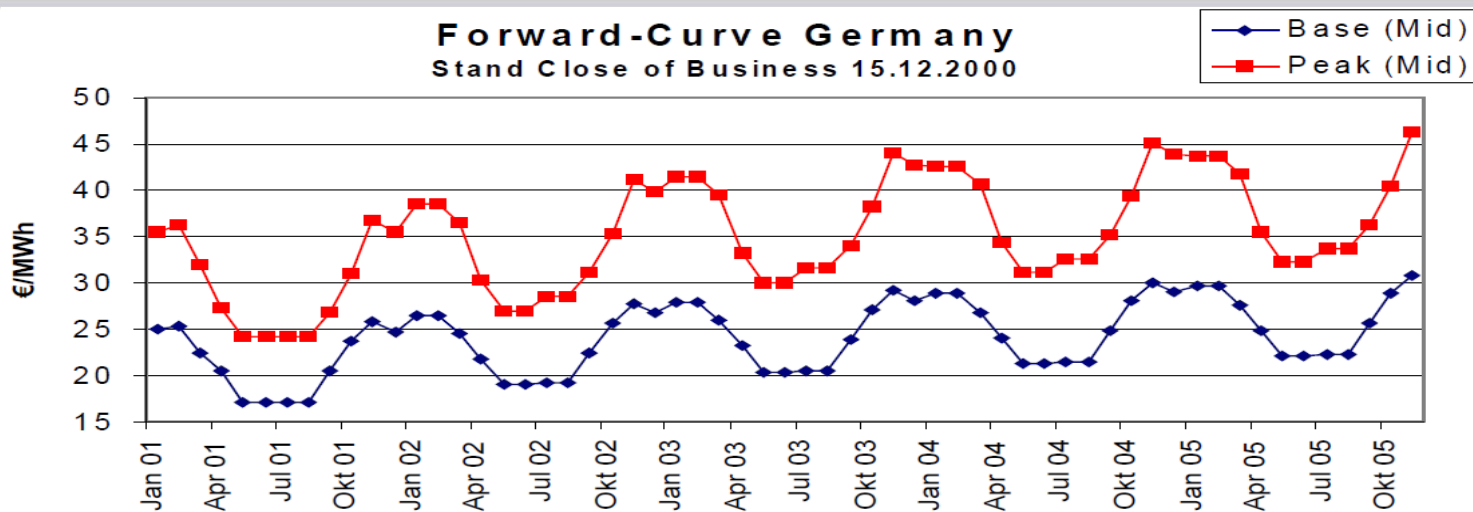
- Settlement of futures contracts involves both a daily mark-to-market settlement and a final spot reference cash settlement, after the contract reaches its due date
- Mark-to-market settlement covers gains or losses from day-to-day changes in the market price of each contract
- Final settlement, which begins at maturity, covers the difference between the final closing price of the futures contract and the System Price in the delivery period



Futures-Spot Price Convergence



Forward Curve



- Forward Curve defines the prices at which a futures contract can be entered into, is derived by market participants (especially traders) based on statistical analysis of historical data and experience
- Forward curves change constantly, with time as underlying factors change. The influencing factors are function of demand-supply, regulation, technical factors or some stochastic factors
- Forward curves are published by consultants, industrial journals, etc in a market based on ones market analysis

- Electricity Swaps are financial contracts that enable their holders to pay a fixed price for underlying electricity, regardless of the floating electricity price, or vice versa, over the contracted time period
- Electricity swaps can be viewed as a strip of electricity forwards with multiple settlement dates and identical forward price for each settlement

Electricity Options

- Electricity options got recognised with the beginning of the electricity industry restructuring in the UK and the US
- Electricity options are based on following underlying attribute
 - Price
 - Volume
 - Delivery location & timing
 - Quality
 - Fuel type

Plain call and put options

- Electricity call and put options offer their purchasers the right, but not the obligation, to buy or sell a fixed amount of underlying electricity at a pre-specified strike price by the option expiration time
- Electricity call and put options are the most effective tools available to Merchant Power Plants and Power Marketers for hedging price risk
- Majority of these transactions occur in the OTC market

