Chapter 7

POWER POOL STRUCTURES

7.1 Introduction

A crucial element in the implementation of a competitive electricity market is the setting up of a wholesale market, commonly known as power pool. Power pool, with spot and bilateral trading, will enhance real competition and contribute to potential cost reduction in power trade. The power pool is effective in enhancing competition particularly in cases where there a large number of buyers and sellers and sufficient generation capacity.

However, there is yet a universal definition of a power pool. However, the terminology is generally accepted as " a group of utilities and other energy companies within a region that have joined to coordinate power plant and electric grid operations to maintain reliable delivery service". [46] However, a power pool is not merely a focal place for power trade among generators and buyers. It is also a pool of information related to competition. Therefore, establishment of a power pool will encourage competition and contribute to the reduction of electricity bills, provided there are large number of buyers and sellers.[47]

As such, various type of power pool models or market structures have been established or are being considered to realize competition in the power sector industry. Different countries have adopted different models to suit the relevant political and economical climates. There is no universal ideal model or solution that can be implemented on an "off-the-shelf" basis. The stage of development of the industry, the primal objectives of the government, the security of fuel supplies, the development of the financial market and the geographic distribution

[46] Record, First Quarter 2001

of demand are some of the key determinants in deciding the type of model to be used.

This chapter provides an overview of the different type of power pools or market structures and mechanism that can be adopted by Malaysia. The different models are outlined and their key advantages and disadvantages are highlighted.

7.2 Pool Models

7.2.1 The Gross Pool

The gross pool model can be illustrated as below.

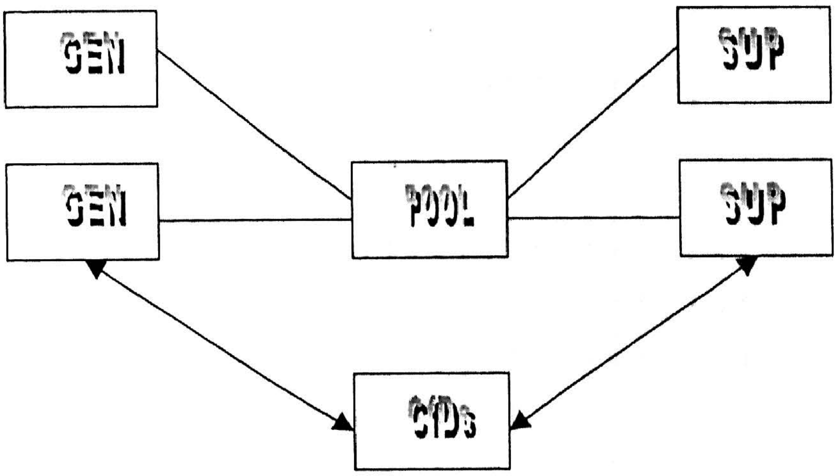

Figure 7.1: The Gross Pool Model

This is the model that is being adopted by the England and Wales Power Pool. It is a mandatory pool where all energy must be traded between generators and suppliers through the pool.

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[47] Electricity Supply Industry Reform and Thailand Power Pool, November 2000.

To gain a better understanding of the operation of a gross pool, it is necessary for us to turn our attention to the England and Wales Power Pool. In UK, the Pool Executive Committee (PEC) is responsible for developing the wholesale electricity market i.e. decisions related to membership of the pool, changes to rules and so on.

Nevertheless, the National Grid Company (NGC) carries out the tasks of operating the power system and operation of the commercial marketplace. The NGC manages and operates the pool with the following three primary objectives:[48]

- Match generation to the varying load profile.
- Minimize the cost of meeting demand.
- Operate the transmission system according to standards laid down in the company's transmission license.

In the power pool, for commercial purposes, each day is broken up into forty-eight half-hour segments, called settlement periods. In advance of the day in question, the system manager calculates the likely demand profile using historical data and weather information.

On the other hand, the generation companies will submit their bids for each half-hour period for the level of power for they are willing to supply at various prices and for various periods. These offer bids, which compromised information related to prices and other engineering parameters, are submitted on the previous day at 10am.
The system manager will issue a "merit order" based on the offer bids received. The cheapest generation units are selected first and supply is capped when enough generation units are available to meet the demand. The pool purchase

[48] Extract from UK Electricity Supply Handbook.

price for all suppliers will be the highest price bid by the last generation facility needed to meet the last unit of demand. That price, is the electricity generation industry's marginal cost and is therefore is called the "system marginal price" (SMP).

