

Power Market in India and its Potential

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Introduction

Indian power sector is at the crossroads. Transformation of the sector was well supported by creation of institutions to enhance efficiency through creation of markets via trading and later on in 2008 through trading on power exchanges. However, long-term contracts usually fail to meet the full requirements of the market participants as electricity cannot be stored, hourly consumption in the long-term without forecasting errors is difficult to predict, long-term contracts for peak load requirement are economically inefficient etc. Development of short-term trading markets is necessary to complement the long-term markets. Recognizing these problems, in 2006, CERC initiated organising electricity market by creating power exchanges. On this backdrop, the paper is directed towards the following objectives: (i) experience of power market operations in selected developed countries, and (ii) assessment of Indian power exchange market and its potential.

Research Methodology

The present study is carried out by evaluating the findings of various studies, which have worth and validity, available in limited literature on the subject. Data used and analysed in the work are obtained from secondary sources.

Market Models in Selected Countries

Different countries adopted/ designed independent market models for power market. Australia (NEMMCO) and USA (PJM) are mandatory power markets while NZEM (New Zealand), Nord Pool, BETTA (UK) and IEX (India) are some voluntary market places. The section deals with design aspect of some important power markets in Europe, USA, Australia and India.

Nord Pool, Europe

In Europe, trading arrangements are mostly bilateral and most wholesale trade is in Over-the-Counter (OTC) markets, often supplemented with day-ahead auction trade (Leonardo and Belmans, 2007)

Nord Pool is jointly operated by two Transmission System Operators (TSO)—Statnett in Norway and Savenska Kraftaunt in Sweden. It also operates a spot market called Nord Pool Spot. Nord Pool has transformed all clearing settlement operations to a wholly-owned clearing company called Nord Pool Clearing House ASA (Flatabo and Doorman, Grande and Raden and

Wangensteen, 2003). The day-ahead spot market in Nord Pool El spot offers contracts for the next delivery. The Elspot exchange price, done using area pricing approach¹, is taken as reference price for financial contracts offered by other financial power markets. The market following Elspot is the hourly ahead market Elbas which enables power generators, distributors and brokers to finetune their portfolio of their electricity delivery contracts. Nord Pool ASA offers contracts of up to six years' duration with contracts for days, weeks, months, quarters and years. The Nord Pool power market structure is depicted below (Fig. 1):

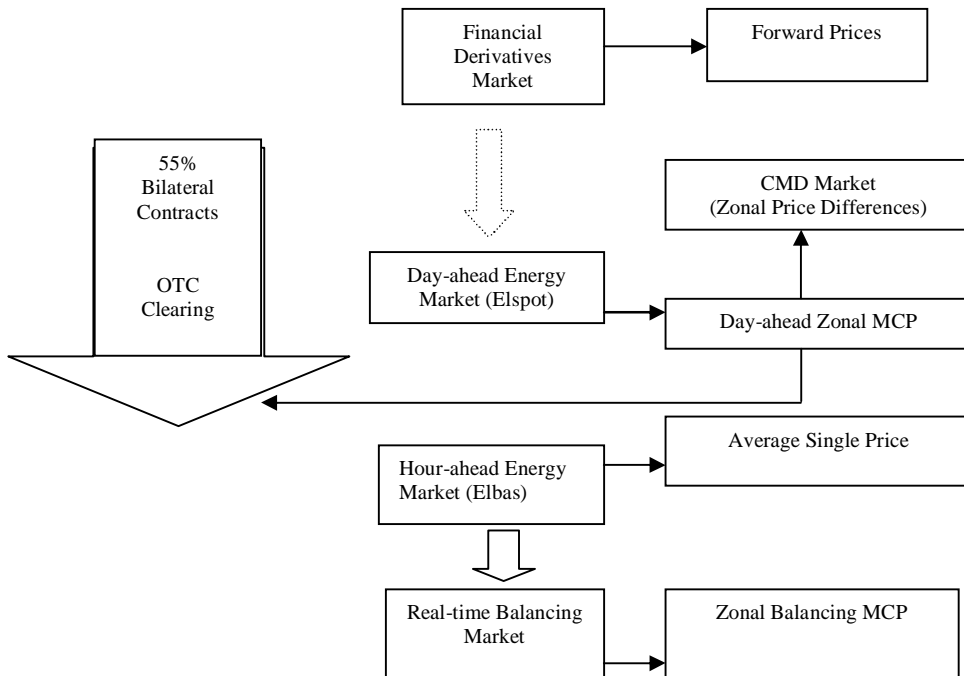


Fig. 1: Market Structure in Nord Pool

PJM, USA

This is a common market for Pennsylvania, New Jersey and Maryland (PJM) and was the first wholesale market designed in USA. The Federal Energy Regulatory Commission (FERC) identified PJM market designed as standard market design. There are more than 500 companies covered by PJM market. It serves about 51 million people. It serves a peak load of 144,644 MW and generation capacity of 164,905 MW. PJM transmits through 49,970 miles of transmission line. Annual energy sold is about 729,000 GWh. It covers 14 states.

