Central Electricity Regulatory Commission
New Delhi

Public Notice

July 20, 2006

Subject: Invitation of comments/suggestions on staff paper on "Developing a Common Platform for Electricity Trading".

Dear Stakeholders,

Section 66 of the Electricity Act, 2003 mandates that Appropriate Commission shall endavour to promote development of market (including trading) in power. This has also been emphasized in the National Electricity Policy issued by Ministry of Power in February 2005. Accordingly, a Staff Paper on "Developing a Common Platform for Electricity Trading" has been got prepared. The findings and recommendations in the Staff Paper are based on independent thinking of the staff and do not necessarily reflect views of the Commission. The Commission invites views and suggestions of the stakeholders in order to create a road map for developing market for electricity in India. Views/suggestions may be submitted latest by August 31, 2006. Public hearing in the subject shall be held subsequently after prior notice.

A.K. Sachan
Secretary

Staff Paper

Developing a Common Platform for Electricity Trading

July 2006

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CENTRAL ELECTRICITY REGULATORY COMMISSION

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New Delhi – 110003

FOREWORD

Dear Stakeholders,

Electricity trading is essential for meeting peak demand and for overall resources optimization. There is a need to explore the possibility of developing a common platform for electricity trading where trade would be conducted in an equitable, transparent and efficient manner.

Organizing the electricity market is a challenging task requiring detailed study, preparation and investment. I am glad that the Staff of the Commission has prepared a thought provoking Paper on the issue. The ideas contained in the Paper are based on their own research and findings. The staff has recommended a cautious approach in the matter in the light of the deficit power situation prevailing in the country. Nevertheless, one must think ahead and create a road map for the future with a view to organizing competition in the long run.

I hope the paper will provide a good starting point for informed debate with the stakeholders and help us in finding a way forward to develop the electricity market in India.

(Ashok Basu)
Chairman

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Chapter I

Introduction

1.1 Trading and market development – Legal framework and Pricing philosophy

1.1.1 Prior to the Electricity Act, 2003, the electricity industry recognized generation, transmission and supply as the three principal activities, and the legal provisions were also woven around these concepts. Bulk purchase and sale, although a regular phenomenon between State Electricity Boards and/or licensees was construed as part of the activity of supply of electricity.

1.1.2 It is only with the enactment of the Electricity Act, 2003 that the transaction involving purchase and sale of electricity has been recognized as a distinct licensed activity. This has been termed as 'trading' and defined in section 2(71) of the Act as "*purchase of electricity for resale thereof….*" The Regulatory Commissions have been given the powers to grant trading licence.

1.1.3 Recognition of trading as a separate activity is in sync with the overall framework of encouraging competition in all segments of the electricity industry. The entry barriers have been sought to be removed and the State Electricity Boards have been mandated to be reorganized within a definite time frame. This is expected to result in multiplicity of players in generation, transmission and distribution, a sine qua non for competition. In such a scenario, traders are expected to add value by facilitating the transfer of surplus power available in one region to the regions experiencing deficit of supply.

1.1.4 The next step in the direction of inducing competition, as the Act envisages, is to create a framework of market in electricity where buyers and sellers could meet and engage in purchase and sale of electricity. The responsibility of developing the market in electricity has been vested with the Regulatory Commission.

1.1.5 As a corollary to the above competitive framework, appropriate pricing philosophy has also been envisaged in the Act. Sections 61 to 66 comprising the Part on "Tariff" in the Electricity Act, 2003 provide for three ways of electricity price determination/discovery viz :

- Tariff regulation/determination by Regulatory Commissions (Section 62);
- Determination of tariff through bidding process (Section 63); and
- Price determination/discovery in the Electricity Market (Section 66).

1.1.6 Section 62 of the Act is the substantive provision for tariff determination by the Regulatory Commissions. For regulating/determining the tariff, the Regulatory Commissions are required to notify the Terms and Conditions of Tariff in terms of Section 61 of the Act. Central Electricity Regulatory Commission as well as most State Electricity Regulatory Commissions have already issued Terms and Conditions for Determination of Tariff.

1.1.7 Section 63 of the Act seeks to move away from regulated tariff to tariff determination through bidding process. The Central Government is required to issue guidelines for transparent process of bidding, which it has already done.

1.1.8 Section 66 providing for Development of Market in electricity by the Appropriate Commission, is the last step in the sequel to electricity pricing philosophy as envisaged in the Act. The provision is quoted below:

"*Section 66. The Appropriate Commission shall endeavour to promote the development of a market (including trading) in power in such manner as may be specified and shall be guided by the National Electricity Policy referred to in Section 3 in this regard.*"

The National Electricity Policy issued on 12th February, 2005 provides in Para 5.7.1 (d) that "*Development of power market would need to be undertaken by the Appropriate Commission in consultation with all concerned*".

1.1.9 In line with the responsibility cast under section 66 of the Act towards development of such a platform, the Central Commission now proposes to design the framework of price determination/discovery in the electricity market.

1.2 Existing power supply and trading scenario

1.2.1 Bulk electric power supply in India is mainly tied in long-term contracts. The bulk suppliers are mostly the central or state owned generating stations, as also a few IPPs. Previously the bulk buyers were generally the SEBs, which are in the process of being unbundled. The power allocations from various generating stations are being assigned to Discoms as part of the unbundling process mandated by the Electricity Act, 2003. The Appropriate Commission regulates the price of bulk supply of a generating station to distribution utilities on the basis of its Terms and Conditions of Tariff or as per the PPA. Thus, most of the existing bulk supply is locked up in long terms contracts having station-wise tariff, usually in two-parts viz. capacity charge and energy charge.

1.2.2 The SEBs/Discoms who have the obligation to provide electricity to their consumers mainly rely on supplies from these long-term contracts. However, it is neither feasible nor economical to meet short term, seasonal or peaking demand through long-term contracts. Be it a deficit scenario or otherwise, power trading is essential for meeting the short terms demand at an optimum cost. Similarly, power trading is essential for distribution utilities for selling short-term surpluses in order to optimize the cost of procurement. A few captive generating plants participate in trading in order to optimize their operating cost and in the process, supply electricity to the grid. The Open Access Regulations and Inter-State Trading Regulations of the Central Commission have facilitated power trading in an organized manner. Today, it is possible to trade electricity between any two points in India through inter-State Open Access on advance reservation basis, on current reservation basis, on day ahead basis and even on real time basis. Transmission charges for trading are applied on Rs./MW/Day basis. For reservation of less than 12 hours, part day charges are applied as per rules. Open Access charges are transaction specific depending on the regions/transmission systems involved between point of injection and point of drawal. At present, power is mostly being traded between power surplus distribution utilities in Eastern Region (ER) and Northeastern Region (NER) on one-hand and deficit utilities in Northern Region (NR) and Western Region (WR) on the other. Typical trading scenario for NR for June 2006 may be seen at Annexure I.

1.2.3 Annual volume of electricity traded through open access route is of the order of 12-13 BU constituting about two percent of the total energy availability. In terms of power, the magnitude of all India short-term bilateral trade is in the range of 1000 to 1500 MW compared to installed capacity of 1,24,827 MW. According to CEA estimates the all India peaking shortage during 2005-06 was 11,463 MW (12.3%). The availability of power for trading peaks during monsoon and bottoms out during winter. Gridco, WBSEB, DVC, Tripura Electricity Department, HP Government, Malana Hydro Power Station, Jindal Tract etc. are among the notable suppliers. The term electricity market in the Indian context usually refers to this kind of bilateral trading where the price is based on the value attached by the buyer to electricity as a commodity and his willingness or capacity to pay that price.

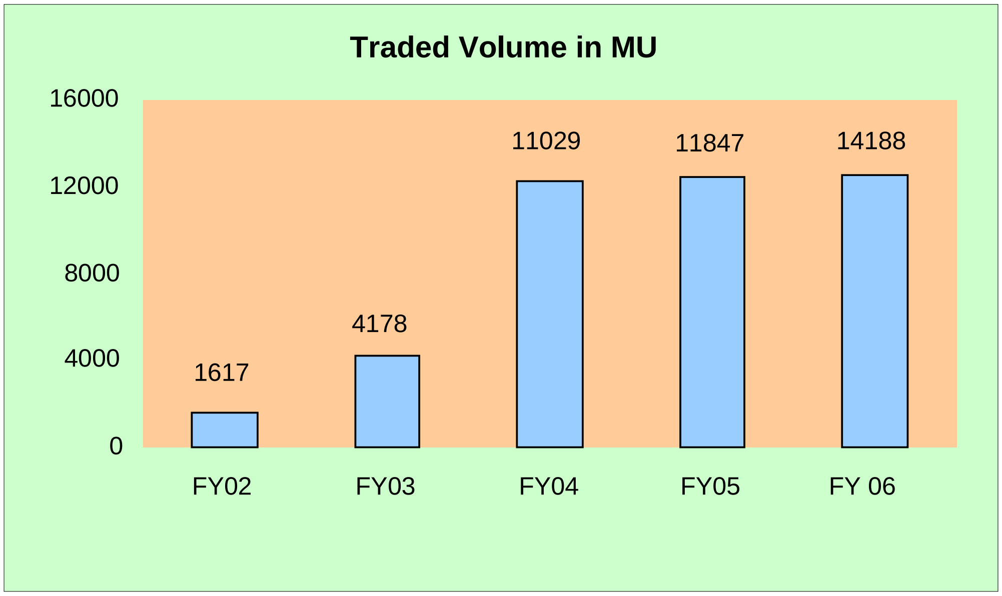

Fig 1.1: Growth of trading volume

1.2.4 The bilateral trading going on at present is mostly between SEBs/Discoms. It is either through a trader as a counter party or direct. Some of the trading is taking place on barter basis. The power trading agreements are mostly inter-state or inter-regional, requiring Open Access through the CTU network. The Open Access Regulations have been amended to suit the needs of the trade. The Open Access charges are reasonable and simple to apply, and not a single payment dispute or default has been reported to the Central Commission so far. However, power trading agreement and Open Access approvals cannot be concluded separately.

1.2.5 A couple of years ago, in the initial phase of power trading, the price was settled through mutual negotiations. Now a days, the sellers invite bids to which traders generally respond. The trader with highest bid price is selected, who in turn sells this power to a needy buyer after adding his trading margin. In a shortage scenario, when the buyers invite bids, only such traders can respond who have already won a supply bid. In this manner, the buyer is left with little choice but to buy at a price already committed by the trader to a seller.

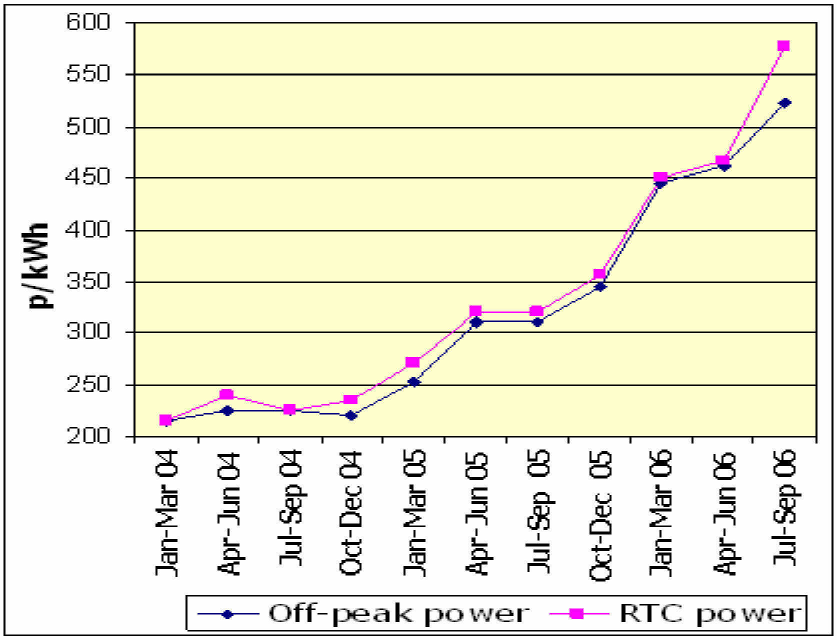

Fig 1.2: Trend analysis of prices of traded electricity

1.2.6 Prices of electricity in the bilateral market have shown consistent upward trend as depicted in the graph above. It is indicative of increasing shortages and reducing elasticity of demand as result of economic development and growing population. The buying utilities are not satisfied with the way bilateral trading is going on, and they strongly feel that something should be done to arrest the trend of rising prices in the electricity market. Some of the buyer's utilities feel that the sale prices should be capped. Others complain that increase in UI rate in 2004 has fueled the price rise. However, recently the traded prices have crossed the UI ceiling rate of Rs 5.70 per unit in some cases and utilities are now giving requisition for liquid fuel based power whose variable cost exceeds UI ceiling rate.

1.2.7 There is adequate inter-state transmission system for wheeling power contracted on long-term basis. The magnitude of traded power is low and the available spare capacity of the inter-state and inter-regional transmission corridors is able to cater to the need of trading most of the time. Transmission congestion occurs occasionally, mostly on the ER-NR link. With the commissioning of Tala Transmission Project in 2006, the ER-NR capacity would increase substantially. However, constraints may be experienced on the ER-WR and ER-NR links.

Table 1.1 : Planned Inter-Regional Transmission Capacity*

Corridor	Transmission Capacity at the end of 10th Plan* (end of 2006-07) (MW)	Transmission Capacity at the end of 11th Plan* (MW)
ER-SR	3,600	3,600
ER-NR	5,000	8,500
ER-WR	2,800	8,500
ER-NER	1,250	2,250
NR-WR	2,100	7,600
WR-SR	1,700	2,700
NER-NR	-	4,000
Total	16,450	37,150

**Source: Draft National Electricity Plan available on the website of CEA*

1.2.8 Despite widespread shortages, the distributing utilities are price sensitive due to their poor finances. Except during special occasions, extreme weather, or urgency they would rather curtail demand by load shedding than buy costly power. However, growing public intolerance to power cuts is making things difficult either way.

1.2.9 Through the bilateral mechanism, electricity trading is beginning to take the shape of commodity trade. The traded electricity is of three types-Round the clock, b) Peak Power and c) off peak power. Peak power is being valued more than off-peak power.

1.2.10 Main features of the existing power trading are summarized below:

I. Sellers dictate prices by inviting bids from the traders. Traders bidding the highest obtain the limited supplies and sell it to deficit entities after topping it with trading margin.
II. Transmission access has to be arranged separately.
III. Trading is taking place through non-standard loose bilateral contracts. Generally, there is little or no penalty if the supplier fails to supply or the buyer backs out.
IV. There is established scheduling procedure at the regional level, which aggregates the trading schedule in day- ahead schedules.

V. Payment for scheduled traded energy is settled directly by the concerned parties. It is usually through LC.
VI. There is energy accounting mechanism at the regional level and all deviations from schedules are handled through UI mechanism.
VII. Volume of traded electricity is tending to become stagnant, while its price continues to increase.
VIII. Sellers located in different Regions cannot compete on equal footing due to pan caking of transmission charges.
IX. In spite of assured demand, the captive and merchant IPPs are not coming for trading in a big way, in the absence of a mechanism for energy accounting etc. Thus, there are barriers for entry into the electricity market.
X. Open access to large consumers recently allowed by the State Regulatory Commissions is not materializing on ground due to technical hitches and lack of supplies.

1.3 Objective

The purpose of this Paper is to explore the possibilities of creating a common platform for trading electricity in India so that:

- Trading is done in a efficient, transparent and equitable manner;
- Existing resources are optimally utilized and availability of power supply increases;
- Standardization of electricity as a tradable product can be achieved;
- Easy access to new entrants is possible;
- Electricity is valued in terms of time of the day/season and there are clear signals for adding capacity; and
- Business confidence in power sector grows.

Before attempting the creation of a common trading platform, it may be worthwhile to first understand fundamentals of electricity market, and also review some of the functioning electricity markets abroad.

Chapter II

Fundamentals of electricity market

2.1 Introduction

In the first 100 years of its commercialization, electricity was supplied by vertically integrated monopolies to consumers. It was generally thought that this was the only way to do the business of electricity supply for the reasons mentioned below.

(i) Natural monopoly aspects of transmission and distribution: A natural monopoly exists because of combination of market size and industry cost characteristics. It exists when economies of scale available in the process are so large that the market can be served at the least cost by a single firm. In case of transmission and distribution only one set of wires would run along the public right of way. The capital cost associated with them is also high thereby exhibiting natural monopoly characteristics.

(ii) Challenge of coordination: The technical challenges of coordinating the generation with transmission and supply led to vertical integration. Transaction costs are considered to be too high if these activities are separated.

(iii) Economies of scale: Economies of scale in generation, where bigger capacity plants produced cheaper electricity, added to the conventional wisdom of running the business in integrated manner.

(iv) Perspective planning: For the purpose of long term planning for investment in generation and transmission vertical integration was thought to be beneficial.

The implication of monopoly characteristic was that the prices had to be regulated to protect the interest of consumers. Many countries of the world responded with public ownership to solve this problem. With passage of time, electricity came to become a public good to be made available by the Governments of the day in the developing world.

Economists have long debated the effects of economic regulation. Such debates remained inconclusive until the deregulation of transportation and financial services in 1970s and the wholesale market for natural gas in 1980s in Western economies. Each of the initial experiments with deregulation produced enormous efficiency gains, accompanied by significant price reduction. In the electricity sector too, by 1980s, economists started questioning the conventional wisdom and argued that electricity can be subjected to market discipline rather than being controlled through monopoly regulation or Government policy. It was argued that the traditional cost of service regulation greatly attenuated regulated firms' incentives to operate efficiently and often introduced incentives to operate inefficiently. Simultaneously, with the invention of Combined Cycle Gas Turbines (CCGT), economies of scale in generation came down from optimum size of 1000 MW for nuclear plants and 500 – 600 MW for coal fired stations to 200 MW – 300 MW and even smaller capacity in case of CCGTs. As for co-ordination, economists argued that the co-ordination was possible through market mechanisms. As a result of these developments, traditional industry structure and regulatory approach started to break down in the West. The concept of non-discriminatory open access in transmission under which transmission owning utilities were required to provide third parties equal access to their transmission lines, made competition possible. This called for various forms of structural unbundling of electricity supply industry into generation, transmission, distribution and supply.

2.2 Indian context

In the Indian context, State Electricity Boards (SEBs) created as vertically integrated monopolies as service providers with some powers of regulation had successfully extended the network to cover the country. By the 1990s, however the losses of SEBs had reached unsustainable levels on accounts of huge pilferage in the system as also the reluctance to allow tariffs to cover reasonable costs. Initial attempts to get significant amount of private investment in generation and transmission did not succeed. Driven by a set of factors, many States brought about legislative changes to facilitate unbundling of the Boards. Unbundling in India was aimed at enforcing accountability, better management and promoting efficient operations, unlike in the west where unbundling was considered necessary primarily for promoting competition.

The Union Parliament enacted the Electricity Act, 2003 laying down a road map for evolving a competitive electricity supply industry in the country. Some of the important features of the Electricity Act, 2003, which have bearing on competition aspects, are as follows:

- Delicensed generation.
- Non-discriminatory open access in transmission mandated.
- Single buyer model dispensed with for the distribution utilities.
- Provision for open access in distribution is to be implemented in phases.
- Provision for multiple distribution licensees in the same area of supply has been incorporated.
- Electricity trading is recognized as a distinct licensed activity.
- Development of market (including trading) in electricity made the responsibility of the Regulatory Commission.
- Provision for reorganization of the State Electricity Boards, with the relaxation to continue as SEBs during a transition period is to be mutually decided between the Centre and the States.

Further, the National Electricity Policy announced by the Central Government in February 2005 *inter-alia* states that the development of power market would need to be undertaken by the Appropriate Commission in consultation with all concerned.