The derivation of SMP is best illustrated by the following example. Assume that the demand for a particular period is 10,000 MW and that there are six bidders for generation for that particular period. The offer bids are arranged in ascending order of price as illustrated below.

Generators	Supply Offer(MW)	Price (RM/kWh)
A	3000	0.06
B	3000	0.09
C	2000	0.11
D	3000	0.15
E	2000	0.18
F	1000	0.20

In the above example, generator D is the last unit called upon to dispatch supply. Therefore, the SMP is based on the bid offered by generator D i.e. 0.15 RM/kWh and this price is applicable to all generators (i.e. A, B & C) select to supply for that given period.

SMP, which reflects the cost of energy, is obviously a main component of the pool purchase price (PPP). However, PPP actually consists of two main components. The other component, known as the "capacity payment", is the incentive paid to generators to make generation plant available at times of high demand. The size of capacity demand is determined by the margin between demand and total capacity declared available for a given period. The payment is high at times when there is just sufficient capacity to meet demand and falls away to zero when there is a large capacity. Therefore, large capacity payments are likely to occur during peak demand periods in the winter period or even during certain soccer matches involving UK in the World Cup!

In deriving the SMP, transmission constraints are ignored. Thus, the same energy price applies irrespective of the physical location of the generators. To provide a final operational schedule, the system manager takes the unconstrained schedule and adjusts it to take account of all the constraints on the transmission network and the need to keep the network stable and secure. As a result, some sets generator units that were supposed to run will be "constrained off" and others that were "out of merit" will be "constrained on" and called up to run. In terms of price settlement, for sets that were constrained off by transmission bottlenecks, generators are paid SMP minus the price that was bid. For sets that were constrained on, generators are paid their bid prices.

To hedge against the volatility of prices in the pool, generators and suppliers are allowed to enter into option contracts known as "contract for differences", CFD. A typical CFD between a generator and a supplier defines an agreed fixed price, commonly referred to as the "exercise" or "strike" price. If the pool price is lower than the exercise price, the supplier pays the generator for the difference. Vice versa, if the pool price is higher than the exercise price, the generator will pay the supplier for the difference. The difference payments balance out the pool price variations and thus effectively stabilising the price for both the generator and supplier at the agreed exercise price.

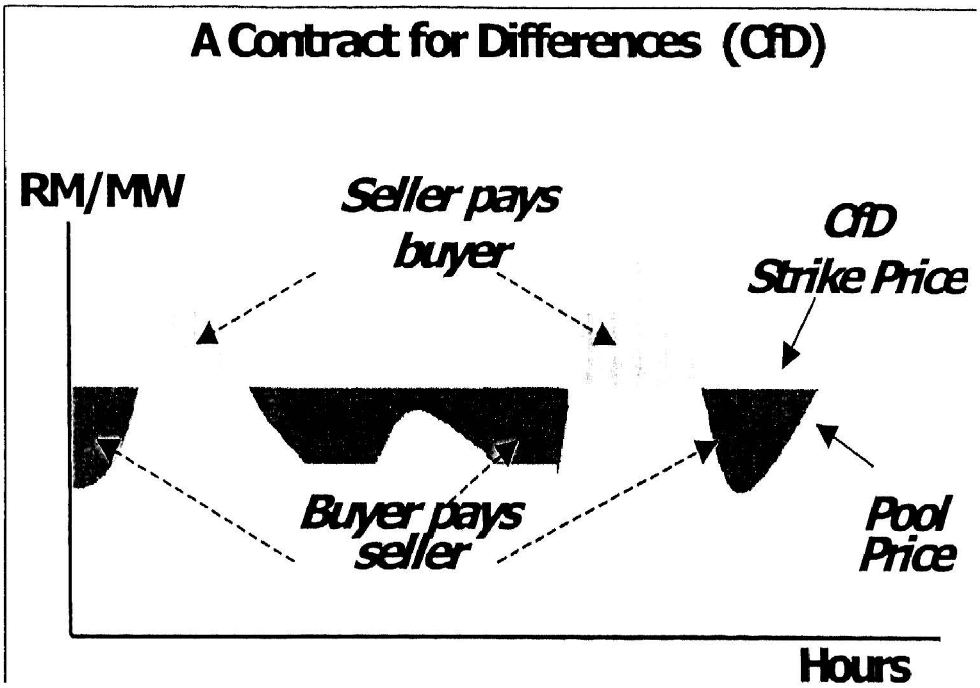

Figure 7.2: A Contract For Differences (CFD)