- These are non-standard electricity options
- Spark spreads are cross-commodity options paying out the difference between the price of electricity sold by generators and the price of the fuels used to generate it
- Spark spread call options play important roles in hedging the price risk of the output of fossil fuelled power plants

Callable and Puttable Forwards

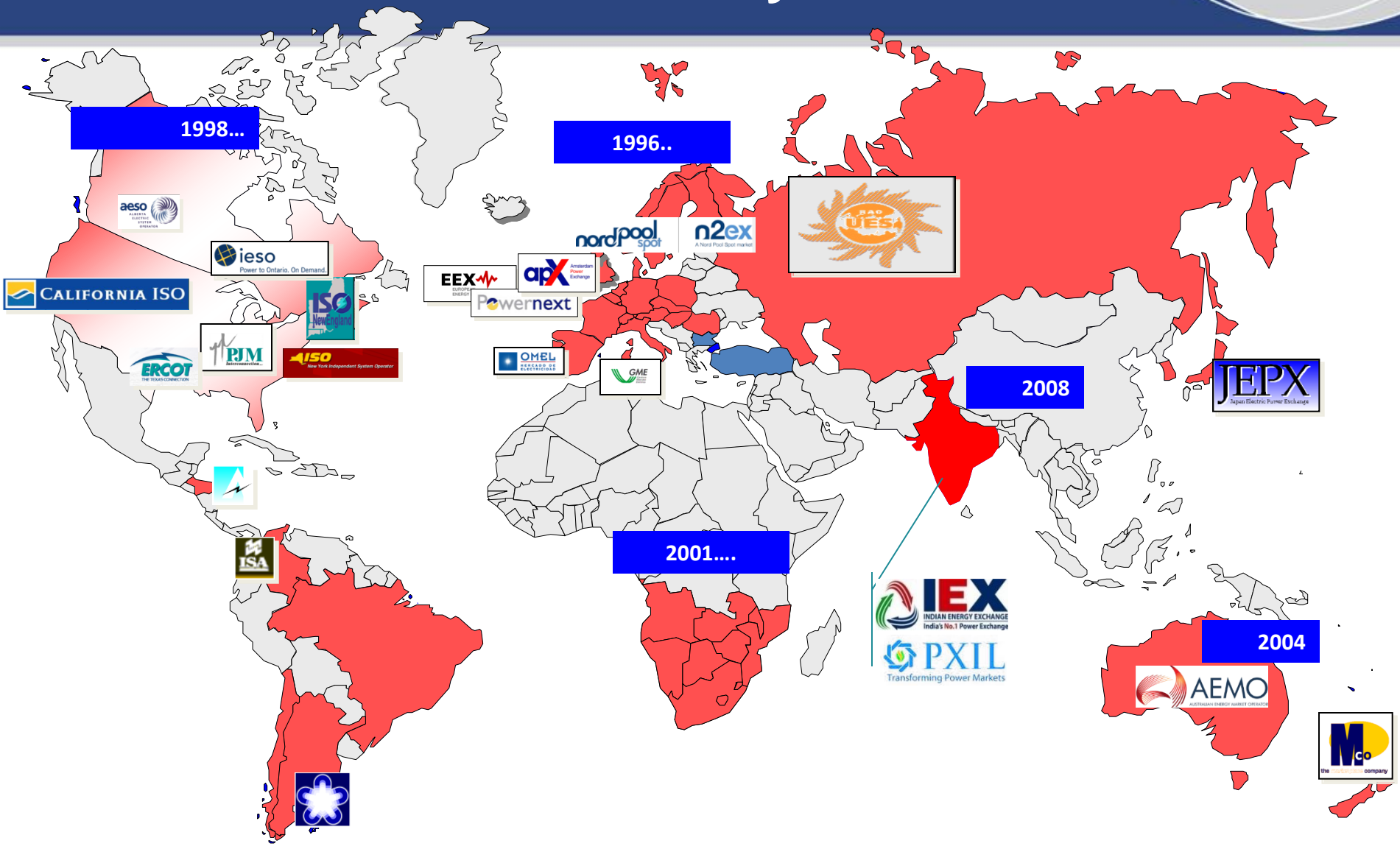
- These electricity derivatives were introduced to mimic the interruptible supply contracts and the dispatchable independent power producer contracts
- In a callable forward contract, the purchaser of the contract longs one forward contract and shorts one call option with a purchaser-selected strike price. The seller of the forward contract holds opposite positions and can exercise the call option if the electricity price exceeds the strike price, effectively cancelling the forward contract at the time of delivery