2.3 Why competition

The major difference between regulation and competition emanates from the debate as to who takes responsibility for various risks. In respect of electricity supply industry the risks could be any of the following:

- Cost and time overruns during construction.
- Fuel supply: availability and price.
- Technological changes: Obsolescence
- Management decisions about manpower, investments and maintenance.
- Market demand and prices.
- Credit risk.
- Risk of payment default by off takers.

Under regulated regimes, customers take most of the risks, as also most of rewards with the regulators doing their prudence checks to verify reasonableness of expenditures incurred. In the regulated regimes many of the old, inefficient or obsolete plants may continue to function and recover investments while in the competitive regimes they may be out of the market. During regulated regimes, overcapacity causes prices to increase as consumers do pay for the stranded capacity, whereas, in a competitive environment, excess capacity causes prices to fall. In nutshell, in a typical cost plus reasonable profit regulation regime, the incentives to cut cost are non-existent. In a publicly owned monopoly, the incentives are very different as the investments, their types, location etc. are often governed by political consideration rather than on sound economic principles.

Under competition, most of these risks are borne at least initially by owners – they would be responsible for bad decisions as also for profits from sound decision and managements practices. Investors also have strong urge to devise methods to hedge these risks taking advantage of various instruments available in financial markets. Competition also improves transparency adding significant value to the customers.

2.4 Challenges of making competition work in electricity

Introducing competition in electricity is based on the premise that the electricity can be treated as any other commodity. There are, however, important differences between electric energy and other commodities, which pose serious challenges in making it amenable to competition. These challenges arise from the following:

a. Electricity cannot be stored:

Electrical energy is linked with a physical system where demand and supply must be balanced in real time. This is because electricity cannot be economically stored. If this balance is not maintained, the system collapses with catastrophic consequences.

b. Demand of electricity varies intra-day and between seasons:

Demand for electricity fluctuates widely within the hours of the day as also from season to season. Since the electricity cannot be stored, it has to be generated when it is needed. Not all generating units will be producing throughout the day. When demand is low only most efficient plants will get dispatched. Since the marginal producers change as the load increases or decreases, the prices also vary over the course of the day. Such rapid cyclical variation in cost and price of a commodity are unusual.

c. Electricity travels in accordance with laws of Physics:

Electricity, not being a commodity in the conventional sense, there is no defined path for delivery. Energy generated from a generator cannot be directed to a specific customer. A customer simply gets whatever electricity was flowing in the wires he is connected to. Power produced by all generators is pooled on its way to the load. Pooling has beneficial effects of economies of scale. However, the downside is that any breakdown in a system affects everybody, not just the parties to a specific transaction.

d. Electricity travels at the speed of light:

The consequence of this property is that it requires advance planning and split second decision-making and control by the load dispatcher to co-ordinate the generation and consumption. Speed of decision making by market is often much slower than the speed of electricity. Balancing of supply and demand of electricity is therefore difficult to be left to the market.

e. Electricity has demand side flaws:

Important demand side flaws in electricity are:-

(i) Lack of elasticity of demand – Electricity being essential for modern life, its demand responds only minimally to price. Even in a country like India, the demand is becoming less elastic to price.

(ii) Ability of a load to draw power from the grid without a prior agreement with supplier. Because of this, it is often impossible to enforce bilateral contracts, as customers who exceed their contracted demand cannot be disconnected. In such an event, some other supplier becomes the default supplier. In an organized power market, the system operator often discharges this responsibility.

2.5 Electricity Market: Concepts & Fundamentals

2.5.1 Market defined

The Oxford Dictionary of Economics defines market as "*A place or institution in which buyers and sellers of a good or asset meet*". A market to an economist means the entire set of conditions surrounding production, transport and distribution of a product. Electricity markets are far more complex as compared to other commodity markets because electricity market does not deal with one homogeneous product but has to simultaneously take care of trading of ancillary services such as frequency response, reactive power etc.

2.5.2 Fundamentals of market

A market must have the following elements to be effective and competitive (Hunt 2002):

a. Many buyers and many sellers – neither to have market power to distort the functioning of the market.

b. Buyers and sellers should be responsive to price.

c. Liquid and efficient market places.

d. Equal non-discriminatory access to essential facilities.

e. Treatment of subsidies and environmental controls so that they do not interfere with the working of market.

Usually, commodity markets evolve themselves as time passes without a need for an institutional way to design them. However, electricity has a long history of regulation leading to concentration of generation, and customers are used to fixed and averaged prices, complexities in use and pricing of transmission service. These reasons call for a deliberate effort to design electricity markets with rules governing such markets.

The market system decides what shall be produced, how resources shall be allocated in the production process, and to whom various products will be distributed. The market relies on the consumer to decide what and how much will be produced and which of the competitors will produce it.

We would now discuss the behaviour of consumers and producers in the market place, interaction of which leads to striking of deals.

2.5.2.1 Demand

Demand indicates the behaviour of buyers. We have to consider as to what determines the quantity demanded of any good, which is the amount of the good that buyers are willing and able to purchase. The amount of an item that a person will purchase cannot be determined without considering its price. A demand curve plotted in two dimensional price/quantity graph will be downwardly sloped reflecting the law of diminishing value. The value, which a consumer will attach to successive units of a particular commodity, diminishes as his total consumption of that commodity increases. Reverse of this is also true – the higher the relative price for the good, the lower its rate of consumption. Simply stated, the quantity demanded varies inversely with price.

2.5.2.2 Shifts in demand curve

Whenever any determinant of demand changes, other than the good's price, the demand curve shifts. Any change that increases the quantity demanded at every price shifts the demand curve to the right. Similarly any change that reduces the quantity demanded at every price shifts the demand curve to the left (Fig 2.1)

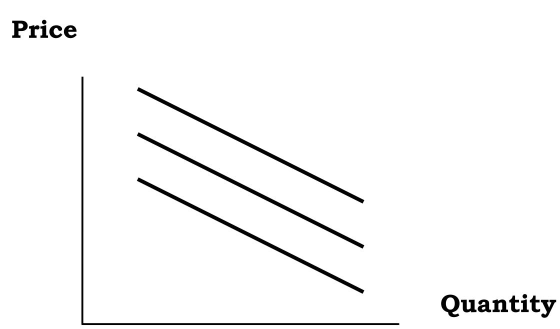

Fig 2.1: Demand curves

2.5.2.3 Supply

Supply indicates the behaviour of producers/sellers. The quantity supplied of any good or service is the amount that sellers are willing and able to sell. When price of a good is high, producing/selling more of it is profitable. Conversely when prices are low, business is less profitable and production will be cut. Because quantity supplied rises as the prices rises and falls as the price falls, it is said that quantity supplied is positively related to the price of the good. Supply curve therefore is upwardly sloping.

2.5.2.4 Shifts in supply curve

Whenever there is any change in any determinant of supply, other than the good's price, the supply curve shifts. Any change that raises quantity supplied at every price level shift the supply curve to the right. Similarly, any change that reduces the quantity supplied at every price level shifts the supply curve to the left. (Fig 2.2)

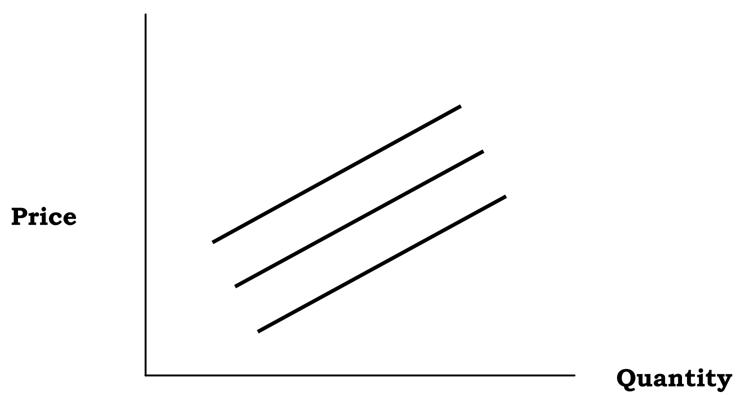

Fig 2.2: Supply curves

2.5.2.5 Market equilibrium

This indicates interaction between buyers and sellers. Fig 2.3 shows the market supply curve and market demand curve together. At a point where demand and supply curves intersect, there is market equilibrium. The price at which these two curves cross is the equilibrium price and the quantity is the equilibrium quantity. At the equilibrium price, the quantity of the good that buyers are willing and able to buy exactly balances the quantity that sellers are willing and able to sell. The equilibrium price is also called market clearing price because at this point everyone in the market has been satisfied: buyers have bought all that they want to buy and sellers have sold all that they want to sell.

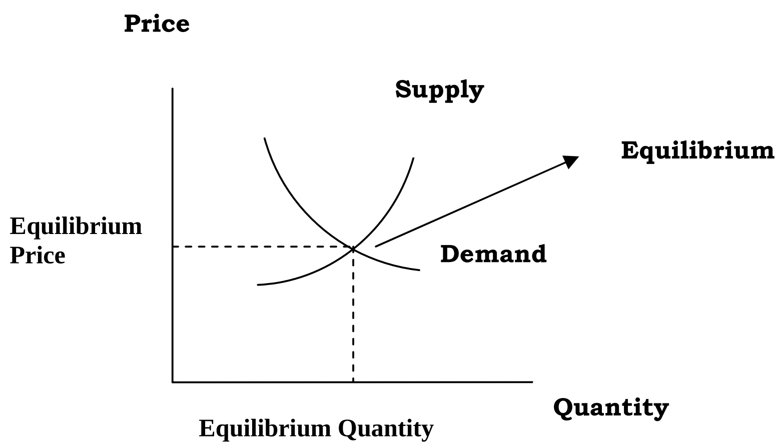

Fig 2.3: Price discovery in the market

2.5.2.6 <u>Consumer's surplus</u>

Consumer's surplus is the amount buyer is willing to pay for a good minus the amount the buyer actually pays for it. Consumer's surplus represents the extra value that a consumer gets from being able to buy all the pieces of a good at the same market price even though the value he attaches to them is higher than the market price.

2.5.2.7 <u>Producer's surplus</u>

Producer's surplus measures the benefit sellers receive from participating in a market. Producer's surplus is the amount a seller is paid minus the cost of production. Producer's surplus arises from the fact that all the goods (except for the marginal production) are traded at a price that is higher than their opportunity cost. Producers with a low opportunity cost capture a proportionately larger share of the profit than those who have a higher opportunity cost.

2.5.2.8 Global welfare

The sum of the consumer's surplus and the producer's surplus is called global welfare. It quantifies the overall benefit that arises from the trading.

2.5.2.9 Relevance of these concepts to electricity markets

a. Efficiency and total surplus

Efficiency means,

(i) The output is produced by the cheapest suppliers.

(ii) It is consumed by those most willing to pay for it.

(iii) The right amount is produced.

The sum of consumer's surplus and producer's surplus is to be maximized for market to be efficient. Fig 2.4 will show that maximum surplus can be achieved only when the market is in equilibrium.

External interventions sometimes prevent the price of a good from settling at the equilibrium value that would result from a free and competitive market. If, through external intervention the price is fixed at P_2, which is higher than the equilibrium price of P, the consumer reduces his consumption form q to q_1 leading to the consumer's surplus shrinking to area K.

Similarly if the price is fixed at P_1, which is lower than P, then producers will cut their output to q_1. In this scenario the consumer's surplus equals to K+L+M while producer's surplus shrinks to only N.

All these interventions have the undesirable effect of reducing the total surplus by an amount equal to O+R. This reduction in total surplus or global welfare is called the Deadweight loss.

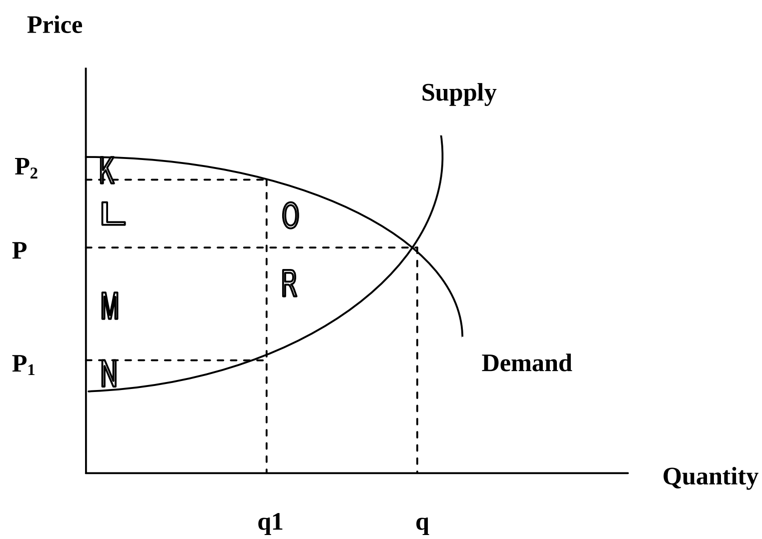

Fig 2.4: Welfare and market equilibrium

b. If generators were able to enter the market freely and there were super profits to be had, new generators would enter the market, which in turn would reduce the levels of profit. This will happen freely if there are no entry barriers. If demand curve shifts to right, the supply curve also shifts to right and a new equilibrium is achieved which will reduce price and increase the quantity purchased (Fig 2.5). In this way, free entry ensures that profits will not be above normal. A normal profit level is the key characteristic of a long run competitive equilibrium.

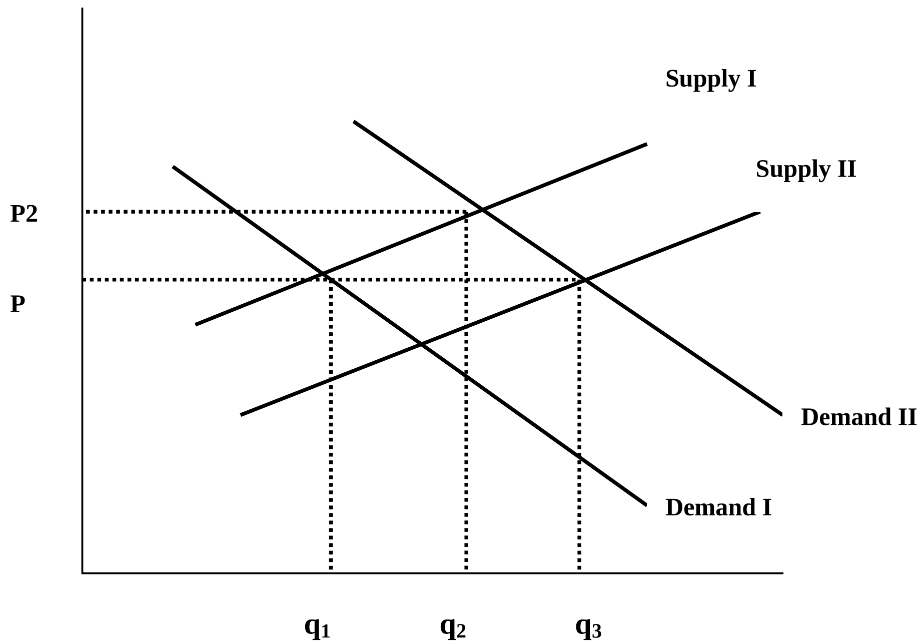

Fig 2.5: Impact of shifting of demand and supply curves on market equilibrium

2.5.3 Types of Markets

Markets can be of different types, depending on how buyers and sellers decide to settle the following terms of trade,

1. Price of goods
2. Its quantity and quality
3. Time of delivery of goods
4. Settlement mode

2.5.3.1 Spot Market

In a spot market, the seller delivers the good immediately and the buyer pays for it on the spot. No conditions are attached to the delivery. Advantage of spot market lies in its immediacy. However, the spot markets are vulnerable to short supply/demand shocks and therefore are quite volatile. In the electricity market, delivery cannot be organized immediately. Therefore, spot markets operate on day–ahead basis and deliveries are scheduled for the next day. The deviations in the real time are handled by the system operators in various ways in what is known as the balancing market or the real time market. Balancing power is either procured fresh close to real-time, or procured on the basis of day-ahead market. In India, balancing power is not procured, but utilities are encouraged to supply it on voluntary basis. Deviations are permitted and frequency is allowed to slide within the limits prescribed by the Grid Code. Deviations are priced as per Unscheduled Interchange (UI) Rate, which is linked to frequency.

2.5.3.2 Forward markets

Considering the volatility of prices in the spot market, buyers and sellers often agrees on price, quality and quantity of goods in advance of actual delivery and the goods are delivered on a future date. These contracts will have mode and timing of payments as also penalties, if any, for failure to deliver goods or failure to make payment. These are called as forward contracts. However, instead of having one to one relationship, many buyers and sellers may develop a market for trading of goods in advance of the delivery. Price discovery in such a market is based on more informed choice as compared to one to one contracts. Besides, the market also facilitates development of standard contracts.

In the electricity sector, long terms PPAs are examples of forward contracts between generators and distribution companies. The practice of having long term PPAs may continue in addition to forward markets as the generators and distribution companies are often interested in having agreements for large quantity of electricity to be supplied over a long period of time and special terms are required to be agreed upon.

2.5.3.3 Futures markets

Over a period of time, standardized forward contracts can be traded in a secondary market. Traders (those neither producing nor consuming the good) can also participate in this market. Parties not willing to take physical delivery can also participate in this market by selling their forward contracts. Such markets where contracts are not backed by physical delivery are called futures markets. On the face of it, this market consists of speculators. However, the market benefits from the presence of these speculators as they increase depth and liquidity.

2.5.3.4 Options

In futures and forward contracts, the delivery is unconditional. Any seller failing to deliver the quantity must arrange it form other sources such as spot market. Similarly, a buyer who cannot take full delivery must sell the excess in the spot market. A variant of this type of arrangement is offered by options. In this type of contracts, the delivery is conditional. The options are of two types, call options and put options. A call option gives a right to its holder to buy a given amount of commodity at the exercise price. A put option gives a right to its holder to sell a given amount at exercise price.

2.5.3.5 Contracts for difference

Buyers and sellers try to mitigate price risks through the mechanism of contracts for difference. It generally operates in a situation where trading takes place through a centralized market and bilateral contracts are not allowed. In the contracts for difference, parties agree on a strike price and the amount of the commodity. Both buyers and seller take part in centralized market. The difference between the strike price and market-clearing price of the centralized market is settled between the parties to the contracts for difference. In the electricity sector this practice prevails in Nord pool where a market for contract for differences also operates alongside the electricity market.

Chapter III

An over view of electricity markets

3.1 Introduction

3.1.1 Keeping with the trend worldwide, the electricity sector in India is undergoing fundamental transformation of its institutional structure particularly after the enactment of Electricity Act, 2003. Vertically integrated SEBs are giving way to unbundled institutions that are conducive to competition. The objective for creating competitive electricity market is to unleash market forces to improve efficiencies, stimulate technical innovations and promote investments. Creation of electricity market can bring economic benefits for consumers and societies in the long run and international experience on the whole has been positive notwithstanding some instances of market failures, which were subsequently rectified. However, in the short run, certain groups may not realize immediate benefits or may even experience losses.

3.1.2 The first serious attempt to form a liberalized electricity market was launched in Chile in 1982. Markets were launched in England and Wales in 1990. Nordic market, now known as Nord Pool, was started in 1991. Electricity markets started operating in Australia and New Zealand in 1994 and 1996, respectively. In North America, several markets were started in the late 1990s, such as PJM, New England, New York and California markets. Spain and Netherlands opened their electricity markets in 1998. Texas and Alberta (Canada) opened electricity markets in 2001.

3.1.3 Long term PPAs or Forward Contracts provide price security to buyers as well as suppliers. In order to cater to the demand variations, it is also necessary for distribution utilities to look for short-term contracts. Short-term arrangements could be of few months to few hours. Open Access facilitates short-term contracts by providing the transmission path. Traders chip in with their matchmaking skills and ability to secure payments.