The major criticism against the England and Wales Power Pool is the emergence of market power. Two companies i.e. National Power and PowerGen dominate the pool price. The following summarizes the frequency with each company set the pool price immediately after the restructuring.[49]

	National Power	PowerGen
1991	90%	10%
1992	75%	15%
1993	50%	35%

[49] Competition in a Restructured Ontario Electricity Market, Henley International Inc., April 1997

In recent years, the two companies have set the price about 85% of the time. Due to the dominance of these two companies, there is serious doubt whether the pool price actually reflects the marginal cost of the plants. Furthermore, in several areas where transmission constraints are known, the pool prices are subject to "gaming". High cost plants, which would normally miss the merit order, may be constrained on and since they are paid their bid price and not the pool price, would bid tempted to bid high.

7.2.2 The Net Pool - Bilateral Trading

The model for net pool is as illustrated below:

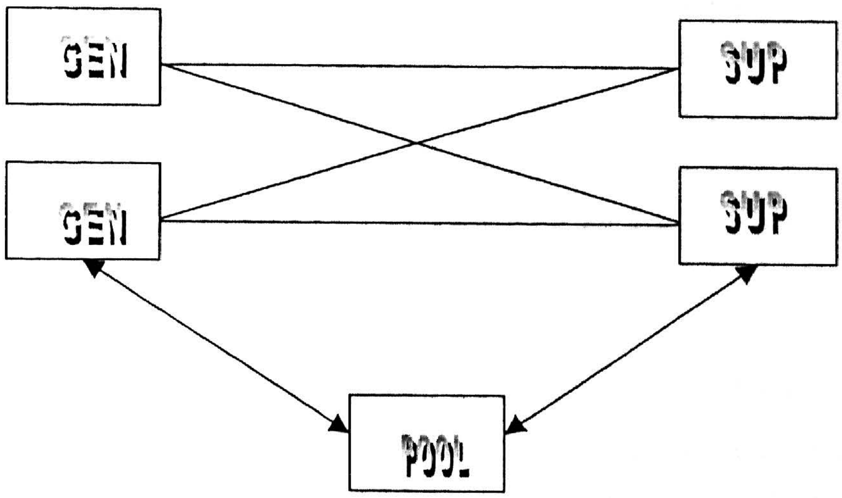

Figure 7.3: The Net Pool Model – Bilateral Trading

This model is the first to be adopted by the Nordpool, which covers Norway and Sweden. Thailand and Singapore's vision of the electricity market, and the implementation of a wholesale electricity pool, is also largely based on the above model.

In contrast with the gross pool, the above model allows for bilateral contracts between generators and suppliers. Since the level of demand and the exact availability of generation cannot be predicted accurately in advance, the net pool is therefore used to market the excess residual energy or demand. In the case that there are constraints in the power network system or that the pool price is lower than the generation costs, the generators may opt to buy power from the net pool to deliver to the suppliers as contracted instead of generating the purchase amount by themselves.

The disadvantage of bilateral contracts is related to the issues of transparencies. Since bilateral contracts are executed privately between generators and suppliers, it is argued that full competition is not realized. Power purchase agreement (PPA) is an example of bilateral contract. PPA usually "locks" the price of electricity for a long term and as such, is not responsive to competitive changes in the environment.

In addition, bilateral markets are feasible only if there is little congestion on the transmission network, a limited number of buyers and sellers and a system administrator who has complete knowledge and effective control of the entire interconnected network. "This type of market may not be workable once the number of buyers and sellers rises above a threshold level because it becomes increasingly difficult to match a group of bilaterally negotiated power sales agreements of varying duration that produce hard to predict physical demands on the grid with the need of a grid operator to balance the overall supply and demand of electricity on a moment-to-moment basis".[50]

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[50] The California Experience with Power Sector Reform, Lessons for Developing Countries, World Bank April 2001.