¹ where market is split in different price areas when congestion occurs

PJM operates a day-ahead market, a real-time energy market², a daily capacity market, monthly and multi-monthly capacity market, a regulation market and a monthly Financial and Transmission Rights (FTR) auction market. Day-ahead market calculates market clearing price and volume for each hour taking into account all generation offers, load bids, bilateral transactions, incremental and decremental bids and virtual bids³. The balancing market is real-time energy market in which hourly clearing prices are determined based on actual bid, least cost, security constrained unit commitment dispatch. Load Serving Entities (LSE) pays balancing prices for any demand that exceeds their scheduled amount but will receive revenue for demand deviations below their day-ahead amounts. Transmission customers pay congestion charges (or receive congestion credits) for bilateral transaction quantity deviations from the day-ahead schedule.

A LSE has the obligation to own or acquire capacity resources greater than, or equal to, peak load plus a reserve margin of 18%. LSEs have flexibility to acquire capacity in various ways⁴. Transmission customers are hedged against real-time congestion by matching real-time energy schedules with day-ahead energy schedules. FTRs can also provide hedge for market participants against the basis of risk associated with delivering energy from one bus to another.

PJM seems to be a complex market and needs modern systems in different market segments and sophisticated data recording system.

National Electric Market, Australia

National Electricity Market Management Company Limited (NEMMCO) was established in 1996, to administer and manage the market and improve efficiency. Members of NEMMCO are: Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia and Tasmania. The Australian electricity market is completely competitive with any participant able to purchase from any other. Participants in the NEM can take part in any combinations of two levels of trading:

- Spot trading with energy traded through a pool and spot price set every half an hour by the last generator selected to run. All wholesale electricity is accounted for through the pool⁵.
- Short-term forward market trading in which purchasers lock in energy prices through hedging contracts.

²These two are part of two settlement system of PJM market in which day-ahead market acts as a financial market and provides a hedge against price fluctuations in real-time market.

³Virtual bids are bids from the load side and its purpose is to increase the generation availability in real-time and reduce the system price.

⁴Capacity can be acquired by building units, by creating bilateral agreements, by participating in the capacity credit markets operated by PJM. These together known as Installed Capacity Market (ICAP)

⁵This is called gross pool or, energy-only pool.

Under hedging contract, the purchaser (generally retailer) agrees to purchase specified quantity of energy from the spot market at set price called Strike Price. If the actual price paid in the spot market by the purchaser is higher than the strike price, the counter party to the contract (typically electricity generator) pays the purchaser the difference in cost. Conversely, if the price paid is lower than the strike price, the purchaser pays the counter-party, the difference.

From the bid submitted, NEMMCO's systems determine which generators are required to meet demand and at what time, and their production levels in a process called Scheduling. Offers to generators are stacked in order of rising price and then scheduled and dispatched into production. More expensive generators are scheduled into production as total demand increases. Market structure of NEM is depicted below:

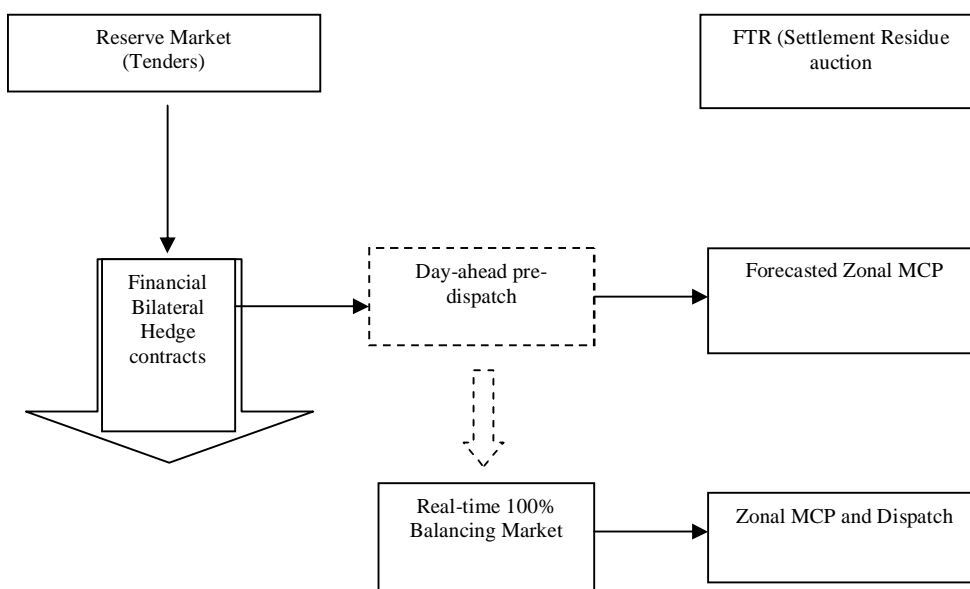


Fig. 2: Market Structure of NEM

Comparative Assessment Nord Pool, PJM And Memmco

A comparative assessment of the different electricity market structures are systematically presented in Table 2. It is observed that Nord Pool model provides more simple power exchange mechanism and suitable for application in India.

Table 2: Comparative Assessment of the Different Electricity Market Structures

Item	Nord Pool	PJM	MEMMCO
Participation	Voluntary for day-ahead adjustment market	Compulsory for day-ahead market	Compulsory for day-ahead market
Market Offerings	Day-ahead spot, Hour-ahead, Forward	Day-ahead spot, Real-time balancing, Capacity credits	Day-ahead spot and Short-time forwards
Bidding type	Double sided	Double sided	Double sided

Item	Nord Pool	PJM	MEMMCO
Adjustment market	Elbas, intra-day auction market	Bid quality can be changed till the gate closure	
Real-time/ Balancing Market	Counter trade for real-time, Participants are given MCP	Deviations are traded in real-time	Through purchase of ancillary services, reserve capacity buying
Pricing Rule	Zonal pricing	Nodal pricing	Zonal pricing
Pricing Type	Ex-ante	Ex-post	Ex-post
Risk Management	Forward, Futures, Options	FTRs, bilateral OTC, Multi settlement market, Virtual bidding, Financial trading	Bilateral OTC, Derivatives on Sydney futures exchanges
Congestion Management	Area splitting	Security constrained economic dispatch	Locational transmission for transmission tariff
Transmission Loss	Included in Zonal price	Included in real-time LMP	To be purchased by generators
Time blocks	Hourly block	Hourly block	Half-hourly block

Indian Power Market

In India, electricity reform re-evaluation of Electricity Supply Act, 1948 and Indian Electricity Act, 1910. This led to Electricity Act, 2003 which has been brought about to facilitate private sector participation to complement cash constrained State Electricity Boards (SEB) to meet the electricity demand. The act envisages transmission towards a competitive electricity market structure in India (Fig. 3).

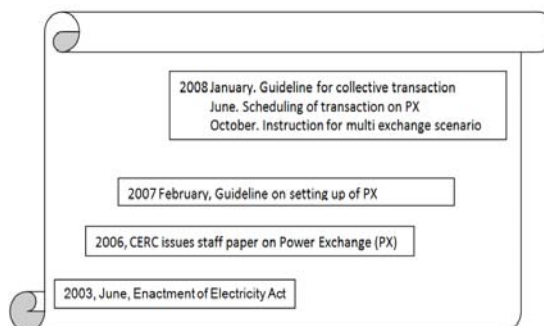


Fig. 3: Transmission towards a Competitive Electricity Market Structure in India

Source: Mercados Energy Market India Pvt Ltd. 2014

Power exchanges have evolved rapidly to compliment and supplement the needs of the wholesale power markets in a transparent and efficient manner. Trading on exchanges has matured despite initial low volumes and high prices. After six years of operation, markets are now more efficient, liquid and promote investment as well as better utilisation of national resources. Indian Energy Exchange (IEX), as the power exchange with maximum volume and largest participation, has played an important role in furthering the objectives of the Electricity Act 2003 by enhancing competition, implementing open access and through realisation of the impact of de-licensing of generation. Creation of national grid has been supported by commercial contracts wherein huge volumes of electricity have been transferred across India to improve the reliability and security of

supply in both the surplus and deficit regions. The exchanges have aided in better utilisation of national resources, reduced unmet demand and consequently reduced economic losses and improved energy security of the nation. Huge bottled up captive generation has also been brought into the national market to facilitate its most productive use of the economy.