3.1.4 In short-term contracts, the price of electricity tends to reflect the economic price for time of the day or time of season. Handling and dispatching large number of short term contracts of varying durations is a challenging task for the system operators who have to all the time maintain the demand-supply balance in order to ensure grid stability. Under such circumstances, a situation evolves when it becomes desirable to organize the trading of electricity through a market operator. Apart from devising ways and means of organizing the electricity trade, the market operator has to enter into institutional arrangements with the system operator for facilitating physical flow of electricity from the suppliers to the buyers, and on the other hand with a clearing house for facilitating cash flow from the buyers to the suppliers. If the market operator organizes the generation and sale of the entire electricity of one area, it is usually referred to as a pool. If the market operator caters only to voluntary trade, it is said to be a Power Exchange. (PX) The impact of PX on market is gradual. PX volume grows as supplies increase and buyers develop confidence in PX. Slowly, long term PPAs give way to day ahead trades through PX. In a centrally dispatched power pool, the market operator is responsible for matching the supply with the demand of various participants. In some markets, each participant is responsible to balance his demand with requisite supply and has to commercially settle all real time deviations from the given schedules as per the agreed pricing scheme. This is known as self dispatched market. In this sense, we have self-dispatched system under the ABT regime, and deviations from schedules are settled as per UI pricing mechanism.

3.1.5 In centrally dispatched markets, only generators/suppliers are asked to bid and the stack of supplies is selected to the extent required to meet the forecast demand. The buyers are not required to participate, as the underlying philosophy is that forecast demand has to be met as far as possible. In distributed markets, there is a clear separation between the market operator and the system operator, and suppliers as well as buyers are asked to participate in bidding. This enables the buyers to calibrate their demand according to their price sensitivity and under take demand side managements in the process. Each buyer gets quoted quantity at the corresponding price quoted by him. In all organized markets, the bids are sought in pairs of quantity and price. In double-sided bidding, it is possible for a participant to dispose as a buyer or a supplier depending on the clearing price. For example, a utility may offer to buy 100MW at a price below Rs 3.00 per unit, but if the clearing price is in excess of Rs 5.00 per unit it may be viable to start its own costly generation and sell a part there from, say 50 MW, to the Power Exchange. Eventually, if the clearing price is below Rs. 3.00 per unit, the utility would be supplied 100 MW, and in case the clearing price is Rs 5.00 per unit the utility would be dispatched for 50 MW as a supplier. Now days, it has become a practice to call for bids for one hour time blocks. Most of the markets, these days, are organized in two parts, i.e., a day-ahead market and real time market. Day-ahead market is also called the spot market. In India, at the inter-state level, all supplies and dispatches are organized by RLDCs on day-ahead basis considering requisitions from central generating stations and requests for bilateral trade through Open Access.

3.1.6 In a competitive market, it is the competition which forces suppliers to submit bids based on marginal costs. In a Power Exchange design, the most critical issue requiring close examination is its price discovery mechanism. Normally, in double-sided bidding, the market-clearing price is the intersection of the aggregated demand and supply curves, i.e., the price at which supply is equal to the demand. In the uniform pricing model, which is adopted in most electricity markets, all the suppliers are paid based one clearing price. At very low prices, demand may be very high but very little supply may be available as no supplier will be willing to supply electricity at a price lower than its marginal cost.

However, as one moves towards higher prices and surpasses marginal cost of suppliers, more and more supply will be available. At the same time, demand will also tend to reduce at higher prices. Thus, at a particular price, demand and supply will match and this price becomes the market-clearing price and corresponding volume will become clearing volume. Thus, the price offered by the last supplier (marginal supplier) sets the price for all suppliers in the uniform pricing model. Its criticism is that such marginal pricing enhances the possibility of gaming by dominant players, and has the potential to create windfall profits. In the absence of perfect competition, suppliers may not be compelled to submit bids close to their marginal costs. Alternatively, the suppliers can be paid the amount they initially bid. This type of pricing is referred to as 'pay-as-bid' or 'discriminatory' pricing. Its criticism is that suppliers/generator will be more bothered about the marginal cost of their competitors than their own. More elaborate discussion on the issue of uniform pricing vis-à-vis pay-as-bid pricing can be found in Chapter-IV.

3.1.7 One of the biggest challenges in efficient functioning of electricity markets is to handle transmission congestion. There are various ways of dealing with congestion in electricity markets. Congestion arises because of limitation in the transmission capacity. Time differentiation is a well-known characteristic of electricity product, which arises out of its non-storability. However, in addition to time differentiation, congestion adds spatial differentiation to electricity product. Since one cannot build infrastructure of infinite capacities, congestion is unavoidable. However, excessive congestion may have adverse impact on the electricity market. Net effect of congestion is separation of single market into geographically separate sub markets.

Characteristics of the some of the functioning markets in the world are discussed below.

3.2 Nord Pool

The electricity reforms were initiated in Norway in 1991. Nordic power exchange was established as an independent company in 1993. It established price quotation on a day-ahead basis and it established the world's first exchange-based trade with futures contracts in 1993.

Swedish electricity market unbundled in 1996. Thereafter, a common electricity exchange for Norway and Sweden was established under the name of Nord Pool.

Finland also completed the electricity reforms by 1996. Two private electricity exchanges were established in Finland in 1995 and they merged into one entity in 1996. However, even the merged exchange did not have sufficient liquidity. In 1998, Finland effectively entered into Nordic Market.

Denmark joined Nord Pool subsequently. Nord Pool was reorganized in 2002. It is still owned by the Transmission System operators (TSO) of Norway and Sweden. Nord Pool provides freedom of choice to the large consumers. Close cooperation between the system operation and market operation is the key feature of Nord Pool. The day-ahead spot market orgainsed through Nord Pool is the cornerstone of the Nordic Electricity market. Demand bids and supply offers must be submitted to Nord Pool by 12:00 noon for the following day. Marginal bids and offers that determine the balance between supply and demand sets the price for the entire market. Considerations regarding fixed cost are not taken into account in the market clearing but market players have various opportunities to submit block-bids. Block-bids enable generators to make a bid conditional for block of hours instead of only one.

Nordic TSOs give Nord Pool PX a monopoly to use all available transmission capacity that interconnects the defined areas or zones in the Nordic market. Currently there are three zones in Norway, but they can change in case of frequent congestions in other places. Sweden and Finland constitute one zone and Denmark has two zones. All network companies are responsible for assessing and purchasing electricity resulting from grid losses. Hence, grid losses are reflected in the zonal prices through normal demand bids in the spot market. Nord Pool also calculates a system price assuming that there are no constraints in the entire Nordic transmission system. This is purely a reference used in the financial market and does not necessarily exact prices in the various market zones.

Initially, some interconnection capacity was reserved for long-term contracts. The last of these reservations was removed in 2000.

The transmission capacity made available to Nord Pool, as announced during the morning before day-ahead bids, is guaranteed by the TSOs. This implies that the transmission right is firm. In real time, the TSOs have to modify dispatches in order to overcome any transmission constraints. They have to do so at their own cost.

Conversely, available transmission capacity is also a source to collect congestion rents, which is used by the TSOs for various purposes and finally to reduce transmission tariffs. The hourly Nord Pool schedules are binding in the sense that market players are financially responsible for their fulfillment. All market players with a physical footprint in terms of generation, load or trade after the scheduling deadline are required to register as balance-responsible market players. They must sign the contract with the TSOs in the zone in which they want physical footprint, through this contract they become physically responsible for deviations and are bound to follow the specified rules and formats for communication with that TSO.

After submitting schedules to the respective TSO, the framework for handling imbalances deviates somewhat from country to country. Nordic TSOs operate balancing market in which they buy and sell electricity to balance the system according to the merit order of bids submitted by the market players to TSOs. Prices for real-time are determined by the marginal bid, as is the case in the day-ahead spot market. Individual imbalances that, by chance (such as underdrawal), are actually helping the system are treated differently in different Nordic countries. In Norway, the imbalances that help the system by chance are also rewarded with the same price and are, thereby, treated equally with the market players that were actively called on in the purchase of balancing power. This pricing principle is referred as the 'single-price' system and is cost neutral. Market players that caused the imbalance pay to those that alleviated the imbalance.

In Sweden, Finland and Denmark, the balance-responsible market players that helped the system by chance are not rewarded. Their imbalances are settled with the day-ahead spot price, which always gives an equal or poorer remuneration than the price settled in the purchase of balancing power. Otherwise, there would be an incentive to make arbitrage between the two markets. Thus, balance-responsible market players that caused the imbalance pay the settled regulating price to the TSO and the TSO passes this price on to those that were actively called on. In reality, they are settling imbalances of those that helped the system by chance at a less favourable price. This pricing principle is referred to as the 'dual-pricing' system and is not cost neutral. In fact, it generates surplus for the system operator.

Imbalances are settled at the cleared regulating prices, usually one or two weeks after the day of operation. Local network companies collect hourly interval meter readings on a daily basis. These are matched with schedules to calculate individual imbalances. All Nordic countries have implemented the system for load profiling for the smallest consumers, primarily to avoid the need to have them install remotely read interval meters.

Nord Pool PX has a market share of 43% of the physical Nordic demand; the remaining 57% is traded bi-laterally. This could be thought of as bi-lateral physical trade but, in realty, it mainly reflects that several generators also have retail arms, and therefore, demand and generation are matched directly within the company.

Nord Pool also operates a trading platform for financial derivatives as well as clearing house for bi-lateral contracts. Nord Pool offers futures contracts for one to nine days ahead and for one to six weeks ahead in time. These futures contracts are settled daily. All these futures and forward contracts use the daily average system price as reference. There are also contracts to hedge zonal price differences, either one quarter or one year ahead.

In 2004, total installed capacity in Nordic market was about 91000 MW including 47000 MW Hydro (mostly storage type), 23000 MW Thermal capacity (mostly coal based) and about 12000 MW Nuclear generating capacity. The inter-connector capacity between Norway and Sweden is 3620 MW over nine different AC lines. Sweden and Finland are interconnected with 2230 MW over five AC lines. Sweden and Denmark east are interconnected with 1810 MW over four AC under marine cables. Sweden and Denmark west are interconnected with 670 MW DC cables. Norway and Sweden are interconnected with 1000 MW sub-sea DC connection. Norway and Finland are interconnected with single 100

MW AC line. Nordic market in turn is also interconnected with neighbouring markets of Germany, Poland and Russia.

The four largest generating companies in the Nordic market are Vattenfall, Fortum, Statkraft and E. ON Sweden. Vattenfall has a market share of 19% in terms of output. Vattenfall is owned by the Swedish State. The other large generating company, Fortum had market share of 16% in 2001 and it is 60% owned by the State of Finland. No other company held more than 4% of the market in 2001. In Norway, 160 companies are engaged in electricity generation; the 15 largest had 88% market share of Norway. In Sweden, 15 large generators have market share of 94% of the domestic generation. In Finland, 15 large companies have a market share of 95%. In Norway, there are about 100 retail companies; in Sweden and Denmark, the corresponding number is 80.

3.3 PJM

The Pennsylvania – New Jersey – Maryland interconnection (PJM) has been a pool that enables co-ordination of trade between the three founding utilities since 1927. Prior to 1978, the United States electricity industry was run by vertically integrated utilities, in most cases privately owned. These companies were regulated by the state public utilities commissions (PUCs). On the federal level, the Federal Energy Regulatory Commission (FERC) has authority only over wholesale trade issues. In 1978, environmental friendly small generators were allowed access to the grid through contracts corresponding to avoided costs. A number of independent power producers (IPPs) came up primarily in those States where the vertically integrated utilities were encouraged to auction least cost contracts to IPPs to obtain the needed power. The Energy Act of 1992 gave the FERC authority to order open access for wholesale trade between utilities and across state borders. PJM started to transform itself into an independent, neutral organization in 1993. The FERC Order 888 on Open Access was issued in 1996 calling for functional unbundling of transmission system operation from power trading. Transmission utilities under FERC jurisdiction had to provide non-discriminatory open access to third parties on a comparable basis on the same terms & conditions as applicable for self-use of the utilities. In 1999, FERC issued order 2000, which encourages the merger of ISOs (Independent System Operator) into Regional Transmission Organization (RTO). In Sept. 2001, FERC made several proposals to encourage standardization of market design and push for the formation of RTOs. FERC issued a White Paper in April 2003 with a refined version of Standard Market Design. However, the proposal did not materialize due to resistance by the States and was withdrawn in 2005. The Energy Act of 2005 gives FERC more authority in the matters of system security and in the approval process of new transmission infrastructure and to monitor and enforce competitive behavior in wholesale market. The Energy Act, 2005 indicates that the development towards competitive and open electricity market should be supported, but not forced on all States.

PJM became a fully organized market in 1997, and was approved by the FERC as the first ISO in the country to be in compliance with Order 888. PJM is responsible for safe and reliable operation of the unified transmission system and for the management of a competitive wholesale electricity market across the control areas of its members. PJM was given full RTO status in 2002.

The first years of PJM operation were used to establish and develop the market. The initial day-ahead spot market was based on a single market-clearing price for the entire region. High costs for congestion management and poor operational flexibility in the utilization of the system due to security restriction called for a stronger locational reflection of real costs. One year later, Locational Marginal Pricing (LMP) was introduced. In 1999, a daily capacity market was introduced and in June 2002 the day-ahead market was extended by the real time market, also based on LMP and competitive bidding. In December 2000, a market for spinning reserves was added. With the implementation of LMP principles in 1999, there appeared a need to offer hedging of price differences between nodes. In April 1999, PJM introduced an auction of allocated financial transmission rights (FTRs), which gave market participants the opportunity to hedge the risk. In May 2003, the FTRs were replaced with auction revenue rights (ARRs). The PJM market operation area has been extended to include West Virginia, Ohio, North Carolina etc.

All generators defined as a capacity resource in PJM system are obliged to submit an offer into the day-ahead PJM market. The bus that connects a generator to the grid is specified when registering. Offers can include incremental prices, specifying different prices at different generation volumes. They can also specify minimum run times and start-up costs to ensure that unit commitments are incorporated into the market-clearing price. Market participants are allowed to self-schedule. On the generator side this is accounted for by indicating that a specific share of a generation unit must run regardless of the price. An offer specifying that a unit must run is basically just a schedule that commits the generator financially.

Retailers and consumers must submit bids to the day-ahead spot market. They can do it by bidding prices and volumes, if they intend to respond to the price by decreasing demand, or they can do it without specifying any price.

Reliability and transmission system security considerations are taken into account in the total market clearing. A marginal pricing principle is used. Each generator is paid market clearing price in its specific node. All loads are charged the market-clearing price in their specific nodes. In 2004, 26% of the load was cleared in PJM day-ahead market. The remainder was generation offer submitted as must run, meaning it was self-scheduled. Most of the States in PJM have ordered retail access for all consumers.

In 2004, the demand peaked at 78,000 MW. Assessed peak demand after the extensions in 2005 is 1,30,000 MW and the energy demand was of the order of 700 TWH. The total population area was about 51 million across 13 states. The total load was served by installed capacity of 1,44,000 MW in 2004 including 41.5% coal fired, 28.4% Natural Gas fired, 19% Nuclear, 7% oil and 3.7 Hydro Electric. By the end of 2003, American Electric Power Company was the largest generation company in PJM, owning 17% of the total installed capacity and generating 22% of the output. Exelon was second with 13% of installed capacity and 23% of the total generation. Public Service Enterprise Group (PSEG) had 9% of installed capacity and 6% of energy generation.

PJM Interconnection is a limited liability, non-profit company, governed by a board of managers. Members of the board of managers must have no personal affiliation or ongoing professional relationship with – or any financial stake in – any PJM market participant. Users of PJM join as members and are represented with a vote in the members committee. The members committee elects a board of managers and provides advice to this board by proposing and voting on changes in market rules; it also has authority to make specific recommendations. There are other committees and user groups for resolution of issues through discussion and negotiation. Market rules and market design issues are often developed through these governing structures.

There is a specific unit within PJM to oversee the functioning of the market; the Market Monitoring Unit (MMU). The MMU is an independent group that assesses the state of competition in each of PJM markets, identifies specific market issues and recommends potential enhancements to improve competitiveness and market efficiency. In particular, the MMU is responsible for monitoring the compliance of members with PJM market rules and for evaluating PJM policies to ensure those rules remain consistent with the operation of competitive market. The MMU issues an annual report on the state of the market.

State regulators, together with a federal regulator, oversee compliance of state and federal legislation. States have public utility commissions (PUCs) and the Federal Energy Regulatory Commission (FERC), which is an independent agency within the Department of Energy, regulates on those areas in which federal legislation gives it authority. PUCs regulate intra-state utility business, such as generation and distribution. The FERC regulates interstate energy transactions, including wholesale power transactions on transmission lines.

3.4 UK markets

Prior to the Electricity Act, 1989, the electricity industry in England and Wales was State owned. Generation and transmission was managed by the Central Electricity Generating Board (CEGB) and 12 area electricity boards managed distribution. Under the Electricity Act, 1989, the entire sector was reorganized, corporatised and eventually privatized. CEGB was split into four companies. All generation assets were divided between National Power (40 conventional power stations with 30 GW capacity), Power Gen (23 conventional Power Stations with 20 GW capacity) and Nuclear Electric (8 nuclear stations with 8 GW capacity). Transmission, power system and market operation was given to National Grid Company (NGC). On April1, 1990, retail competition was opened to 5000 consumers with load higher than 1 MW and the Pool commenced operation. In Scotland, the North of Scotland Hydro-Electric Board was restructured with Scottish Hydro-Electric and Scottish Power. Both were privatized as vertically integrated utilities in 1991. The Electricity Boards were corporatised into Regional Electricity Companies (RECs) and partly privatized. IPPs (for CCGTs with new found gas) were permitted to sign long term PPAs with RECs.

The ten-year-old reform process was reviewed in 1997. The review report criticized the mandatory pool system and gave recommendations for New Electricity Trading Agreements (NETA) based on voluntary approach. NETA replaced the Pool in 2001. In 2000, NGC established a separate company to manage the new Balance and Settlement Code. The new company ELEXON is a subsidiary of NGC and operates and settles the balancing market in NETA. Scotland was integrated with NETA in 2005, which is now referred to as British Electricity Trading and Transmission Agreement (BETTA). ELEXON is the market operator and NGC the system operator.

In the erstwhile Pool, Generators gave bids and specified start up costs and other technical constraints. Bids were ordered in the ascending order and the software calculated the dispatch that would meet the forecast demand. The marginal bid set the system marginal price to be paid to all dispatched generators. It was a one-sided market with no demand side participation. It was a day-ahead market mechanism. In addition to system marginal price, capacity payment was also made to the generator. The capacity payment increased with decreased reserve margins. The buyers paid for transmission losses and system operation charges. The Pool had many flaws. NETA/BETTA is a voluntary bilateral trade divided into four markets segments. The intention was to develop a medium term/long term market with standardized financial contracts traded Over the Counter (OTC) as well as to develop a short term Over the Counter bilateral trading. All these markets are voluntary. However, participation in balancing market operated by NGC/ELEXON is mandatory. Gate closure in the balancing market is one hour before real time operation. Generators as well as buyers can participate in the balancing market. NGC calls on the cheapest bids to balance the system physically. The prices paid to those called on to deliver the balancing services are pay-as-bid or discriminatory prices and there is no uniform clearing price in the balancing market.

Those having imbalances in the same direction as the total system imbalance are charged at the weighted average price of those who were called on by NGC to physically balance the system. Those having imbalances in the other direction, and who thereby have helped the overall system imbalance by chance, are not rewarded, but are charged at spot reference price taken from day-ahead UK Power Exchange (UKPX). The balance market account is not a zero sum matrix unlike our UI mechanism. The system operator (NGC) generates a cash surplus, which is credited to all the participants by a proportionality formula. Except for the balancing market, the other three types of voluntary markets discussed earlier have not reached a mature stage so far. Out of the several projects for day-ahead spot market, only UKPX has been in operation and here too, traded volumes are very low.