- In a puttable forward, the purchaser longs one forward contract and one put option with a seller-selected strike price. The seller holds the corresponding short positions. The purchaser exercises the put option if the electricity price drops below the strike price at the maturity time, effectively cancelling the forward contract

Swing Options

- Electricity swing options are adopted from the natural gas industry
- These options may be exercised daily or up to a limited number of days during the period in which exercise is allowed
- When exercising a swing option, the daily quantity may vary (or swing) between a minimum and maximum daily volume limit
- The strike price of a swing option may be either fixed throughout its life or set at the beginning of each time period
- If minimum-take quantity of any contract period is missed by buyer, then a lump sum penalty or a payment making up the seller's revenue shortfall needs to be paid (take-or-pay)

Global Evolution of Electricity Markets

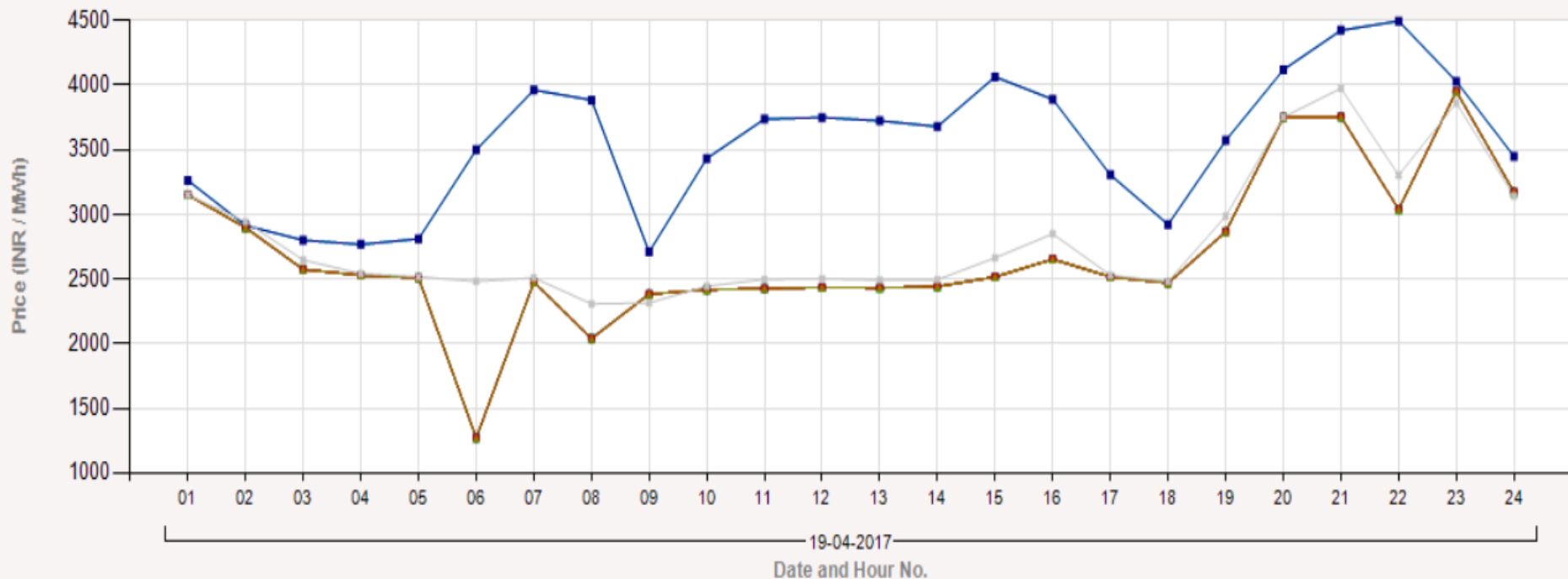


Derivative Markets, Examples

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

Intraday price volatility in IEX DAM

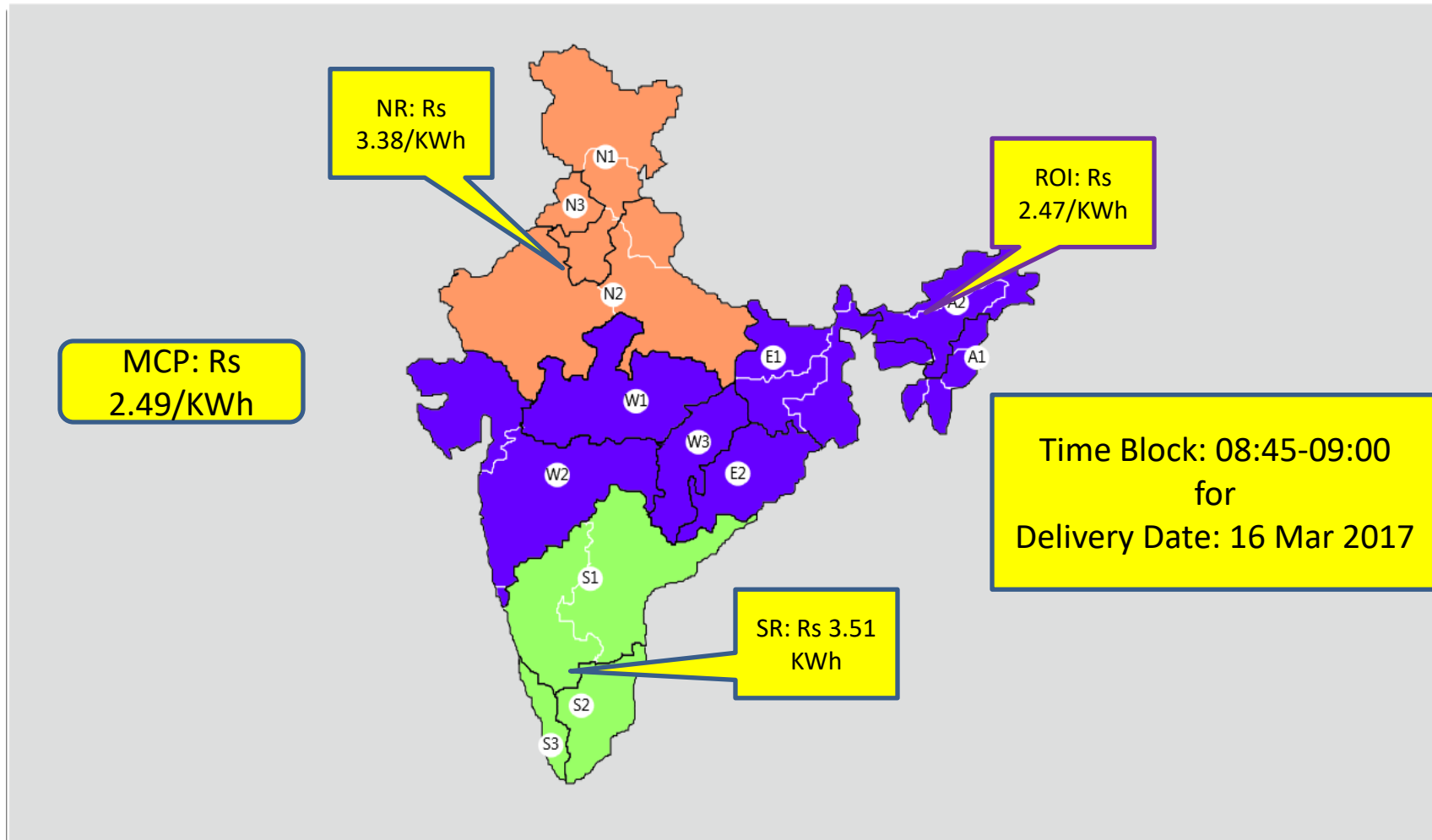
Price at Indian Energy Exchange (IEX) INR / MWh