The Electricity Act, 2003 is for promoting competition in electricity market, protection of consumers 'interest and power for all'. The act recommended National Electricity Policy (NEP), open access in transmission, phased open access on distribution, mandatory State Electricity Regulatory Commissions (SERC), licence free generation and distribution, power trading, mandatory metering and stringent penalty for theft of electricity. Another step we have seen is the implementation of Availability Based Tariff (ABT) which brought about the day-ahead scheduling and frequency sensitive charges for deviation from schedule for efficient real-time balancing.

ABT treats the fixed and variable costs separately. The fixed cost, known as capacity charge is associated with plant and its capacity to deliver MWs on day-to-day basis. Variable cost, known as energy charge, and the total amount paid to the generators is based on their scheduled energy production rather than actual production. ABT has a third component called *Unscheduled Interchange* (UI) which is the payment for deviation from schedule and rate is decided in accordance with system frequency (e.g., Fig. 4). In India, ideal system frequency considered as about 50 Hz. Deviation from this requires synchronization which involves cost. That is the reason behind price difference for different frequencies.

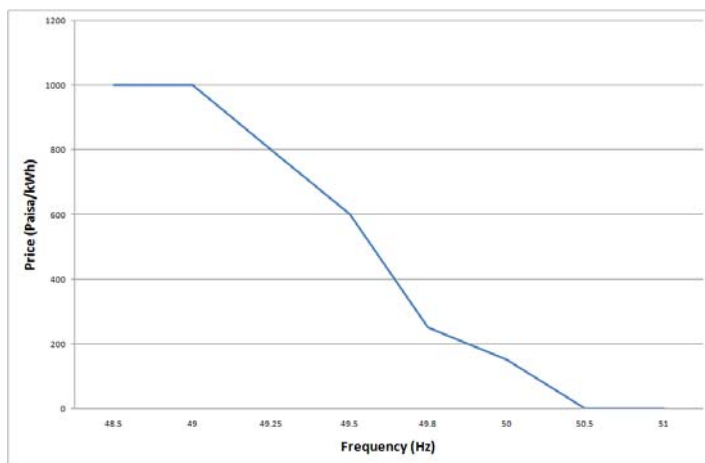


Fig. 4: UI Price Vector with Effect from 29/12/2007

Source: Prepared from data available in <www.cercind.gov.in>

Beneficiaries are paid for under withdrawal or charged for over withdrawal according to the system frequency. UI mechanism acts as balancing market in which real-time price is determined by system frequency.

To promote power trading, CERC approved the setting up of IEX. It is designed on the basis of the most successful international power exchange Nord Pool. The exchange has been developed as market based institution where the participation in exchange operation is voluntary. Presently, IEX offers day-ahead contracts with time line set in accordance with Regional Load Dispatch Centres (RLDC). IEX co-ordinates with National Load Dispatch Centres (NLDC)/ RLDCs and State Load Dispatch Centres (SLDC) for scheduling of traded contracts.

The day-ahead market of IEX is double-sided auction and discovers the price incorporating supply and demand side bidding. In the year 2008, and the first half of the year 2009, when the participants presented in each hour were relatively less, high prices were discovered not due to monopolistic behaviour of suppliers but because of the inelasticity of demand. This is typical of economies where demand exceeds supply and supply curves need to be extended vertically to discover the market clearing price as shown in Fig. 5. Hence, the prices were 'high' because of the inelasticity of demand and a strictly positive gap between the demand and supply. Though such high prices are not desirable from political and social considerations, from an economics perspective, this indicates functioning of the market in accordance with the principles of social welfare maximisation as enunciated in the regulations governing the operation of IEX. However, the incidence of such phenomenon has declined significantly. Thus, fewer price peaks together with declining volatility is an indicator of short term markets achieving higher liquidity. In the current market scenario, given the low prices on the exchange, the price is close to the marginal costs of generation, thus, reflecting any perceived lack of market abuse.

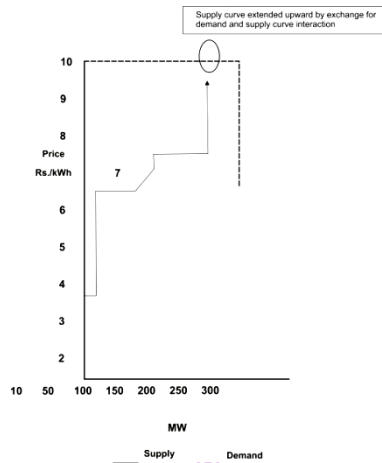


Fig. 5: Demand and Supply Curve at IEX During Initial Period

Network constraints are considered in deriving the price and market splitting approach is used to clear the market with congested lines. The exchange, at present, offers only day-ahead contracts of an hourly time block. However, the exchange envisage plans to offer the adjustment contracts and long-term contracts like forwards and future to hedge the risk against electricity market uncertainty. Indian electricity market mechanism can be described as follows (Fig. 6):