3.5 Electricity Markets in South Africa – EPP and SAPP

3.11.1 ESKOM Power Pool (EPP)

The electricity supply system of South Africa is operated by a state owned integrated utility called - ESKOM. There is functional ring fencing among generation, transmission, distribution and international trading functions. The net generating capacity of ESKOM is 36208 MW, including 32066 MW coal based, 1800 MW nuclear and 2000 MW hydro. The generation plants are divided into 4 clusters in order to create internal competition. South Africa had surplus generating capacity in the past. However, growth in demand has reduced the surplus to insignificant levels. There may be a deficit situation by the year 2007. ESKOM has been operating an 'internal' power pool –EPP, in which the four generating clusters of coal base power stations owned by ESKOM have to compete on the basis of day-ahead bidding against the demand forecast for the next day. Operational reserve of the order of 1900 MW is maintained. ESKOM has load interruption contracts with select large consumers in the metal processing industry for reducing the load in case of an emergency. The load generation balance is maintained by a specially designed automatic generation control (AGC) scheme, which sends raise or lower signals to the selected generating units depending on frequency excursions. Generating units selected for responding to AGC pulses are paid separately. AGC functions in the frequency band of 49.85 Hz to 50.15 Hz and governors response are kept suppressed in the above frequency band. However, governors become active if the frequency falls below 49.85 Hz or increase above 50.15 Hz, and automatically pick up or shed load. ESKOM is also responsible for integrated resource planning for generation, transmission and distributions, all of which are licensed activities. There is practically no transmission congestion on the ESKOM networks of 27169 km (132 kV – 765 kV). The generation schedule is prepared by topping the anticipated load demand with average losses. The overall profit of ESKOM is fully regulated by the National Electricity Regulator of South Africa (NERSA). However, ESKOM is free to do international trade at any price. NERSA was constituted in the year 1995 to regulate the electricity sector in South Africa. In September 2005, the regulation of gas and petroleum pipelines was also entrusted to NERSA. NERSA also sets the distribution tariff that provides cross subsidy to the poor and rural areas as per the government policy.

According to the original road map, the 'internal' power pool was to be converted into a real pool. The generation was to be incorporated into generation companies and partly divested. The distribution was to be split into three distribution companies, one each for Johannesburg, Cape Town and the rest of South Africa. Power Pool was to be operated by a separately incorporated company to be owned by the transmission company. The generation prices were to be deregulated while NERSA would have continued to regulate transmission and distribution tariffs. However, during an interaction between SARI and SAPP executives recently organised by the US Energy Association, it was learnt that there is a rethinking going on about the future course of electricity reforms in South Africa. The unbundling and divestment programme has been shelved, as also the plan to set up an independent market operator. It is understood that the main reason for rethinking is the tight supply situation. By the experience gained from operating the 'internal' pool, it has been realized that in a tight supply situation, the costlier generation would set the market-clearing price and market abuse would be difficult to check. The current plan is to switchover to cost plus regulation for generating stations based on two-part tariff and merit order dispatch based on marginal or variable cost. ESKOM will remain vertically integrated.

South Africa requires significant investment in generation to catch up with the growing load demand as also to replace its fleet of aging thermal power stations, which are generally more than twenty years old. It is targeted to obtain 30% new generating capacity through IPPs or joint ventures with balance 70% coming from ESKOM. ESKOM has a healthy balance sheet, a very good international credit rating and does not require non -recourse funding. The Government of South Africa has initiated the competitive bidding process for inviting private investment in coal-based generation through the private sector. ESKOM would enter into long term PPA with the IPPs.

It is noteworthy that South Africa has not been carried away by the hype of developing electricity market and they have chosen to take decisions based on their specific conditions.

3.11.2 <u>SOUTH AFRICAN POWR POOL (SAPP)</u>

SAPP is entirely different from the internal ESKOM power pool of South Africa. SAPP has been constituted in 1995 under the aegis of South Africa Development Council (SADC), which became active after the resolution of conflicts and civil wars in South African region, particularly after the end of apartheid regime in South Africa. The objective of SAPP is to promote energy cooperation among nations of the region, including South Africa, Botswana, Mozambique, Zambia, Zimbabwe, Angola, Democratic Republic of Congo and Namibia. Inter-government MOU, Inter-utility MOU and operating agreements /grid code have been put in place for the purpose of operation of SAPP. A Regional Electricity Regulators Association (RERA) has also been formed and it is invited to SAPP meetings if required.

Three system operators, ESKOM-TSO, ZESCO and ZESA handle the real-time operations of SAPP. There is no central dispatch. The grid operation in SAPP resembles inter-regional grid operation in India based on the IEGC. The gross generating capacity of SAPP countries is 52743 MW (74% Coal, 20% Hydro, 4% Nuclear, 2% Gas/Diesel), and it is dominated by ESKOM. SAPP operations include scheduling and managing long term (for1-5 years) and short term bilateral trades (for hours, days or weeks) among the various nations of South Africa. There are HVDC and AC links among the South African nations and more links are planned in future. SAPP would facilitate the setting up of large hydro power stations in countries like Congo, which are rich in hydro potential but have low demand base. During drought or low hydro flows it would be possible to supply thermal power to such countries through the SAPP infrastructure. The volume traded in SAPP in 2005 under long-term contracts was about 18 BU (1770 MW hydro and 1706 MW thermal power), mostly by ESKOM, at negotiated prices. The volume of short-term trade was very low (of the order 200 MU) during the year 2005. SAPP control centre centrally manages the short term trading. Every day the SAPP control center declares the spare transmission capacity on cross-country transmission links. The participants send their bids and offers. The prices are set on matching seller prices *i.e.* suppliers are paid as bid. Full transmission service charges are recovered for long term contracts *pro-rata* to capacity used, while for transmission charges for short term trades are applied @ 50% and lower priority is given *vis-à-vis* long term bilaterals.

The SAPP has engaged Nord Pool as consultants to move from the cooperative power pool as of now to a competitive power pool in the future. A double-sided bidding platform has been proposed with the integrated utility of each country as the participant. Uniform market clearing price, billing on scheduled energy, settlement in US dollars and market splitting in case of congestion are salient features of the proposed market design. Each country utility tries to optimize its operations through the SAPP platform. The association of regional regulators (RERA) oversees the SAPP operations but it does not have the authority to check market abuse by the country participants. Lack of depth, liquidity, ESKOM domination and entry barriers appear to be the weak points of the proposed common trading platform.

3.6 California experience

3.6.1 California experienced energy crisis during spring 2000 until spring 2001 that led to sky rocketing natural gas and electricity whole sale prices which culminated in the massive regional energy shortage. While demand grew by 5500 MW between 1996 and 1999, the generating capacity increased by 672 MW over the same period. On top of it, retail prices were fixed and there was no reason for retail customers to moderate their consumption. The situation was compounded by poor hydro conditions and abnormally hot weather leading to high air conditioning load. Further, some old plants could not operate because they did not have emission credits. In addition, import from neighbouring States became problematic due to increase in local demand in the respective States. Moreover, the period saw large increase in natural gas prices, which was the fuel of choice for peaking power plants. The crisis culminated into rotational load shedding.

3.6.2 Market design flaws also played part in the California crisis and they are relevant for our discussion on power exchange. The following flaws have been ascribed:

- Freeze on retail prices
- Restriction placed on long term contracts
- Faulty design of day ahead and balancing markets

The California market was organized through a power exchange (CalPX) and an independent system operator (CAISO). The power exchange ran a day-ahead market using one-sided bidding for each hour with a marginal clearing price system. The power exchange was mandatory for the demand and supply for investor-owned-utilities. The power exchange handled 85% of the volume of day-ahead transactions. Investor-owned-utilities were forced to divest much of their fossil-fuel based power plants and not permitted to sign multi-year contracts to buy part or all of the output from the plants they had just sold. Due to this prohibition, the distribution companies were required to buy almost all the power they needed from the power exchange and on real time market run by CAISO. Companies other than the investor-owned-utilities were, however, allowed to form their own markets, called the scheduling coordinators.

3.6.3 Market manipulation

Some of the traders took advantage of flaws in the California market design to maximize their profits. The strategies used are summarized below:

i) Arbitrage between Real-time and Day-ahead markets by buying power from the PX, exporting it to a party in neighboring countries, and importing it back to sell the energy to the ISO market where no price caps are in place.
ii) Scheduling transactions on a transmission line already out or full and receiving payment for being rejected.
iii) Artificially creating congestion and getting paid for relieving it.
iv) Arbitrage between transmission pricing system by simultaneously scheduling a transaction from A to B and from B to A.
v) Arbitrage between location by buying in California day-ahead and selling outside California when prices outside California exceed the price cap of the day-ahead market.

3.6.4 Withholding capacity

The withholding of vital generation capacity in California's electricity market is said to have been one of the causes that led to and made California's energy crisis worse during the winter of 2000 and spring of 2001. During the final months of 2000 especially, strategic withholding of generation seems to have taken place. The unprecedented amount of power plant outages during the winter and spring of 2000-2001, at times 16,000 MW or nearly 35% of California's total generation capacity - roughly double the typical historical forced outage rates, strongly indicates the occurrence of strategic behavior. Evidence points towards privately owned out-of-state generators such as Enron and Reliant, and to some public entities. Furthermore, there is evidence of capacity withholding in California's natural gas market, which supplies more than 50% California's electricity industry.

3.6.5 Strategic bidding

California's market structure stimulated a shift in the amount of power that was traded in the day-ahead market to the more unpredictable and volatile real-time spot market. This strongly increased the volatility of the prices in the real-time market. As California's electricity shortages became more acute, the amount of energy traded in the day ahead market declined to the point that the California independent system operator was unable to procure enough electricity reserves in the real-time market to cover California's load. This forced the system operator to make out-of-market purchases at far higher prices, which further drove up electricity prices, resulting in vicious cycle.

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3.6.6 As early as 1998, the market surveillance committee of CAISO had identified the following problems:

- Some firms were subject to cost-based price caps, while other were allowed to earn market-based rates.
- Perverse incentives for generator-bidding behaviour had been created by reliability must run contracts.
- CAISO's dispatch practices had not been transparent.

3.6.7 After the crisis, the California power exchange went bankrupt and was closed. The Governor of California was recalled. The emphasis now is on resource adequacy and transmission investment. Long-term contracts are again in vogue. At present, the distribution utilities rely on long-term contracts to the extent of 95% of their needs and the remaining is met through real time bilateral trading organized by CAISO.

Chapter IV

Developing a common trading platform for India

4.1 Exploring alternatives

4.1.1 The major issues, which need to be addressed are:

- To provide an equitable and transparent trading platform.
- Energy contracts and transmission clearance to be handled simultaneously through a single window.
- To create standard firm contracts, preferably on day-ahead basis, aligned with the day-ahead scheduling process already in place.
- To address financial risk, hassles and costs so that more entities are encouraged to trade.
- To increase trading volumes so that more short term demand can be met at reasonable cost.

4.1.2 Power Exchange (PX) is a proven mechanism for efficient and transparent trading. Power Exchange can provide an alternative to bilateral trade with or without replacing it. After unbundling of the electricity sector, developing electricity market is a next logical step, which is also mandated by the Electricity Act and the National Electricity Policy. We will have to design our PX in a manner compliant with the Indian Electricity Grid Code while fulfilling the expectations of market participants.

4.1.3 In a Power Exchange, it is possible to allow both buyers and suppliers to participate in the bidding process in an equitable manner. The Power Exchange could be a counter party to all the deals in order to ensure payment security to all the participants. A well-designed and functioning Power Exchange providing payment security to participants has the potential to energize the power sector and put it into orbit of self-sustained growth. At the same time, it has to be kept in mind that Power Exchange is merely a facilitator for trading and therefore price discovery in a Power Exchange can not be anything other than the reflection of the ground realities. In a Power Exchange, the electricity prices are bound to reflect varying conditions of generation, transmission and consumption.

4.1.4 Markets for electricity generally require sufficient generation capacity. Therefore in India, where there are moderate off-peak surpluses and large peak shortages, we should move cautiously towards development of electricity market. In an overall deficit scenario like we have, one cannot think of wholesale change from regulated tariffs to market driven wholesale prices. Under the present circumstances, it is essential that no long-term contracts are re-opened or disturbed for the sake of market development. It is suggested that one should focus on improving the existing trade, and from there, try to carve out road map for future.

4.1.5 In the Indian context, it is important that buyers are allowed by the Power Exchange to bid according to their budget and price sensitivity. A buyer should get the quantity sought by him corresponding to his price bid. Real time power trading is not feasible at the national level but day ahead trading through Power Exchange should be feasible since day ahead trading through exclusive Open Access has already been successfully implemented. In a Power Exchange, energy contract and transmission path is managed in a composite manner. As far as buyers are concerned they should be more than willing to buy through a day-ahead exchange because it would make their life easy. However, on days of limited supply and high demand, the buyers would have to be satisfied with less amount of power. Aggressive bidding by the buyers to grab a bigger slice of the limited supply would naturally result in price rise. The suppliers should also find Power Exchange a convenient platform for trading providing better payment security. There are concerns that even in the PX the supplier would try to take advantage of the shortage situation, and may try to raise their price bids. In a Power Exchange with two side bidding, this will not raise the clearing price but reduce the dispatchable power and put pressure on the supplier to lower prices. However, the combined effect of both suppliers and buyers raising their bid prices would obviously be to raise the market-clearing price. Once the buyers start reducing their bid prices, the suppliers would have no option but to reduce their bids otherwise they will not get dispatched. In this manner, market corrections would set in.

4.2 Appropriate alternative for India

4.2.1 In a PX, price is determined by anonymous bidding so as to match demand and supply of electricity. However, several variations in this process are possible. Some of the issues, which need to be decided before setting up the PX, are listed below:

(i) National power exchange Vs many power exchanges
(ii) Mandatory Vs Voluntary participation
(iii) Double side bidding Vs supply side bidding
(iv) Uniform pricing Vs Discriminatory pricing
(v) Day-ahead exchange Vs same day exchange
(vi) Time block for bidding (hourly/half-hourly etc.)
(vii) Congestion management
(viii) Taking care of operational inflexibilities of generating stations

4.2.2 National power exchange Vs many power exchanges

At present, the country is dived into 5 Regions each being served by a regional grid and a Regional Load Dispatch Centre (RLDC). One of the options could be to have regional power exchanges in close coordination with the concerned RLDC. However, to ensure simultaneous clearance of supply and transmission, the power exchange (s) will have to have a close coordination with NLDC/RLDCs. It will be very difficult for NLDC/RLDCs to interact with more than one exchange. Another factor, which needs to be considered, is that with the limited surplus tradable capacity, operating more than one exchange may create serious liquidity problem. In view of the above consideration, the idea of having many power exchanges does not seem to be sound at present.

4.2.3. **Mandatory Vs Voluntary participation**

As already mentioned in Section 4.1.4, market development should not result in opening of long-term contracts. Therefore, at the most, the gap in estimated demand and availability though long-term contracts, can be met through PX. If participation in PX is mandatory, all the trading transactions (other than long-term) will necessarily have to be through PX. On the other hand, in case of voluntary participation, a buyer or supplier may carry out bilateral trading with or without some trading through PX. PX like Nord Pool started in the form of voluntary PX but later it was mandated that all international transactions will have to be through PX. Advantage of Voluntary PX is that impact of price fluctuations, which are not so uncommon in trading through PX will, at least to some extent, be cushioned by negotiated bilateral trading taking place simultaneously. Further, prices of negotiated bilateral trading will act as check on prices discovered in PX and vice versa. On the other hand, when supplies to PX are expected to be limited, which is the case in our country, mandatory participation may help in improving liquidity and reduce price fluctuations. Also, if it is mandated that inter-regional trading will have to be through PX, the complications of assigning transmission capacity to PX (please refer 5.2) could be avoided. It is suggested that participation in the PX could be voluntary, at least to begin with, and mandatory participation could be thought of when some experience of its operation is available.

4.2.4 **Double side bidding Vs only Supply side bidding**

4.2.4.1 In Supply side bidding, only suppliers submit their offer to supply various quantities of electricity with corresponding prices. This type of design is usually adopted where centralized dispatch is in vogue. The demand is assessed by forecasting and it is price insensitive. One variant could be that buyers may be asked to submit their demand bids with price cap. Offers of all suppliers are aggregated to arrive at the

Aggregate Supply curve (AS), which is a typically upward sloping curve (which means that suppliers are generally willing to supply higher quantities at higher prices). The Aggregate Demand curve (AD) is a step-like function with various steps appearing at the price caps indicated by individual buyers. Fig 4.1 depicts price determination in case of supply side bidding without price cap while fig 4.2 depicts price determination in case of supply side bidding with price cap specified by individual buyers.

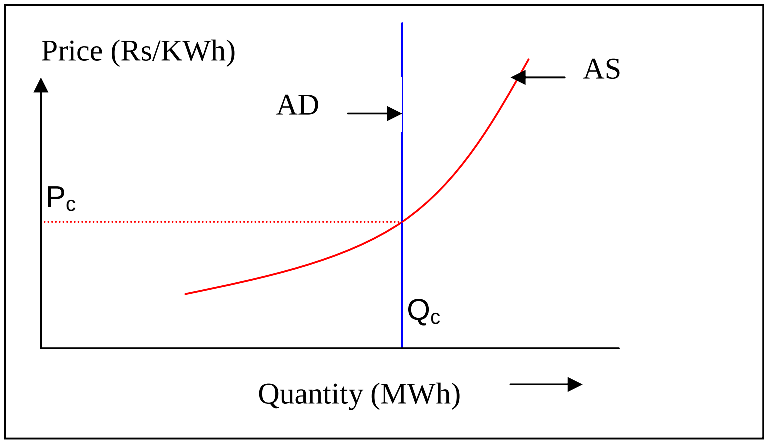


Fig 4.1: Price determination in case of Supply side bidding without price cap by buyers

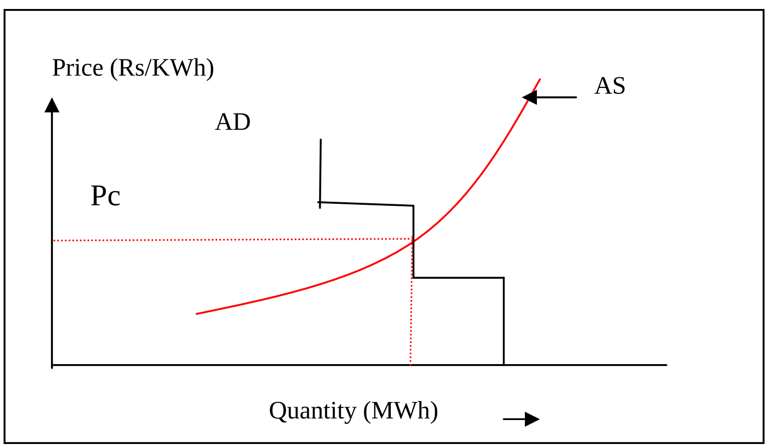


Fig 4.2: Price determination in case of Supply side bidding with price cap specified by individual buyers

On the other hand, in case of Double side bidding, buyers also submit their demand at various prices. This means that in double side bidding, buyer's demand is sensitive to prices. Double side bidding is more suited for markets where decentralized dispatch is in vogue.

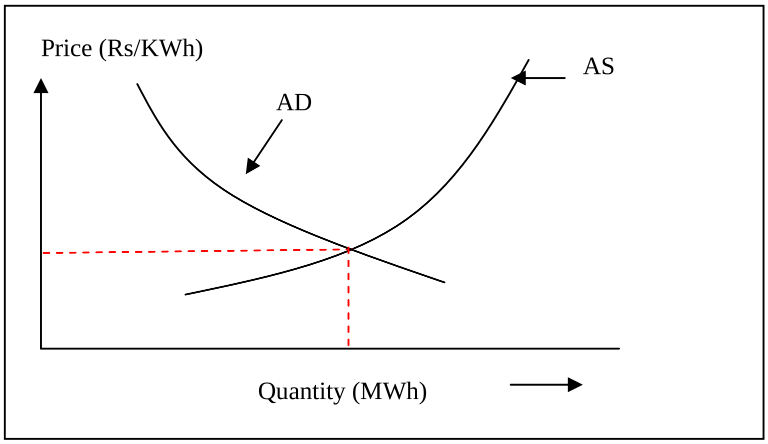


Fig 4.3: Price determination in case of double side bidding

4.2.4.2 Following points need consideration on the issue of Supply side *vis-à-vis* Double side bidding for the PX in India-

- Meeting demand irrespective of the prices may not suit distribution licensees in India, due to poor financial condition of most of the distribution licensees. In any case, load shedding due to shortage of power is not uncommon. Therefore, submitting demand with reference to price appears to be the right choice for PX in India.
- Generally SERCs, while determining Annual Revenue Requirement for distribution licensee, specify the amount for purchase of power. Such budget based purchasing can be easily translated into Double side bidding wherein a distribution licensee may express willingness to purchase higher quantum of electricity at lower price but lower quantum of electricity at higher prices.