- A1 Price
- E1 Price
- N1 Price
- N2 Price
- N3 Price
- S1 Price
- S2 Price
- S3 Price
- W1 Price
- W2 Price
- W3 Price
- MCP Price
- A2 Price
- E2 Price

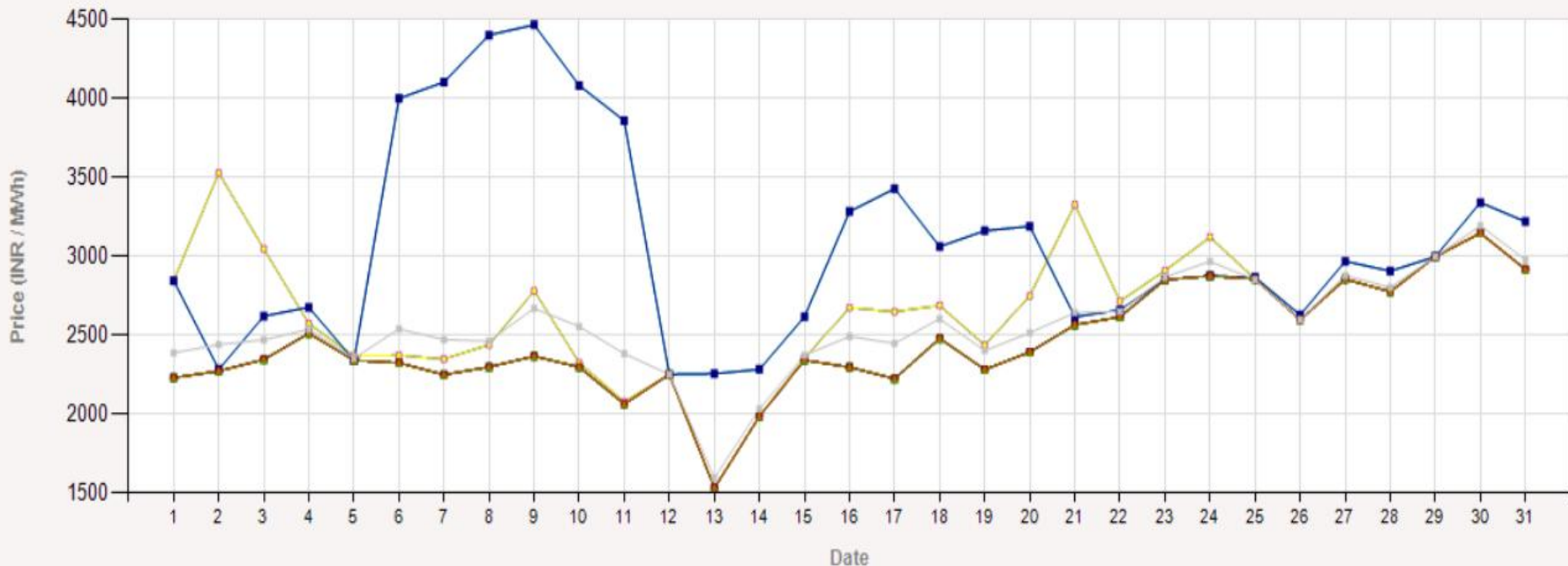
Area Prices @ IEX

Different Prices due to Congestion



Daily price volatility in IEX DAM – Mar 17

Price at Indian Energy Exchange (IEX) INR / MWh

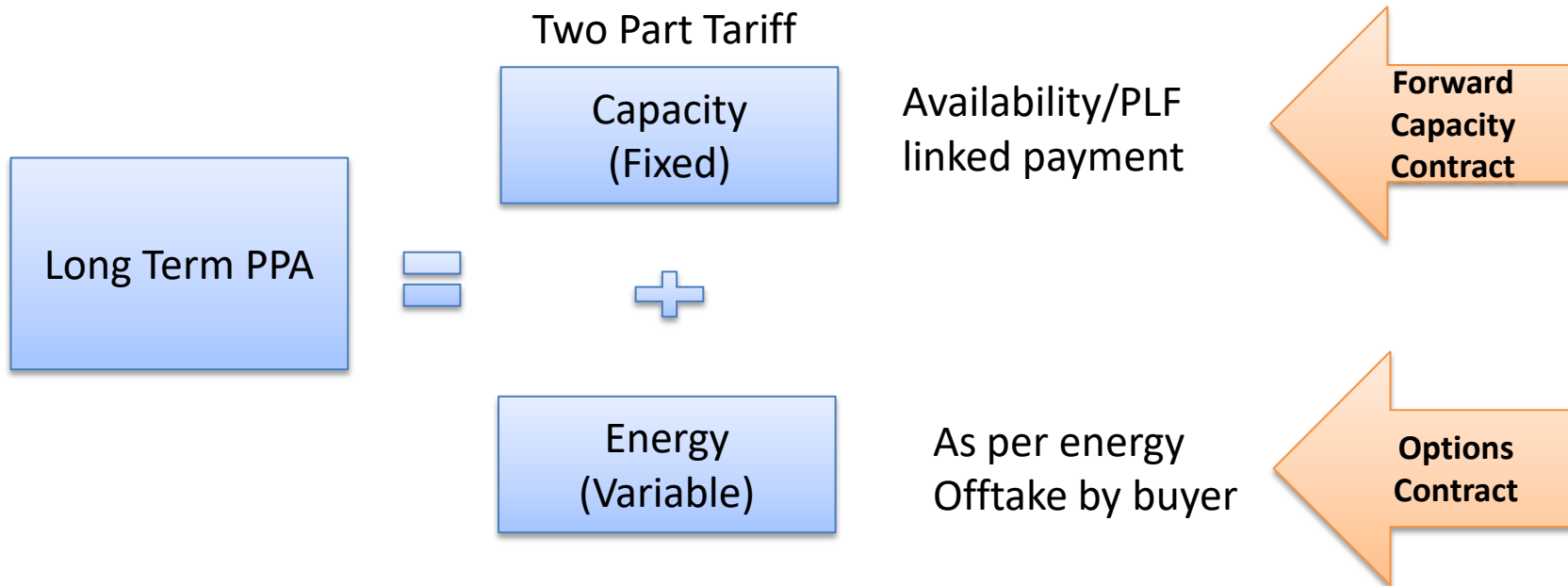


- A1 Price
- E1 Price
- N1 Price
- N2 Price
- N3 Price
- S1 Price
- S2 Price
- S3 Price
- W1 Price
- W2 Price
- W3 Price
- MCP Price
- A2 Price
- E2 Price

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
- 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

Derivatives in Indian Power Market?



Application: Example-1

- **Participant:** Open Access Consumer
- **Power portfolio:** 10 MW load, with Discom charging industrial tariff @ Rs 8000/MWh. PX spot market (DAM) prices are in the range of Rs 2000/MWh to Rs 3500/MWh, with landed cost in the range Rs 7000/MWh to Rs 8500/MWh. Contingency power is charged @ Rs 12000/MWh by Discom

Derivative Trading Strategy:

- Purchase Futures contract say @ Rs 2500/MWh and lock the price of electricity w.r.t spot market (Alternatively, Swap contract would fulfill the requirement). Bidding in DAM could be placed with upper threshold of Rs 12000/MWh