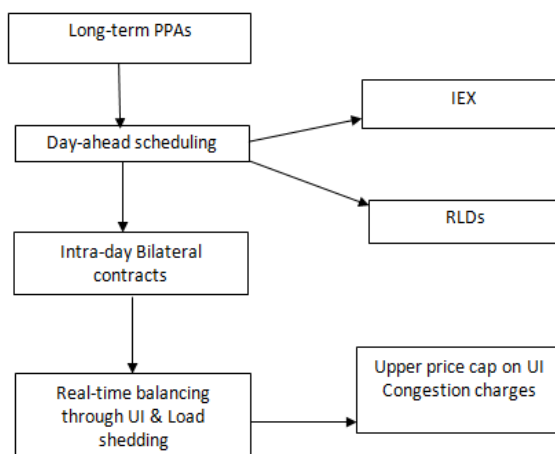


Fig. 6: Indian Electricity Market Mechanism

Specific Features of IEX are as given below (Table 3):

Table 3: Specific Features of IEX

Participation	Market Offering	Bidding Type	Real-time/Balancing Market	Pricing Rule	Pricing Type	Risk Management	Congestion Management	Transmission Loss	Time Blocks
Voluntary	Day-ahead spot	Double sided	UI charges	Zonal	Ex-ante	Bilateral OTC	Area splitting	To be purchased by participants	Hourly blocks

Potential of Indian Power Market

Indian power market is still to achieve full potential. In 2012/13, India's buying potential was 15.35% while the selling potential was 4.57% at the national level. If 10% load shedding is considered, the potential size increases to 23.5%. This potential is only on account of co-skewness of the demand met in each state.

The actual potential is, however, higher and would be 23.5% if load shedding in energy terms, assumed conservatively to be 10%, is addressed. The potential would also increase if all the states were to allow their large industrial customers (greater than 1 MW) to procure from markets. The supply side potential is also high because: (a) the private sector plants—e.g. Sterlite, Jindal, JSWL, etc. sell a fixed percentage of their output in short term markets, (b) the un-requisitioned capacity of central sector plants (which the staff paper of CERC on Ancillary services market proposes to be used for providing frequency support ancillary services) is also available in short term markets.

There is huge untapped potential which provides opportunity for further development of power market in India. Given the impact of NEW and SR grids and CERC Regulation 2014⁶, the size of the day-ahead market is expected to increase over time.

⁶ Deviation Settlement Mechanism & related matters and Indian Electricity Grid Code

Gap between demand and supply from capacity tied up under long-term contracts, indicates that long-term contracts of utilities will be sufficient to meet entire demand across various states. States will continue to depend on markets for meeting their power requirements on real-time basis. In this context, power exchanges would play a lead role.

Achieving full potential has some impediments also. The state level demand reported is usually the constrained demand that does not take into account the latent demand or unserved demand that is not recorded in the CEA/ Load Dispatch Centres (LDCs) recording systems. Demand currently reported does not capture demand of the large industrial and commercial open access consumers, which is met through captive diesel generating sets. The state level supply ignores the power 3.42% that is sold on merchant basis.

Trading, in the short term markets, is governed by the differences in the load curves of various trading utilities/ entities in the country. It may not, however, always be possible to transmit power—from a region which has a peaking capacity, during other than peak periods—to another region where there is a peak requirement, due to transmission constraints. In these conditions, the local distribution utility facing peaking conditions may need to tie up with a local peaking generator for short term. Therefore, short-term planning is distinct from long term planning and involves consideration of both the local peaking resources and transmission from other regions for the reason of economy.

Recommendations

Indian power exchange market is in a nascent stage compared to the developed world. But it is developing in line with Nord Pool of Europe. It should expand its operations to enhance efficiency for delivering electricity in a cost effective manner to fulfil the national objective of Power for All, 24 x 7.

References

- [1] Flatabo, D., Doorman, G., Grande, O., Raden, H. and Wangenstein, I. (2003), “Experience with Nord Pool Design and Implementation”, *Institute of Electrical and Electronics Engineers (IEEE) Transaction on Power Systems*, Vol. 18(2), pp. 541–547.
- [2] Lornaldo, M. and Belmas, R. (2007), “Is the Prevailing Wholesale Market Design in Europe and North America Comparable?”, *IEEE Power Engineering Society General Meeting*, pp. 24–28.
- [3] Mercados Energy Market India Pvt Ltd. (2014), *Indian Power Market: Journey so Far and Way Forward*, June, p. 6.