- In Supply side bidding, to a large extent, price determination depends upon on price-quantity offers submitted by suppliers. Therefore, Supply side bidding may be more susceptible to market manipulation. In contrast, in Double side bidding, both suppliers as well as buyers have equal say in determination of prices. Therefore, possibility of market manipulation is reduced to a great extent.
- In India, scheduling and dispatch is being done on decentralized basis and therefore, Double side bidding can be readily adopted.
- If Double side bidding is to be adopted, distribution licensees will have to gear up to the task of submitting price sensitive bids for each bidding time block. The person or group of persons who will be assigned the task of submitting the bids must have clear guidelines and full authority to submit their bids.

Overall, it appears that Double side bidding may be a better option for PX in India.

4.2.5 **Uniform pricing *Vs* discriminatory pricing**

4.2.5.1 Most of the power exchanges across the world work on the principle of uniform pricing. In this method, the clearing price and clearing volume of electricity corresponds to the point of intersection of the Aggregate Demand curve and Aggregate Supply curve. All the suppliers are paid based on the clearing price, irrespective of their offer. This means that price is set by the last accepted offer of supply. In the alternative approach, referred as discriminatory pricing or "pay-as-bid" method, each supplier is paid as per its bid. Each buyer pays a price, which is the weighted average of the price for all suppliers cleared by the PX.

4.2.5.2 At first glance, discriminatory pricing appears attractive as it gives the impression that prices for buyers will be lower in this option. However, a more careful analysis reveals that this may not be the case, as the philosophy of submitting offers by the suppliers may be entirely different in the two alternatives. In uniform pricing, suppliers are likely to submit their offers based on marginal cost. This is so because most of the suppliers are aware that the clearing price will be higher than the offer submitted by them and the difference between clearing price and offer price will set off their fixed charges. On the other hand, in case of discriminatory pricing, the suppliers are likely to submit bids based on the average cost, covering fixed expenses as well. It is more likely that in case of "pay-as-bid" pricing, each supplier quotes prices which are not based on its own costs but based on anticipated clearing price of marginal supplier. It is also argued that market manipulation by collusion is more likely in case of uniform pricing. However, critics of "pay-as-bid" pricing, point out that even if market manipulation takes place, it would be hard to monitor and detect in case of "pay-as-bid" pricing because suppliers will not quote consistently around a price (which will be marginal cost) but will quote higher than marginal price to a varying extent depending on their anticipation about clearing price. Though not much practical experience is available on discriminatory pricing so as to compare with uniform pricing, theoretical work done in this regard suggests that discriminatory pricing may lead to higher price level but less volatility as compared to uniform pricing.

4.2.5.3 Overall, it appears that in view of the limited practical experience worldwide on "pay-as-bid" pricing, there is no evidence to suggest that perceived advantages of this method will turn into reality. Therefore, uniform pricing appears to be a better option.

4.2.6 **Day-ahead exchange *Vs* same-day exchange**

Various options are possible on the issue of timing and periodicity of clearing the market. In day-ahead exchange, bids for the next day are submitted by the specified time of the previous day and prices / volumes are determined for each time block of the next day. In the same-day exchange, bids are submitted each hour for clearing the market in the next hour. Typically, a market can have either a day-ahead exchange alone or a day-ahead exchange with hour-ahead exchange for real time balancing. In some markets the system operator uses the bids submitted in day ahead market for re-dispatching in real time. In India, presently, real time balancing is being managed through UI mechanism. Therefore, for the present, PX may operate on day-ahead basis only.

4.2.7 **Time blocks for bidding**

It is possible to have several variations in the bidding time blocks (i.e. the smallest period for which price - quantity bids are to be submitted) in case of day ahead market. The period could be whole day, peak / off peak period, blocks of few hours, one hour, half hour etc. The smaller the time block, the better it will suit to take care of varying estimated demand. However, a smaller time block also means increased complexity for buyers and suppliers while submitting the bids as well as large volume of data to be handled by the PX. It is also pertinent to note that small time block of say 15 minute or half-hour will not serve the purpose unless sophisticated demand estimation techniques leading to very accurate demand forecast are in vogue. Considering all the aspects mentioned above, it appears that bidding time block of one-hour may be the optimum choice for PX in India.

4.2.8 **Congestion management**

4.2.8.1 Some of the common methods used for handling congestion in electricity market are:

- Re-dispatch
- Coordinated auction of generation and transmission capacity
- Nodal pricing or locational marginal pricing
- Market splitting

4.2.8.2 In case of re-dispatch, the system operator, issues suitable dispatch instruction to costlier suppliers located in the area downstream of the congested corridor, to meet demand in this area. In India, where major supply for the exchange is expected to come from Eastern and North-Eastern Region, unmet demand in other regions due to congestion in inter-regional transmission corridors is unlikely to be met because supply in other region may not be available even at higher prices. Further, distribution licensees may prefer load shedding to buying high cost electricity in view of the financial constraints. Therefore, re-dispatch does not appear to be the right choice for India. In case of coordinated auctions, every day transmission capacities of the congested corridors are auctioned first. The participants of the Power Exchange then take part in auction for supply of energy with transmission rights in hand. These transmission rights are available on "use-or-lose" basis. Thus, if transmission right holder gets supply less than what is commensurate with transmission right, the unused transmission capacity is made available to other participants. Coordinated auction introduces some element of uncertainty and therefore may not be favoured.

4.2.8.3 In contrast to the methods, discussed above, nodal pricing and market splitting methods are based on bundling of transmission service with electricity product. In case of market splitting, the market is divided into two or more sub markets with congested links acting as boundary. Clearing price for each sub market is determined separately based on the Aggregate Demand and Aggregate Supply curves of each sub market taking into account limitations of flow over the congested corridor. In case of nodal pricing, each node of the power system has separate price depending on cost of energy, cost of transmission including cost attributable to congestion and appropriate transmission losses. Thus, it is a limiting case of market splitting where each node in itself becomes a separate sub-market. Nodal pricing was introduced in PJM system in 1998 and is still operational. It is generally recognized that Nodal-pricing method is more efficient compared to other methods of handling congestion. However, it is difficult to comprehend and also complex to implement. It is noted that presently there is seldom any congestion inside the regional grids in India. The congestion is mostly observed in the interregional links. Therefore, for the present, complexity of nodal pricing may be avoided without losing much on economic efficiency by implementing Market splitting method. In the succeeding paragraphs, we are describing, with the help on an example, the classical market splitting model. We have also suggested a variant of this model to be considered for adoption for the PX for India.

4.2.8.4 Congestion management by market splitting can be explained with the help of an hypothetical example involving three regions. A, B and C are buyers whereas G1 and G2 are suppliers. A,B and G2 are located in region 1, whereas G1 and C are located in Region 2 and Region 3 respectively . The geographical location of buyers and suppliers is shown in Fig 4.4.

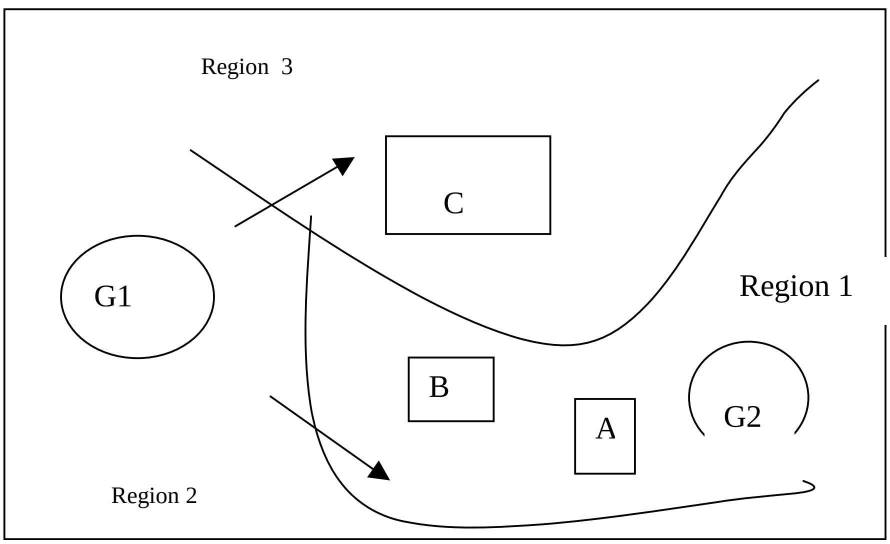


Fig 4.4: Geographical location of buyers and suppliers in the example

4.2.8.5 The demand curves for buyers A, B and C as well as supply curves for G1 and G2 can be drawn based on the price bid (Rs /KWh) submitted by them against the quantity of demand/supply (MWh). AD and AS are Aggregate Demand curve and Aggregate Supply curve, respectively.

Price (Rs)	Demand (MWh)			Supply (MWh)	
	A	B	C	G1	G2
1.4	200	230	220	0	0
1.6	200	230	220	0	0
1.8	200	230	220	200	0
2.0	175	192	220	213	0
2.2	156	153	183	227	200
2.4	141	115	147	240	218
2.6	129	77	110	253	237
2.8	119	38	73	267	255
3.0	111	0	37	280	273
3.2	103	0	0	280	292
3.4	0	0	0	280	310
3.6	0	0	0	280	310
3.8	0	0	0	280	310

Table 4.1: Price bids and supply offers submitted by buyers and suppliers

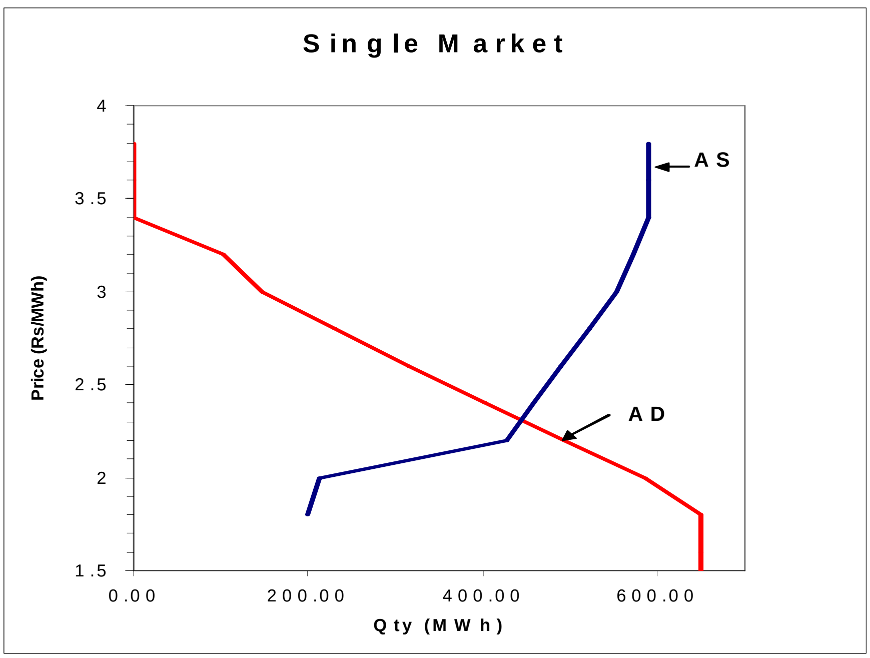


Fig 4.5: Market clearing in single market without considering congestion

4.2.8.6 It may be seen that Aggregate Demand curve and Aggregate Supply curve cross each other at a price of Rs. 2.33, which becomes the clearing price. At this price A, B and C will receive 148, 128 and 160 MWh respectively whereas G1 and G2 will be required to supply 235 and 201 MWh respectively. The aggregate demand of A and B located in region 1 is 276 MWh. Out of this, 201 MWh will be met by supplier G2 located in this region itself. The balance aggregate demand of A and B i.e 75 MWh will be met by supplier G1. Thus, resultant power flow on the inter connector between region 1 and 2 will be 75 MWh and that between region 2 and 3 will be 160 MWh.

4.2.8.7 Now let us consider the case when the available transmission capacity on the inter connector between region 1 and 2 is only 50 MW. Therefore, the market will have to be split into two sub-markets. The sub-market 1 will be unaffected by congestion consisting Region 2 and Region 3. The sub-market 2, consisting region 1 will be affected by congestion. The demand and supply curves only for sub-market 1 are drawn in Fig 4.6. The Aggregate Demand Curve for sub-market 1 is obtained by adding 50 MW of demand from sub-market 2. It may be seen that clearing price in sub-market 1, located upstream of the congested corridor is Rs 2.225 per KWh.

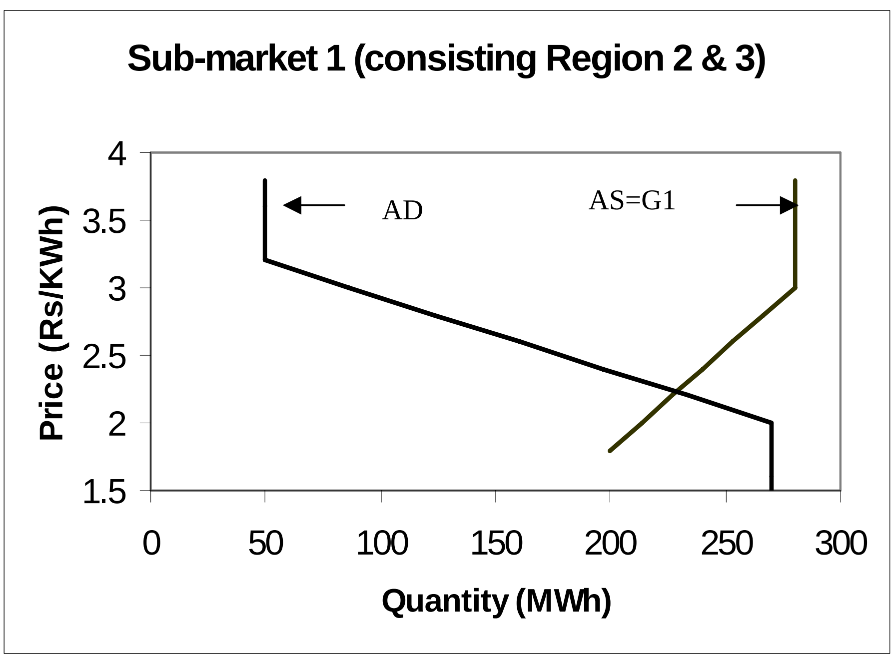


Fig 4.6: Market equilibrium in sub-market upstream-congested corridor

4.2.8.8 Similarly, AD and AS curve for sub-market 2 located downstream of congested corridor are drawn in Fig 4.7.

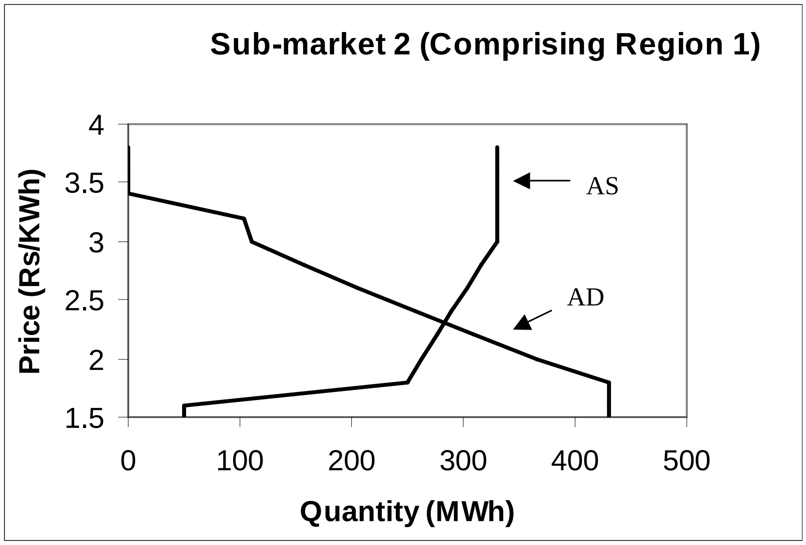


Fig 4.7: Market equilibrium in sub-market downstream congested corridor

4.2.8.9 It may be seen that price in sub-market 2 located downstream of the congested corridor is 2.368 Rs/KWh. At this price, demand of A and B is 145 and 121 MW respectively. Aggregate Demand at the clearing price is 266 MW. Out of this demand, supplier G2 located in this sub-market is able to supply 216 MW and balance 50 MW is supplied from sub-market 1.

4.2.8.10 It may also be noted that clearing price downstream of the congested corridor is higher than the clearing price of the single market if there is no limitation of transmission capacity. On the other hand, clearing price of sub-market located upstream of the congested corridor is lower than clearing price of single market if there is no limitation on transmission capacity.

4.2.8.11 In the classical market splitting, buyers of the sub-market located downstream of the congested corridor pay clearing price of this sub-market. However, the PX pays to suppliers located in this sub-market the clearing price for this sub-market, but suppliers located in other sub-market(s) are paid the clearing price of that sub-market.

In our example,

- Payments received by PX from buyers located in sub-market-2
  = Clearing price of sub-mkt 2 x quantity cleared in sub-mkt 2
  = 2.368x266x1000
  = Rs 6,29,888 /-

- Payment made by PX for supply in sub-market 2
  = Payment made to supplier G1 for supply of 50MWh +payment made to supplier G2 for 216 MWh
  = (50x2.225x1000 + 216x2.368x1000)
  = Rs 6,22,738 /-

- Surplus available with PX due to congestion
  = Rs 6,29,888 - Rs 6,22,738 /-
  = Rs 7,150 /-

4.2.8.12 In the Nordic and other European Power exchanges, this surplus is handed over to the Transmission System Operator, who uses this amount to meet the demand of buyers located in the sub-market downstream of the congested corridor by re-despatching, and the balance amount, if any, is used for augmentation of transmission capacity. It is argued that this system not only gives locational commercial signals to generators and loads but also gives commercial signals for augmentation of transmission capacity.

4.2.8.13 As already discussed, in India, the option of re-despatching is not feasible. Therefore, elaborate guidelines for utlisation of surplus for building additional transmission capacity will have to be prescribed. In order to obviate the problem of handling the surplus amount collected in the market splitting method, an alternative method is suggested. Collection of congestion surplus can be avoided if buyers located in sub-market 2, instead of paying clearing price for this sub-market, pay the weighted average price of the suppliers.

In our example, buyers located in sub-market 2 have received 216 MWh from supplier G2 whose price is 2.368 Rs/KWh and 50 MWh from sub-market 1 where clearing price is 2.225 Rs/KWh.