Application: Example-2

- **Participant:** Generator
- **Power portfolio:** 1000 MW capacity, with technical minimum of 500 MW. FC is Rs 1500/MWh @ Technical Minimum (50% PLF) and VC is Rs 1800/MWh (Rs 4500/MWh below technical minimum)

Derivative Trading Strategy:

- Sell Futures contract for 1000 MW say @ Rs 3300/MWh (if available, based on Forward Curve) and lock the price of electricity w.r.t spot market (Alternatively, Swap contract would fulfill the requirement)
- Trade the entire 1000 MW power on PX DAM and receive the market determined price from PX. To ensure schedule for technical minimum quantum, the generator places bid at '0' price for 500MW to ensure selection and receives the cleared PX price and price difference with the futures contract is settled separately
- Alternatively, Options could be procured at a relevant strike price, in place of Futures

Regulation of Derivative Markets in India

- Exchange traded equity and commodity derivative markets are regulated by SEBI. Post merger of FMC with SEBI, and repeal of FCRA 1952, commodity derivatives came under the purview of SEBI w.e.f 28th Sep 2015
- CERC Power Market Regulations, 2010:
 - Regulation-4:** These regulations shall apply to the following types of contracts:
 - (ii) Financially settled electricity derivatives contracts transacted in OTC market
 - (iv) Financially settled electricity derivative contracts transacted on Exchange
- Electricity is a notified good, under regulatory of FMC/SEBI

- Bombay High Court Judgement dated 07/02/2011 in MCX Vs CERC case:

“...it will not be possible either for FMC or MCX to control and regulate the mandatory requirements of electricity, at various stages, which are well within the exclusive domain and control of the CERC and/or authorities/commissions. It will create more complications than solving it, unless an experts body constituted and specialized rules and regulations are framed. Both authorities/commissions cannot deal in futures/forward contract in electricity excluding other and/or independently.....”

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03:40 PM | 29 SEP **EOD** | SENSEX **27,827** ▼ -465.28 | NIFTY 50 **8,591** ▼ -153.90 | GOLD (MCX) (F) **31,130.00** ▲

Sebi allows options contracts commodity trading

By ET Bureau | Sep 29, 2016, 07:45 AM IST

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MUMBAI: Exactly a year after strengthening regulation of the 13-year-old [commodity derivatives market](#), the Securities and Exchange Board of India (Sebi) has taken the first steps towards its growth by allowing exchanges like [MCX](#) and [NCDEX](#) to launch options in commodities.

Also, it has expanded the list of notified commodities that exchanges can launch by adding to it eggs, diamonds, skimmed milk powder, tea, cocoa, pig iron, biofuels and brass.

MINISTRY OF FINANCE

(Department of Economic Affairs)

NOTIFICATION

New Delhi, the 27th September, 2016

S.O. 3068(E).—In exercise of the powers conferred by clause (bc) of section 2 of the Securities Contracts (Regulation) Act, 1956, (42 of 1956), the Central Government in consultation with the Securities and Exchange Board of India established under section 3 of the Securities and Exchange Board of India Act, 1992 (15 of 1992), hereby notifies the goods specified in the Schedule for the purposes of clause (bc) of section 2 of the said Act, namely:-

SCHEDULE

1.	2.
S. No.	Goods
(VIII)	ENERGY
62.	Carbon Credit
63.	Coal (including variants such as coking, thermal, lignite etc.)
64.	Crude Oil
65.	Electricity
66.	Bio-fuel (Including Ethanol, Bio-diesel)
67.	Furnace Oil
68.	Gasoline/Petrol
69.	Diesel
70.	Methanol
71.	Natural Gas

Derivative Products to start with..

- Futures Contracts, parallel to Long Term Contracts (or replacing them) help address the price risk and at the same time provide flexibility in volume offtake rigidity of Physical LT PPAs
- Introducing Futures will bring some arbitrage between forward and spot markets. Also, the share of long term and short term market will be set freely by market itself based on its optimum

Thank You for your attention

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Best Performing Power Exchange – Power Line Awards '13 & '12