- Therefore, price for buyers located in sub-market 2,
  = (216 x 2.368 + 50 x 2.225)/(216+50)
  = 2.341 Rs/KWh

4.2.8.14 With application of the price calculated above, the payments made by buyers in sub-market 2 will be equal to payment to be made to supplier supplying power in this sub-market. Thus, no surplus will get collected with the PX. In the alternative of "pay at the cost of supply" for pricing in the congested sub-market as suggested above, suppliers will get a price which is the same as in classical market splitting, therefore suppliers will continue to get locational signals of same intensity. The buyers affected by congestion will pay a price (Rs 2.341/KWh), which will be less than the price payable in classical market splitting (2.368/KWh). But this price will still be higher than the price payable by buyers in the sub-market upstream of the congestion (Rs 2.225/KWh), as well as the price in a single market without limitation on transmission capacity (Rs 2.33/KWh). Therefore, buyers also continue to get locational signal though intensity of the signal is somewhat lower than in classical market splitting model. This leaves only commercial signals for setting up of transmission facility to relieve congestion. The Electricity Act, 2003 as well as draft policy on competitive bidding for investment in transmission, envisages investment in transmission through planning process. The operational experience available with RLDCs as also with beneficiaries will act as input for planning the transmission systems, which are required on priority basis. In the Indian scenario, market signals for setting up of transmission facilities may not be necessary. Therefore, the alternative suggested to the classical market splitting will result in avoidance of difficulties associated with congestion surplus without greatly sacrificing the perceived advantages of the classical market splitting model with congestion surplus. The market splitting model of managing transmission congestion is depicted schematically in Fig 4.8.

4.2.8.15 The advantages of the "Pay at the cost of supply" congestion management philosophy proposed above are as follows:

- ✓ Simple and practical
- ✓ The price to be paid by buyers located downstream of congested corridor gets moderated
- ✓ More flexibility to the system operator for optimization
- ✓ No windfall gain in the form of 'congestion rent' to the transmission owner or transmission right owners

4.2.8.16 However, there is a flip side of the "pay at the cost of supply" alternative suggested above. The buyers in the sub-market downstream of congested corridors will be charged below their quoted price for the corresponding quantity. If the pattern becomes predictable, the buyers in the constrained market would be tempted to quote higher price corresponding to quantity in order to grab the limited supply, knowing well that they would not have to pay the price they are actually quoting.

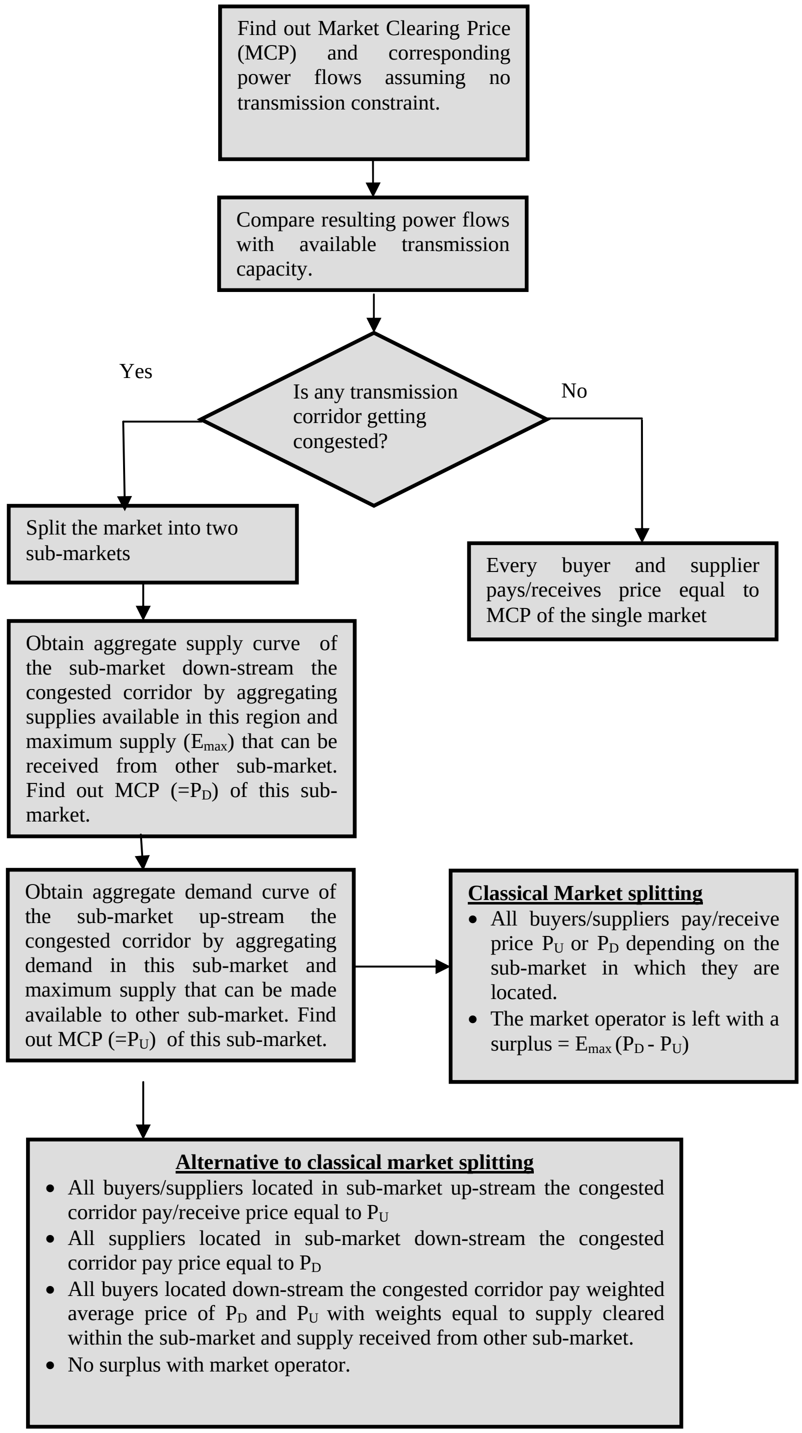


Fig 4.8: Summary of market splitting method for congestion management

4.2.9 Taking care of operational inflexibilities of generating stations

4.2.9.1 The process of obtaining market solution is not as simple as plotting the aggregate demand and supply curves and finding the cross over point. One of the complications is transmission congestion, which has already been enumerated in the preceding section. Another complication is operational inflexibilities such as start-up and minimum load, typically associated with thermal generating stations. Such generating stations require relatively more time and costs for start-ups. Also, their operating costs go up below a certain threshold loading. A look at the various functioning power exchanges indicates that these operational inflexibilities are handled in different ways.

4.2.9.2 In European Power Exchanges, these inflexibilities are handled through *block bids*. In a block bid, a supplier defines a block of consecutive hours and specifies limits of volume and price during this block. Initial market solution is obtained for all the 24 hours of the day and thereafter, additional conditions imposed by block bids are checked. A block bid is accepted if during the defined hours, the volume cleared for that supplier is equal to or more than the specified volume, and the average clearing price during the block is equal to or more than the specified price. In case of rejection of block bid, market solution is again worked out by excluding the block bid.

4.2.9.3 In US markets such as PJM and NYISO, the suppliers submit multi-part bids, where in addition to quantity-price bids, suppliers also quote start-up costs and minimum load costs. Instead of optimization in each hour of the day, the optimization is carried out over a day taking into account the cost of inflexibilities as well.

4.2.9.4 There is no doubt that multi-part bidding would lead to true optimization as compared to block bidding, which would yield sub-optimum solution. However, the algorithm for multi-part bidding may be very complex. Further, this method attempts unit-wise scheduling, which is possible only in case of centralized dispatching. Therefore, it appears that in India, block bidding may be the appropriate way to take care of operational inflexibilities.

4.2.9.5 In the internal power pool of South Africa, the problem of inflexibility of coal based power stations was overcome by dividing the twelve coal based power stations into four clusters for the purpose of bidding. By grouping a large number of units into one bidding cluster and informing the day-ahead demand forecast to the generators in advance, it became possible to obtain a variable supply side response.

4.3 Summary of proposed trading platform

Based on the discussion in the preceding paragraphs, a single national power exchange dispensing tradable power through day ahead bidding (in one hour time blocks) would be appropriate for India. It is proposed that price discovery will be through double side bidding and buyers & suppliers shall pay/receive uniform price, which will be the price of the marginal supply. It is also proposed that PX will manage congestion by market splitting. However, unlike market splitting practiced in European markets, it is proposed that buyers located downstream of the congested corridor will pay the weighted average price of the clearing price in this sub-market and the clearing price of the sub-market upstream of the congested corridor. It would be appropriate to handle operational inflexibilities of generating stations in the form of block bids. It is also proposed that to begin with, participation in the PX will be on voluntary basis.

4.4 Additional remarks

In the Indian context, futures markets need not be encouraged/facilitated, since they are inherently speculative in nature. Forward markets comprise of long-term PPAs and short-term bilateral, and these would not be routed through PX. The Balancing market is adequately, and fully taken care of by the established UI mechanism, and PX shall have no role in it. Contracts for differences are not relevant/applicable in our case. The purpose of options would be served by resorting to spot sale/purchase or UI. Thus, the only type of market left to be catered by a PX would be spot market, which in our case may include day-ahead and days-ahead.

Chapter -V

Transmission and system operation issues

5.1 Introduction

Electricity as a product is closely inter-linked to the transmission service required to transport this product. While content and carrier can be separated for the purpose of pricing, they are inseparable in so far as actual operation is concerned. There are three issues relating to transmission, which will have important bearing on functioning of PX. These issues are-

(i) Assignment of transmission capacity for PX

(ii) Treatment of transmission charges

(iii) Treatment of transmission losses

5.2 Assignment of transmission capacity for PX

5.2.1 The issue of assignment of transmission capacity will be relevant in case of voluntary PX, wherein transaction through PX would be competing with other bilateral transactions for using available transmission capacities. For the effective functioning of PX, it is essential that sufficient transmission capacity is available at the disposal of the PX. If PX is not able to clear the desired quantum of electricity due to congestion (lack of transmission capacity) too frequently, buyers located in the area downstream of the congested transmission corridor may remain discontented.

5.2.2 Presently, transmission customers are classified into two categories; Long-term and Short-term. Long-term customers are those who have signed 25 years agreement with transmission licensee. At the time of implementing open access regulations, pre-existing users of ISTS i.e. SEBs and their successor entities have been conferred the status of deemed long-term customers. On the other hand, short-term customers are given reservation of transmission capacity for a maximum duration of 3 months after which they have to re-apply, if they want to continue using the transmission system.

5.2.3 It is clear that PX in itself will be a separate category of transmission customers. This is because, unlike bilateral transactions, the transmission path from source to sink cannot be identified in case of transaction through PX. There are multiple suppliers and multiple buyers, not dealing with each other but only dealing with PX. Based the location of the members of PX (pure suppliers, pure buyers as well members who at occasions may be acting as suppliers and at other occasions as buyers), it may be possible to estimate the requirement of transmission capacity over various inter-regional links. Unlike inter-regional corridors, which are point-to-point carriers, regional transmission systems are meshed carrier systems. Present operational experience indicates that there is seldom any congestion in the regional transmission system, therefore, it may not be necessary to pre-identify transmission capacity for PX in the regional transmission system. However, transmission capacities on inter-regional corridors will have to be assigned to PX.

5.2.4 Usage of pre-assigned transmission capacity by PX on inter-regional corridors shall be akin to long-term usage, because PX cannot operate on uncertainty of transmission capacity after every three months, which is associated with short-term customers. However, on day-to-day basis, sub-optimal use of one or more inter-regional corridors cannot be ruled out. One solution to avoid such sub-optimal use could be to limit bilateral transactions (except allocation from Central Generating Stations across the region) to within the region only, and make it mandatory to have all inter-regional trading through PX. However, such a move may not be popular because bilateral transactions have their utility, and therefore buyers and suppliers may like to have portfolio of bilateral transactions as well as PX based transactions. As such, it may be necessary to fine-tune the quantum of the transmission capacities allocated to PX on inter-regional corridors, based on power flows through

PX vis-à-vis power flows resulting from bilateral transactions. The process of assigning transmission capacity on the each day may work as under-

- Generally, a pre-identified transmission capacity shall be assigned to PX for each inter-regional corridor.
- RLDCs, while allowing advance reservation as well reservation on first-cum-first-served basis, shall keep aside the capacity assigned to the PX.
- On each day, PX shall first find out unconstrained solution to the market clearing and convey it to RLDCs.
- If resulting flows are within the pre-assigned transmission capacities, the balance transmission capacities will be made available for bilateral transactions on day-ahead or same-day basis. On the other hand, if there is congestion on any corridor taking into account pre-assigned transmission capacity to PX and if spare transmission capacity is available on that corridor, the balance transmission capacity shall also be made available to PX so as to relieve congestion to the extent possible.

5.3 **Treatment of transmission charges**

5.3.1 In case of transactions through PX, it is not possible to identify buyers who received supply from a particular supplier and vice versa. Therefore, transmission charges will have to be billed to the PX based on transmission capacity used for flows arriving from the clearing solution of the exchange.

5.3.2 As already mentioned, PX will be a separate category of transmission customer. Transmission Charges would have to be applied to PX on Rs/MW/Hour basis. It is to be noted that transmission charges have to be levied based on implemented scheduled flows and not pre-assigned transmission capacities. This is because, as proposed in the earlier section, scheduled flows attributable to exchange may be less than or more than pre-assigned transmission capacity.

5.3.3 Presently, transmission charges are being applied on postage stamp basis. However, even if the methodology for sharing of transmission charges is made distance and/or direction sensitive as envisaged in the Tariff Policy issued by GOI, the charges for PX may continue to be calculated for the exchange as a whole.

5.3.4 PX would socialize total transmission charges among its members. Total transmission charges for the day as billed to the PX, may be allocated either to buyers only, or to buyers and suppliers in a fixed ratio. Further allocation to individual buyers (or suppliers) may be done in the ratio of respective energy (MWh) for that day.

5.4 **Treatment of transmission losses**

In most of the electricity markets, the transmission System Operator compensates transmission losses by purchasing equivalent amount of energy. The cost of meeting the losses is distributed among market participants. What it effectively means is, that in the price-demand pairs submitted by the buyers, the demand corresponds to the point of drawal. However, in India, traditionally, transmission losses are adjusted in kind and Transmission System Operator is not burdened with the responsibility of meeting the transmission losses. Therefore, in the price-demand pairs submitted by the buyers, the demand would correspond to purchase points of exchange. Thus, the buyers would actually get schedule for the energy, which would be less than the demand submitted by them to the extent of the estimated transmission losses. As is being done presently, RLDCs may apply average losses for each inter/intra regional segment of the transmission system and work out the schedules accordingly. However, in future even if incremental losses are to be applied, there should be no difficulty and schedules may be adjusted based on incremental losses.

5.5 System operation issues

5.5.1 It is clear form the preceding write-up that PX will have to work in close coordination with NLDC and RLDCs.

5.5.2 NLDC shall propose a time line and guidelines to be followed by the Power Exchange, subject to approval of the CERC. Since final PX schedules shall be decided by the RLDCs considering real time transmission constraints, it will be necessary for RLDCs to furnish finally implemented schedules to the Power Exchange.

5.6 Suggested time line for PX

Time	**Activity**
11.00 -	PX opens for day-ahead bidding
12.00 -	NLDC informs the PX about the available inter-regional transmission capacities (transmission capacities assigned to PX plus spare capacity if any)
13.00 -	PX closes for bid submission
15.00 -	PX selects suppliers, buyers, sets prices and quantities taking into account available inter-regional transmission capacities and communicates this to NLDC for concurrence
16.00 -	NLDC gives go head to PX or conveys transmission constraint if any, in the intra-regional system.
16.30-	PX conveys revised suppliers, buyers and corresponding sets of quantities to NDDC.
17.00 -	RLDCs issue day ahead - • Generation schedule for CGS • Drawal Schedule for beneficiaries of CGS • Bi-lateral Schedule • PX trades
17.00 -	PX issues Buy and Sell trade schedules to participants indicating prices and quantities.

Chapter- VI

Important aspects of market design

6.1 Price mitigation measures

6.1.1 If one can ensure perfect competition in the market, the prices coming out of the bidding process will be true reflection of the value of the electricity as a product. Under such ideal conditions, there will be no need to monitor the markets or to put in place any mechanism to mitigate market abuse. Unfortunately, no market is perfect. One can only strive for workable competition in the electricity market provided there are sufficiently large number of suppliers and buyers and there are minimum entry barriers. However, there are some inherent characteristics of the electricity market, which come in the way of reaching towards goal of workable competition. One such major factor is transmission congestion, which can result in pockets with limited suppliers. Wholesale electricity markets with limited number of suppliers and buyers, who have to interact regularly at the trading platform, have an incentive to "game" i.e. to behave opportunistically in an attempt to increase their individual gains from the trade. Gaming can be by one dominant player alone or by many players through implicit collusion. The biggest factor, which determines the degree to which a particular electricity market is susceptible to manipulation, is the elasticity of demand. If the demand is completely inelastic (demand curve is in the form of a vertical line) i.e. if all the buyers are price takers, the clearing price and quantity shall be solely determined by supply curve. Under this situation, opportunistic behavior of one or more suppliers will lead to high clearing price without affecting quantity. However, the more elastic the demand, the less will be the ability of the suppliers to manipulate prices to increase their trade gains. In developed countries, distribution companies are generally obliged to supply power to its consumers irrespective of the price at which it is required to purchase the power. However, as mentioned elsewhere is this paper, load shedding is not uncommon in India especially in the background of shortage of electricity. This leads us to the conclusion that distribution licensees may limit their purchase based on the availability of finances and demand may be curtailed. Thus, buyers in the PX would most likely present a demand which will be reasonably elastic, thereby limiting the market abuse by suppliers to push up the prices.

6.1.2 In spite of the demand elasticity, there might be a need to put in place a mechanism to check market abuse. Generally, two ways can be thought of for mitigating market abuse in wholesale electricity market:

- Uniform price cap
- Bid caps

Uniform price cap has traditionally been suggested as a method of mitigating the effect of market abuse. However, uniform price cap is often criticized for distorting market signal. Moreover**,** uniform price cap will have to be set at sufficiently higher level and may result in consistently higher prices due to opportunistic behaviour of one or more suppliers. On the other hand, bid caps put a ceiling on the maximum price that a supplier can quote. It is logical to set bid caps based on slightly liberal estimate of marginal costs associated with the technology used for generation. In case of a competitive market, it is the competition which forces suppliers to submit bids based on marginal costs. In the absence of perfect competition, suppliers can be forced to submit bids close to their marginal costs by way of bid caps. The advantage of bid caps is that the clearing price during periods of low demand may get settled at prices lower than during peak demand periods depending on the last supplier to be dispatched in that period. The price signal for setting up peaking plants will not get lost as in case of uniform price cap.

6.1.3 There is no doubt that deciding bid caps for various classes of suppliers is no mean task particularly for hydro generators. In case of coal based generators- pithead or load centre based, there may not be any opportunity cost (cost of foregone alternative). It is noted that for Central Generating Stations, variable (energy) charge varies from 56 paise/KWh for Korba STPS to 123 paise/KWh for Farakka STPS. Some of the State generating stations may be even less efficient than this and therefore, a bid cap of Rs 1.5 per KWh may be suitable for coal based pit-head stations. On the same line, it is noted that variable charge for load centre based CGS varies from 114 paise/KWh for Unchahar STPS to 168 paise/KWh for Dadri NCPP. Accordingly, a bid cap of Rs 2.0 per KWh may be appropriate for load centre coal based generating stations. The maximum variable charge for gas based combined cycle (CCGT) CGS is 141 paise/KWh and therefore bid cap of Rs 1.75 per KWh may be appropriate for this class of generator. In the same manner, bid cap of Rs 2.5 per KWh and Rs. 6.0 per KWh may be appropriate for open cycle gas based stations and Naphtha based (liquid fuel) CCGT generation respectively. In case of captive generation and co-generation, which are generally of much smaller capacities and are relatively less efficient, a bid cap of Rs 3.5 per KWh is suggested. In case of run-of-the-river hydro stations and renewable plants, the marginal cost of generation is almost zero and there is no opportunity cost involved; so, even if a bid cap of say Rs 1.0 per KWh is set for such generating stations, it is unlikely to affect the clearing price because such generators will hardly, if ever, set the clearing price. However, in case of hydro generation with pondage and hydro generation with storage dam, there is an issue of opportunity cost. In case of hydro stations with pondage, it may be possible to manoeuver to a small extent the time of water release and thus, such generator would like to generate when clearing price is maximum. Incidentally, PX also will be looking to use generation from hydro stations with pondage during peaking time so as to lower the clearing price. Therefore, in case of such hydro generating stations, it may be sufficient to specify bid cap equal to pit head coal based station. Ultimately, it may be left to the PX to optimally utilize the energy content for the day as declared by the generator. This would automatically ensure maximum revenue for such hydro stations. In case of hydro stations with dam, theoretically, it may be possible to maneuver release of water over a longer period of few days or even months. However, in actual practice, most such projects are multi-purpose projects with almost definite requirement imposed on release of water each day depending on the season. Therefore, such stations may also be handled in the same manner as hydro stations with pondage. For pumped storage hydro stations, the marginal cost will depend on the price of electricity used for pumping the water. From this consideration, the bid cap may have to be set around Rs 3.5 – 4.0 per kWh. In this case also, realization of opportunity cost to the generator may be ensured for utilizing its generation at appropriate time. In case of distribution licensees, who, in surplus conditions have the option to supply to PX, bid caps may be fixed based on weighted average of marginal costs of sources constituting top 5% (say) of its purchases. This price may not exceed Rs 3.0 -3.5 per kWh although the value will be different for different distribution licensees. We may apply uniform bid cap on SEB/Discom surplus power so that they do not feel discriminated against one another. The bid caps suggested below are indicative and could be reviewed, if it is agreeable to apply the same:

	Type of supplier	Suggested bid cap (Rs/kWh)
1.	Hydro (run-of-the-river) and renewables	1.00
2.	Hydro (storage)	1.50
3.	Coal based (pit head)	1.50
4.	CCGT (gas)	1.75
5.	Coal based (load centre)	2.00
6.	Open cycle gas	2.50
7.	Hydro (Pumped Storage)	3.50-4.00
8.	Captive/cogeneration	3.50
9.	CCGT (liquid fuel)	6.00
10.	SEB/Discom	3.00-3.50

It may however be kept in view that any form of price intervention tends to blur the market signals for attracting investment and better demand side management. Therefore, pros and cons of applying bid caps would have to be carefully evaluated. Further, the suppliers will always be interested in alternate ways of trading where either there are no price caps or price caps are higher. Therefore, if concept of bid caps is accepted for implementation in the PX, similar caps may have to applied in case of bilateral trading also.

6.2 Settlement and clearance mechanism

6.2.1 Assured and timely payouts would be a vital function of Power Exchange in the Indian context. The Power Exchange would have to establish a credible and viable settlement and clearance mechanism in order to achieve this objective. The power exchange would be counter party to all the trades. The power exchange would have to depend on payment from buyers to meet its payment obligation to the suppliers. The resultant payment exposure would have to be managed through a properly designed financial mechanism. A suggested conceptual design of such a mechanism is given below.

6.2.2 The power exchange would appoint a bank / FI as 'clearinghouse' which will be responsible for settlement of all dues on its behalf. Expertise of commodity exchanges can also be used is setting up or running of Clearing House.

6.2.3 Any grid connected generator or buyer, who has become member of the power exchange, shall be eligible to become member of the clearinghouse. In addition, any licensed inter-state electricity trader would also be eligible to become member of the clearinghouse. The membership of the clearing house would involve membership fee as well as security in the form of bank guarantee, cash, fixed deposit etc. Allowing traders to join the clearinghouse would facilitate trading, and at the same time it would provide a useful role to the traders as clearing agents.

6.2.4 All members of the clearinghouse would be required to open pledged current account in approved settlement bank branches. All financial transactions shall be settled by the clearinghouse through the settlement bank only. All financial transactions shall be preferably through Electronic Clearing System.

6.2.5 Depending upon the settlement period, payment time and anticipated turnover, the power exchange would advise the settlement bank to maintain adequate cash in the pledged account and/or collateral. A concept of rolling collateral would be adopted. The requirement of rolling collateral would increased /decreased depending on the trading pattern of the member. In case collateral has been consumed for pay out, it would have to be replenished immediately to enable further trading. The collateral at all times should be sufficient to cover the PX exposure.

6.2.6 The settlement bank would be required to confirm the adequacy of collateral / cash in the account of the clearinghouse member as per the agreed protocol. In the absence of such a confirmation, the power exchange would not consider the bid of the concerned party in the next trading session.

6.2.7 The settlement bank shall clear all invoices of the clearinghouse as per agreed protocol and automatically dip into collateral securities in case adequate cash is not there in the pledged current account of the clearinghouse member.

6.3 Market regulation

6.3.1 The purpose of market regulation has been described as protection of public from the detrimental consequences of inadequacies of competition. The Regulator is always confronted with information disadvantage concerning the true costs of the entities it has to regulate. In classical regulation, Rate of Return and Price Cap regulation are two basic regulatory schemes for controlling prices. Market regulation, on the other hand, deals with promoting competition and presenting unfair trading practices. Market regulation consists of the following:

- Defining the rules of the game
- Enforcing the rules and obligations
- Market monitoring

6.3.2 Market regulations are necessary because (a) electricity is physically different from all other commodities and (b) a well functioning market needs to be regulated. Markets for other commodities have existed for centuries, but electricity markets are a recent phenomenon. The first important part of market regulation is to create a proper market design. It has to be followed by effective market monitoring to assess the efficacy of the market design on a regulator basis. In a competitive market, no single player should be able to systematically set the market price. Identifying which players are setting the price on the power exchange provides interesting information on the extent of competition. Apart from watching the market share of various players, one also needs to keep a watch on the market behaviour of various participants in terms of (i) aggressive bidding (ii) withholding capacity (iii) tacit collusion and (iv) rule manipulation. This is done through a dedicated market monitoring unit or cell.

6.3.3 Sensitivity of the market-clearing price to incremental demand provides useful insight into the level of liquidity in the market. Estimating the impact of different values of additional demand on market prices is a good indicator of the sensitivity of a market to potential market manipulation. For example, if a small increment of 10 MW demand can dramatically increase the clearing price, it reflects a low level of competition where almost any player can influence prices.

6.3.4 Price-cost markup index is a more sophisticated indicator of competition. It estimates the difference between the observed market price and what might be expected in a competitive market.

$$\text{Price-cost markup index} = \left[\{MP-MC\}/MP\right] \times 100\ \%,$$

Where,

MP is the actual market clearing price, and

MC is the estimated marginal cost of supply at that point.

The market monitoring units in PJM and California regularly use this method.

6.3.5 Since the last accepted bid fixes the price on a power exchange, the price offered by the last bidder is an indicator of the existence of a dominant position. Systematic identification of the players that set the market-clearing price provides information on the level of competition. For example, if one player sets the price on the power exchange 90% of the time, this would strongly indicate lack of competition and high possibility of market abuse.

6.3.6 Withholding capacity is the most known strategic behaviour in electricity markets to abuse market power and it is widely known to have happened in California. It consists of decreasing supply so that supply from generators with high marginal costs (such as liquid fuel based plants) sets the market-clearing price. The suppliers may resort to aggressive bidding for peak hours in order to increase the market-clearing price. Bidding rules have to take care of all these aspects of undesirable market behaviour and make them punishable. It is then for the market monitoring cell to detect deviant behaviour so that punishment could be imposed by the PX or the Regulator as per Rules.

6.3.7 Due to confidential nature of the data used, the work of market monitoring unit should remain confidential. Any data or analysis should be published in a generalized form. No information or data should leak to the participants from the staff of the market-monitoring cell. Confidentiality of bids is a must to ensure competitive behaviour.

6.3.8 **Typical competition indicators**

<u>Competition indicators based on public information</u>:

- Clearing price Vs. System load demand
- Clearing price Vs. traded volume
- Comparison of clearing price with bilateral contracts

Competition indicators based on confidential information:

- Individual market share on PX traded volume
- Who set the price on PX
- Level of liquidity
- Profitability of withholding capacity
- Price-cost mark up index

6.3.9 Existence of an official power exchange facilitates the task of market monitoring. Access to information is important for developing competition and effective market monitoring. Therefore, a private or a closely held PX is not a good idea.

6.3.10 The Power Exchange should draft its own rules and adopt them after taking approval of the Commission. They would cover various aspects including, membership rules, financial rules, technical rules, ethical rules, appointment rules, reporting rules etc.

6.4 **Organization of PX**

6.4.1 Organization of PX should be such that decision making is insulated from the bias of the members. Lot of detailing will be required to be done before finalizing the exact organization of the PX, which will also depend on the rules and regulations framed by the PX with due approval of the Commission. However, broad organizational features can be identified at this stage and the same are suggested below.

Ownership

6.4.2 It is clear that PX will be buying electricity and then re-selling the same. Therefore, the activity of PX will squarely fall under the definition of trading as per the Electricity Act, 2003. Accordingly, PX will need to have a licence for trading from CERC, although in addition to usual terms & conditions of licence, PX will have to comply with additional terms & conditions stipulated by the CERC. Alternatively, rules & regulations about its working, framed by the PX itself and approved by the CERC, may act as additional conditions of licence.

6.4.3 Most of the PX in Europe like NORDPOOL (Norway), APX (Netherlands), OPCOM (Romania), GEM (Italy) and BORZEN (Slovenia) are owned by transmission operators. However, in India neither CTU nor NLDC/RLDCs can be the sole owner of PX because these entities have been barred from engaging in trading by the Electricity Act, 2003. However, since PX will have to work in close coordination with CTU and NLDC/RLDCs, it may be desirable to have these entities as one of the owners. Therefore, PX will have to be a multi owner organization. Entities like generators, trading licenses, distribution licensees, CTU, Financial Institutions/Banks and Commodity Exchanges etc may join hands to set up a PX. However, there could be a limit of say 25% on the equity contribution by a single promoter.

Membership

6.4.4 The process of constituting the PX could be initiated by the promoters. They may seek membership for the exchange. Only grid connected entities like SEBs, distribution licensees, bulk industries, generating companies, captive power plants etc will be allowed to become member of the PX. A member would be eligible to participate in the PX bidding platform.

6.4.5 Trading licensees, who have long term/medium term PPAs with generating plants, may be granted associate membership. Trading licensees shall be allowed to bid only on behalf of such contracted long-term/medium-term capacities. They shall not be allowed to aggregate capacities from two or more sources.

6.4.6 There shall be a separate Clearing House and members/associate members of the PX as well as other entities can become members of the Clearing House. Before starting trading, the power exchange members/associated members would have to either become a ‘member of the clearinghouse’ or appoint any other clearinghouse member as its ‘clearing agent’.

Advisory Council

6.4.7 The entities joining the PX as members and associate members may nominate one representative each to a body called Constituent Council. It is the Constituent Council, which shall formulate rules & regulation governing working of the PX and submit the same for approval of CERC. The Constituent Council shall also recommend the first set of Directors and Chairperson of the Board of the PX. Once PX starts functioning, the Constituent Council may be rechristened as Advisory Council. The Advisory Council shall advise the Board of Directors and also recommend to CERC names for vacant positions in the Board.

Expenses of the PX

6.4.8 It is also clear that PX should not be working with the motivation of profit but should be striving to earn revenue enough for meeting budgeted expenses. Expenses of the PX will be met from the Membership fee, annual fees and transaction fee to be specified by PX after approval of CERC. Membership fee shall be a one-time fee to obtain membership of PX. As the name suggests, annual fees shall be payable by all members of the PX every year. The transaction fee, on the other hand, shall be specified in terms of paise/KWh.

Selection of Board of Directors

6.4.9 Neutrality is the most important consideration in the operation of the PX and therefore, it is suggested that all the Directors may be independent. The Board may have 5 full-time Directors including Chairperson, out of which 4 Directors including Chairperson may be recommended by the Advisory Council. The Directors may be eminent professionals and their qualifications and experience may be specified in the rules & regulations governing the PX. Before starting the PX, the Constituent Council and subsequently, the Advisory Council will recommend for approval of CERC, one name for each vacant position in the Board, including that of the Chairperson. If the recommended name is not accepted by CERC, fresh name will be recommended for consideration of CERC. In order to eliminate possibility of bias emanating from majority of members/

associate members belonging to one particular category, Sectoral voting in the lines of PJM may be adopted. One of the Directors may be nominated by NLDC/RLDCs subject to approval of CERC.

6.4.10 The Board may appoint executives and other employees of the PX. All officers, employees and Directors must divest their interests in any market participant within specified time (say 3 months) of taking over. Working of the PX may be organized into various departments such as Operation, Settlement & Clearing, Information Technology, Market Monitoring, Personnel & Administration etc.

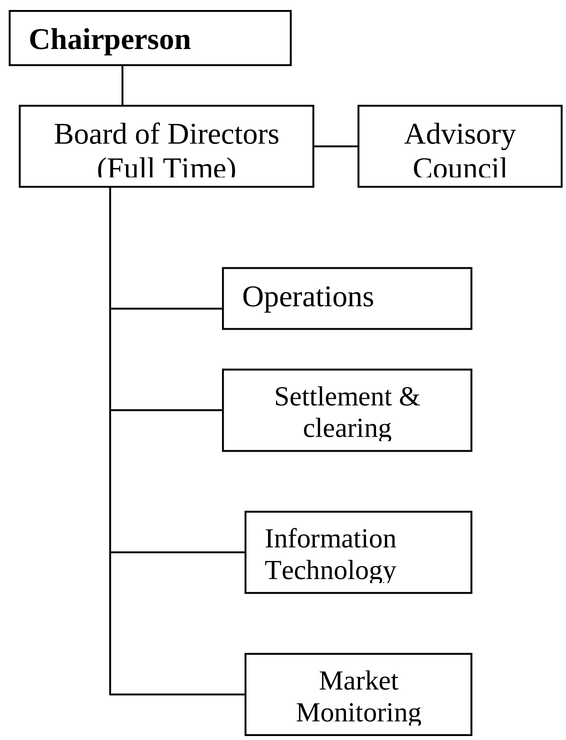


Fig 6.1: Organization of the proposed Power Exchange

6.5 Harnessing captive and merchant generation

6.5.1 PX would also like to have as many generators as possible in order to increase liquidity of supply and better price discovery through competition. The procedure proposed below for harnessing surplus generation through PX is fully in line with the revised grid code [IEGC].

Generators embedded in the STU/Distribution system.

(a) They would be required to arrange open access up to periphery of their state network.

(b) They would directly bid into the PX. PX trades would be informed to them directly with a copy to their SLDC.

(c) RLDC would issue day ahead and implemented schedules of a state to its SLDC indicating the requisitions received from SLDC and PX.

(d) Scheduled energy charges would be directly settled by the PX.

(e) SLDC would manage UI account of all intra-state entities including the ones buying/selling through PX.

Generators directly connected to ISTS/CTU network

(a) They would not be required to obtain open access separately.

(b) They would directly bid into the PX. PX trades would be intimated to them.

(c) RLDC would issue day ahead and implemented schedules to them directly.

(d) Scheduled energy charges would be directly settled by the PX.

(e) RLDC would manage the UI account of all entities directly connected to the inter-state transmission system.

6.6 Hedging instruments

In the long run, it would be desirable to develop financial hedging instruments such as contract for differences to provide security to buyers and suppliers against price fluctuations. Financial derivatives such as forwards and futures, contract for differences etc are generally in vogue in established electricity markets. Traders and financial institutes bring liquidity to the market for financial derivatives. However, the idea of some of the commodities exchanges to start futures trading around some price discovery like UI price, without any physical delivery would be nothing but pure speculation. It would not be of any help in bringing investment in the power sector.

6.7 Other benefits of PX

6.7.1 PX as security against PPA defaults

The CERC regulations, the Tripartite Agreement as well as the GOI Guidelines on procurement of generation on long term and medium term through competitive bidding had given option to the generator to progressively reduce supply to the buyer in case of payment default. The ability of the generator to organize third party sale with adequate payment security is crucial. With the move to set up ultra mega power projects through competitive bidding route, the issue assumes greater significance, because these projects will not be covered by the Tripartite Agreement. If a Power Exchange is set up, the generator will feel assured that they have a convenient and assured option for selling power in case of PPA default.

6.7.2 Cross- border trading

At present, cross border trading is going on essentially on long-term contracts or on barter basis. In the long run, the creation of voluntary Power Exchange would be positive development not only for India but for the South Asian region as well. Bilateral trading in the last couple of years has started creating time differentiated electricity products such as peak and off-peak power. This is necessary for resource optimization and to provide better value of electricity to sellers and buyers. A PX would be able to commoditize electricity into one-hour standard product, which in turn would result in better optimization and value realization of scarce energy resources. Some of our neighboring countries have abundant hydropower resources. While, long term cross border PPAs are very difficult to conclude, border trading through PX would be far more convenient since it is a commercial deal and does not involve any long term commitment of price and quantity. Access to Indian electricity market through PX or bilaterally has the potential to make IPP projects viable in neighboring countries.

6.7.3 **PX as facilitator of consumer's choice**

Sec 42 (2) of the electricity empowers the big consumers to opt out of their distribution licensee and to source their electricity from the supplier of their choice. Even if a consumer were willing to bear the burden of surcharge to be levied by the Regulator, it would be difficult for him to exercise his choice unless he is sure of the reliability of alternate arrangement. The consumer would definitely require a back up to his bilateral arrangement through an alternate source. If there were a PX, the consumer would have the assurance that he can get his backup or peak demand met from PX whenever power from bilateral source is not available.

Chapter- VII

Challenges

7.1 Basic Requirements

Notwithstanding the need for an efficient trading platform, enabling legislative provisions and our ability to design a suitable mechanism, there are certain aspects, which require careful consideration and concreted action. In general, the success and efficient price discovery by any power exchange is critically dependent on the following factors as explained in the foregoing analysis.

- Depth (large number of buyers and suppliers)
- Liquidity (adequate supply)
- Adequate transmission
- Proper congestion management
- Good software
- Limited market power
- Ability to check market abuse

The challenges specific to the Indian condition are discussed below.

7.2 Inadequate volume due to division of trade

Taking the concept of a Power Exchange from the drawing board to the ground would require concerted efforts on a number of fronts. Unlike the bilateral trading and UI mechanism, Power Exchange is a centrally controlled mechanism requiring considerable planning, investment in hardware, software development and institutional engineering. The Power Exchange would have to electronically interact with hundreds of entities and create a credible financial settlement system. A well-defined relationship with the system operator on one hand and the clearing house on the other is vital for successful functioning. Even though sufficient experience of Power Exchange operation is available world wide, still it would be quite a challenge to develop software suited to

Indian conditions, and to train all the participants to use it. Power Exchange would be a no profit no loss organization and all the costs would have to be recovered through transaction charges. In order to keep the transaction fee low, for example, 1 paise/kWh, it would be necessary to have adequate trading volume. In case of voluntary Power Exchange, it would have to compete with other available trading options. During the year 2005-06, the volume of energy traded bilaterally was of the order of 12.9 billion units while energy transacted under the UI mechanism was about 18 billion units. As it is there is a scarcity of supply and further division of trading volumes into bilateral, PX and UI routes is likely to result in low volume through the Power Exchange. In case the trading volumes are low, the per unit transaction cost would increase. Ensuring adequate trading volume is perhaps the biggest challenge for the viability of common trading platform.

7.3 Suppliers may avoid PX

The bilateral trading route of individually contracting energy in time horizon of a few months helps in managing seasonal requirements on one time basis rather than depending on day-to-day bidding. It requires accurate demand forecasting and arranging open access separately. Day ahead load forecasting is much easier and a PX can conduct day ahead trading efficiently. Energy transactions through the PX are based on matching generation and load, and have positive effect on the grid stability. Therefore, energy exchanges through the PX need to be encouraged in order to reduce the headache of the RLDCs in real time grid operation. The Power Exchange would provide its own pricing mechanism along with transmission and payment security. However, if participation in Power Exchange is voluntary in the beginning, the suppliers may not like to participate in the Power Exchange in case they feel bilateral or UI mechanism is a more profitable option.

7.4 **Harnessing captive generation**

Long term PPA with two part tariff, whether determined by the regulated norms or through tariff based competitive bidding, provide price certainty to both buyers and suppliers. In a deficit scenario, it is not in the interest of the consumers to disturb these contracts. Therefore, we have to necessarily look for new supplies in order to increase the volume of the tradable power. There is significant captive generating capacity, which could be targeted for this purpose. However captive generating stations are embedded in the state networks and the present metering arrangements may not be suitable for energy accounting for trading/UI settlement. Without the active support of the SERCs and State entities it will not be possible to harness this source. The Forum of Regulators (FOR) has discussed various issues involved in connection with harnessing of captive generation in detail in 2005.

7.5 **Power Exchange may stimulate demand without matching supplies**

Since Power Exchange will be a convenient platform for purchase of power, it will give rise to expectations from all types of buyers. Apart from distribution utilities, open access consumers would also expect the power exchange to meet their demand. Special Economic Zones, tourist complexes, software centres, industrial estates, private townships, shopping malls etc will look forward to Power Exchange with hope and salvation from perennial power cuts. We should be geared up to fulfill the buyers' aspirations. If open access consumers are allowed to procure power from the Power Exchange, it will increase the demand. Consequently, the clearing price may go up and the expectations of price stability through Power Exchange may not be fulfilled. In a situation of increasing power shortage it is apprehended that there may be demand-supply gap and the Power Exchange may have to frequently resort *to pro-rata* demand curtailment in order to match supply with demand. In such a situation, the buyers may resort to over stating their demand to avoid curtailment and distort the situation. Unless there are adequate supplies, it may not be possible to serve open access consumers. Seeing the emerging trend of increasing prices of bilateral trading, it appears that elasticity of demand is reducing. Recently, in some transactions, the traded prices have pierced the threshold of UI ceiling rate of Rs 5.70 in some transaction. Under such acute shortages, when the Distribution Utilities are willing to pay more than Rs 5.70, the price discovery in the exchange may be no better. If this were not what we want, then it would be advisable to wait till the supply situation improves.

7.6 **Compatibility with the existing framework**

Availability Based Tariff (ABT) and frequency-linked pricing of deviations, i.e. UI are now very well established in India, and provide the stable base (i.e. the long-term contracts for bulk of the supply), as well as the required framework for energy accounting and handling of defaults/deviations. A pre-requisite for long-term contracts is a priority over the associated transmission system. Another feature of the existing system is decentralised scheduling and dispatch, which provides autonomy to the States in our federal structure. The mechanism and operation of PX has to be compatible with these.

7.7 **Facilitating additional supplies to PX**

In all future generation projects, 15% capacity may be earmarked for free market and corresponding capacity charge liability should not be passed on to long-term beneficiaries. Further, in spite of generation having been de-licensed, investors are yet to show interest in setting up significant capacities through merchant generation plants. It is important to facilitate setting up of merchant power plants and ensuring their connectivity to the grid.

7.8 **Providing transmission for power trading**

There is a robust inter-state transmission system in place, which is expanded and strengthened continuously to take care of power evacuation need of inter-state power stations. Many inter-regional links have also been built to facilitate inter-regional energy exchanges. We have institutional arrangements for planning the expansion of transmission systems with CEA as the apex planning body and involving CTU and STUs. CTU and STUs are also mandated to provide non-discriminatory open access. The Commission implemented open access in inter-state transmission in 2004. The Open Access customers are categorized into long term or short term. The short-term access, which is sought for electricity trading, is provided depending on the availability of surplus transmission capacity without disturbing long term contracts. So far the magnitude of trading has been small and our transmission system has been able to cater to it. However, it needs to be kept in view that power trading has the potential to increase manifold through a PX. Accordingly, in future, the transmission planning would also have to give adequate weightage to the need of power trading in planning network expansion. The inter-regional links are critical corridors in power trading and it should be our endeavour to ensure that they do not get congested as far as possible. The need for transmission capacity for power trading may not be viewed merely as the need of traders or PX, rather it may be seen as the need of the power sector.

7.9 **What is the right time to launch PX?**

The timing of launching a Power Exchange is very important. Once a Power Exchange has been launched, it would be under pressure to fulfill the expectations of buyers. As per the technical estimate of CEA, the all India peaking shortage is of the order of 12000 MW. The price at which this demand exists is not known. However, it would be reasonable to assume that the above figure of unmet demand is conservative and it definitely exists at a price level corresponding to the average aggregate cost of bulk supply for various utilities, which is of the order of Rs.2.00 per unit. Assuming the unmet demand to be elastic, it would be fair to assume that in the electricity market there is short-term demand of the order of 5000 MW at a price level of about Rs.4.00 per unit on a typical day during summer. The above scenario is dynamic, and has to be viewed in the backdrop of increasing demand and capacity addition going on continuously. Going by the international experience, it can be argued that the right time to set up a Power Exchange would be when the aggregate demand and supply streams are more or less evenly placed on all India basis and the twin objectives of meeting the peak demand and resource optimization could be achieved through a common trading platform. On the other hand, it may be prudent to launch it in the near future even in a situation of shortage, to send the tight signal to investors and consumers about transparent market development. Finally, unequivocal support of the Central and State Governments, Electricity Regulators and cooperation of all other stakeholders would be necessary for creating a suitable environment required for building a common trading platform.

Chapter VIII

Summary of findings and recommendations

I. *National Electricity Policy mandates the creation of a Power Exchange (Para 1.1.8).*

II. *It is generally not advisable to disturb existing long-term contracts for the sake of market development (Para 4.1.4).*

III. *Short-term trading is essential for resource optimization and meeting peak demand (Para 3.3).*

IV. *Short-term trading through Open Access constitutes 2-3% of the total supply. The market lacks depth. It is dominated by limited number of Suppliers having limited quantum of tradable power (Para 1.2.3).*

V. *At present, electricity can be traded bilaterally at mutually agreed rates. There is a need to further develop short-term trading to bring equity, transparency and efficiency in trading (Para 1.2.6 & 4.1.1).*

VI. *A Power Exchange (PX) would provide a common trading platform. The PX should be designed for the purpose of dispensing short-term power available for trading through competitive bidding by inviting simultaneous anonymous bids from buyers as well as suppliers on day ahead hourly basis (Para 4.1.2 & 4.1.3).*

VII. *The PX should adopt marginal pricing principle. It is proposed that the PX may essentially follow the classic market splitting model. However, in a congested zone, the buyers could be served at the weighted average cost of supply and the PX may not collect any congestion revenue (Para 4.2.8)*

VIII. *Uniform pricing philosophy based on marginal cost of supply may be followed for suppliers. In order to ensure that suppliers quote close to their true marginal costs, bid caps could be considered (Para 4.2.5 & 6.1).*

IX. *Bid caps for PX trading cannot be effective if it is profitable to sell at a higher price bilaterally or through UI mechanism. Similar caps may be considered for pricing in case of bilateral trading (Para 6.1.3).*

X. *Under acute shortages, when the Distribution Utilities are willing to pay more than Rs 5.70 per unit (the existing ceiling UI charge), the price discovery in the power exchange may be no better (Para 7.5).*

XI. *Participation in the PX may be voluntary for the present (Para 4.2.3).*

XII. *The PX should be a counter party to all trades, providing payment security to the suppliers (Para 6.2).*

XIII. *PX should handle trading and transmission clearance in a composite manner. The PX should be designed in line with all relevant provisions of Indian Electricity Grid Code and function in close coordination with NLDC/RLDCs (Para 5.2 &5.5).*

XIV. *The electricity traders should have a useful role in the PX trading (Para 6.4.5).*

XV. *The PX may be run by an independent Board having five Directors including Chairperson. The Advisory Council, constituted with one representative from each member of the PX, would recommend name of an eminent professional for each vacant position including that of Chairperson and three other Directors for approval of the Commission. One of the Directors would be appointed on the recommendation of NLDC/RLDCs (Para 6.4).*

XVI. *Since the amount of tradable power is low, PX on regional basis may not be viable. Only one PX at the national level could be conceived subject to availability of adequate power (Para 4.2.2).*

XVII. *If the PX is put in place immediately, it may be hampered by lack of liquidity in supply due to meager surpluses, division of trade and lack of interest from suppliers (Para 7.2, 7.3 & 7.5).*

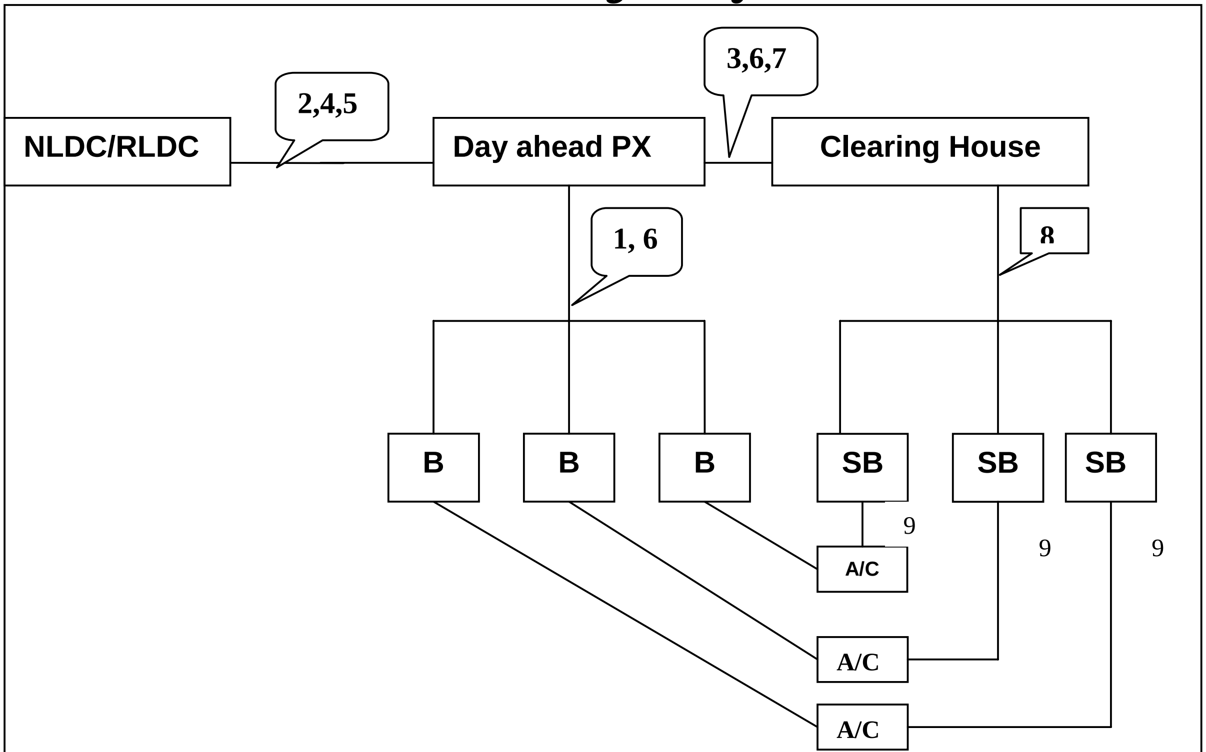
XVIII. *The PX would provide a platform for harnessing captive generation and cogeneration. It would also provide positive signal for investment in merchant generation and encourage the setting up of peaking power plants (Para 6.5).*

XIX. *Merchant power plants should be allowed grid connectivity (Para 6.5).*

XX. *Additional supplies would have to be ensured for PX to enable it to serve open access consumers (Para 7.4 & 7.7).*

XXI. *The right time to launch a Power Exchange needs to be debated. It may be argued that it would be better to wait till the aggregate demand and supply streams are more or less balanced on all India basis so that it is feasible to meet the twin objectives of serving the peak demand and resource optimization through a common trading platform. On the other hand, it may be prudent to launch it in the near future to send the right signal to investors and consumers about transparent market development (Para 7.8).*

Function Diagram of PX



B : Bidders
SB : Settlement Bank
A/C : Pledged Account & Collaterals of Clearing House Members in SB

Activities

i. 1 Bidders send their bids to PX.
ii. 2 NLDC informs transmission capacity to PX.
ii. 3. Clearing House confirms adequate collaterals of clearing agents.
4 PX obtains NLDC concurrence before releasing day ahead Trade schedules.
v. 5 RLDCs issues day ahead generation & dispatch schedules for PX participants.
v. 6 PX issues day ahead trade schedules.
i. 7 PX issues rolling collateral requirement.
ii. 8 After settlement period Clearing House issues Invoice/Credit Notes .
9 Settlement Banks debit/credit the appropriate amounts.

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Annexure

NORTHERN REGION

Open Access Transactions (June-06)

Last updated on Thu Jun 01 11:14:56 IST 2006

S.No	RefNo/ AprNo	Application no	Utilities	FromDate	ToDate	Quantum	Route
1	**Mar-06/AP-2259** 24-Mar-06	CC/NVVN/OA /03/1089 dt14-Mar-06	**NVVN** Tripura -HPGCL	01-Jun-06	30-Jun-06	1700-2300: 25 MW	NER-ER-NR
2	**Mar-06/AP-2260** 24-Mar-06	CC/NVVN/OA /03/1090 dt14-Mar-06	**NVVN** Tripura -PSEB	01-Jun-06	30-Jun-06	0000-1700: 50 MW 1700-2300: 0 MW 2300-2400: 50 MW	NER-ER-NR
3	**Mar-06/AP-2261** 24-Mar-06	CC/NVVN/OA /03/1092 dt16-Mar-06	**NVVN** KSEB -PSEB	01-Jun-06	30-Jun-06	0000-1700: 150 MW 1700-2300: 0 MW 2300-2400: 150 MW	SR-WR-NR
4	**Mar-06/AP-2262** 24-Mar-06	CC/NVVN/OA /03/1094 dt16-Mar-06	**NVVN** KSEB -HPGCL	01-Jun-06	30-Jun-06	0000-1700: 50 MW 1700-2300: 0 MW 2300-2400: 50 MW	SR-WR-NR
5	**Mar-06/AP-2263** 24-Mar-06	PTC/OA/NR/1 536 dt16-Mar-06	**PTC** GRIDCO -DTL	01-Jun-06	30-Jun-06	0000-2400: 100 MW	ER-NR
6	**Mar-06/AP-2264** 24-Mar-06	PTC/OA/NR/1 537 dt16-Mar-06	**PTC** GRIDCO -HPGCL	01-Jun-06	30-Jun-06	0000-1700: 50 MW 1700-2300: 0 MW 2300-2400: 50 MW	ER-NR
7	**Mar-06/AP-2265** 24-Mar-06	PTC/OA/NR/1 538 dt16-Mar-06	**PTC** GRIDCO -DTL	01-Jun-06	30-Jun-06	1700-2300: 100 MW	ER-NR
8	**Mar-06/AP-2266** 24-Mar-06	LEUL/OA/03 dt16-Mar-06	**LANCO** WBSEB -PSEB	01-Jun-06	30-Jun-06	0000-1700: 83 MW	ER-NR
9	**Mar-06/AP-2267** 24-Mar-06	RETL/NRLDC /222 dt18-Mar-06	**Reliance** WBSEB -PSEB	01-Jun-06	30-Jun-06	0000-1700: 117 MW	ER-NR
10	**Mar-06/AP-2268** 24-Mar-06	Ch-41-2/HPGC/PP-71 dt17-Mar-06	**HPGCL** WBSEB -HPGCL	01-Jun-06	30-Jun-06	0000-1700: 100 MW	ER-NR
11	**Apr-06/AP-0048** 23-Apr-06	CC/NVVN/OA /04/1182 dt19-Apr-06	**NVVN** KAYKLM-NTP -PSEB	10-Jun-06	30-Jun-06	0000-2400: 150 MW	SR-WR-NR
12	**May-06/AP-0183** 25-May-06	PTC/OA/1621 dt17-May-06	**PTC** MALANA -HPGCL	01-Jun-06	30-Jun-06	0000-2400: 81 MW	----
13	**May-06/AP-0217** 31-May-06	PTC/OA/1637 dt29-May-06	**PTC** HPSEB -UT-Chd	01-Jun-06	15-Jun-06	0000-2400: 20 MW	----
14	**May-06/AP-0218** 31-May-06	PTC/OA/1638 dt29-May-06	**PTC** HPSEB -PSEB	01-Jun-06	09-Jun-06	0000-2400: 40 MW	----
15	**May-06/AP-0218** 31-May-06	PTC/OA/1638 dt29-May-06	**PTC** HPSEB -PSEB	10-Jun-06	15-Jun-06	0000-2400: 60 MW	----
16	**May-06/AP-0219** 31-May-06	PTC/OA/1639 dt29-May-06	**PTC** HPSEB -DTL	01-Jun-06	15-Jun-06	0000-2400: 60 MW	----
17	**May-06/AP-0917** 31-May-06	PTC/OA/1640 dt29-May-06	**PTC** HPSEB -HPGCL	01-Jun-06	15-Jun-06	0000-2400: 40 MW	----

18	**May-06/AP-0220** 31-May-06	01/2006-07 dt29-May-06	**DTL** HPSEB -DTL	01-Jun-06	15-Jun-06	0000-2400: 40 MW	----
19	**May-06/AP-0920** 31-May-06	PSEB/OA/UP CL/041 dt30-May-06	**PSEB** UPCL -PSEB	01-Jun-06	09-Jun-06	0000-0600: 30 MW 0700-1900: 30 MW	----
20	**May-06/AP-0221** 31-May-06	PSEB/OA/J& K/042 dt30-May-06	**PSEB** J & K -PSEB	01-Jun-06	09-Jun-06	0000-0500: 50 MW 0700-1900: 50 MW	----
21	**May-06/AP-0918** 31-May-06	CC/NVVN/OA /05/1277 dt30-May-06	**NVVN** WBSEB -PSEB	01-Jun-06	03-Jun-06	0000-0200: 100 MW 0200-0400: 31 MW 0400-0700: 0 MW 0700-0800: 11 MW 0800-1000: 81 MW 1000-1800: 100 MW 1800-2300: 0 MW 2300-2400: 100 MW	ER-WR- NR
22	**May-06/AP-0919** 30-May-06	UPPCL/OA/N R/APST-UP dt31-May-06	**UPPCL** ARUNANCHAL -UPPCL	01-Jun-06	01-Jun-06	0000-1700: 40 MW 1700-2400: 50 MW	NER-ER- NR

Abbreviations

AD	Aggregate Demand
AS	Aggregate Supply
BETTA	British Electricity Trading & Transmission Agreement
BU	Billion KWhr Unit
CCGT	Combined Cycle Gas Turbine
CEA	Central Electricity Authority
CEGB	Central Electiry Generating Board, (UK)
CERC	Central Electricity Regulatory Commission
CTU	Central Transmission Utility
DVC	Damodar Valley Corporation
ER	Eastern Region
FERC	Federal Electricity Regulatory Commission
FTR	Financial Transmission Right
GOI	Government of India
GRIDCO	Grid Corporation of Orissa
IPP	Indpendent Power Producer
ISO	Independent System Operator
kWh	Kilo Watt Hour
LMP	Location Marginal Price
MU	Million KWhr Units
MW	Mega Watt
NER	North Eastern Region
NERSA	National Electricity Regulator of South Africa
NETA	New Electricity Trading Agreement, (UK)
NGC	National Grid Company, (UK)
NLDC	National Load Dispatch Centre
NR	Northern Region
OTC	Over the counter
PJM	Pennsylvania-New Jersy-Maryland Interconnection
PUC	Public Utility Commission
PX	Power Exchange
Rs.	Indian Rupees
RLDC	Regional Load Dispatch Centre
RTC	Round the Clock
RTO	Regional Transmission Organisation
SEBs	State Electricity Boards
SERC	State Electricty Regulatory Commission
SLDC	State Load Dispatch Centre
SR	Southern Region
TSO	Transmission System Operator
UI	Unscheduled Interchange
WBSEB	West Bengal State Electricity Board