7.2.3 The Single Buyer Model

The single buyer model is as illustrated as below:

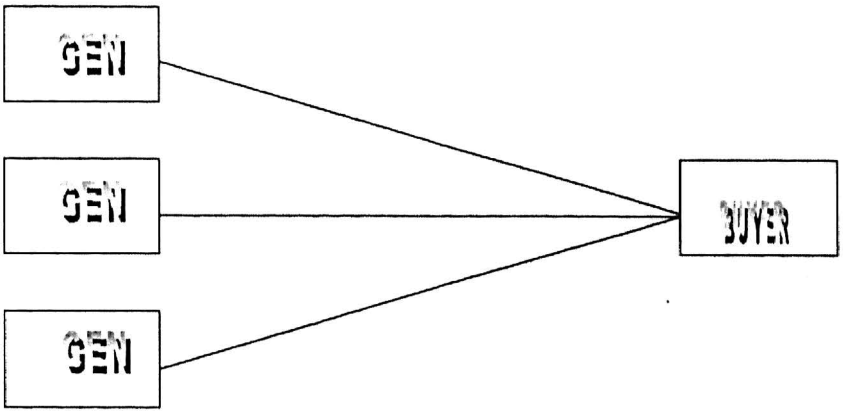

Figure 7.4: The Single Buyer Model

The above model requires that all generation supplies to be procured by a nominated authority that is acting on behalf of all registered consumers. The nominated authority, which tend to be state-owned, collates demand predictions and negotiate with generators to buy energy and services as indicated above.

The major drawback of this model is that the nominated authority represents a monopoly that is not subjected to market forces. This model is often cited as the "toe in the water" approach to introducing competition. Though moderate competition could be achieved through the selection of generators, it is often poorly implemented because the single buyer entity is "forced" into signing high priced power purchase agreement through political and commercial pressure exerted by the government. Furthermore, certain parties that benefited from the political and commercial interests of this approach would tend to resist or block further reform in the system.

Nevertheless, countries with smaller power systems tend to favor the above model. For these countries, the process of unbundling generation and distribution into smaller entities are too complicated and time consuming. Moreover, these countries lack the sophisticated market and financial mechanisms in implementing a power pool model. Even in advanced countries such as France and Italy, the above model is adopted, as there are strong opposition to third party access and a need to "protect" national interests.

The Managed Market Model (3M), as recently proposed by TNB of Malaysia as a part of power restructuring plan, is actually a single buyer model in disguise. The disadvantages of the model, as explicitly stated above, shall be taken into consideration by the Malaysian government in considering TNB's proposal.

7.2.4 The Zonal Pool Model

The Zonal Pool Model is as illustrated below:

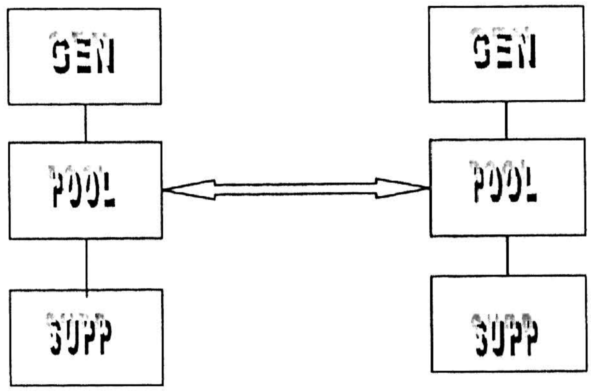

Figure 7.5: The Zonal Model

The zonal pool recognizes the constraints in the transmission network. With this model, different price energy is defined for different geographical area. Though separate pricing exists in each zone, trading can still be conducted between zones. Nevertheless, the amount of trading will be dependent on the interconnection capacity and price differentials among the different zones.

An advantage of the above model is that generation within a zone can be freely used without limitations due to transmission constraint. This model is appropriate where the existing network is weak and the introduction of more inter-zonal trading capacity might bring consumer benefit. This model is obviously suitable for countries with large geographic coverage such as the United States and Australia.

The major disadvantage of the above model is concerning the complexity of the system. In addition, new regulations need to be introduced and coordinated for inter-utility trading.

7.2.5 The Mixed Generation Model

This model is almost similar to the single buyer model. However, in the mixed generation model, the vertically integrated utility is being retained i.e. generation, transmission and distribution are still state owned. The participation of non-utility generation or sometimes known as Independent Power Producers (IPP) are required up to a certain proportion of the total energy output.

The above model provides a useful intermediate step towards introducing full competition in generation. However, it is claimed that the utility would always favor its own generation. As such, true competition cannot be realized.

7.2.6 The State Utility Model

This is the model that has been historically being implemented through out the world. The generation, transmission and often the distribution are all state owned. The absence of competition may lead to inefficiencies, over-investment and government interference for fiscal reasons that may disrupt development and investment in the industry.

The main advantage of the model is that it enables integrated generation and transmission planning. The state authority can also adopt a tariff policy which encourages the development of the infrastructure of the country as well as supporting the financing of major projects like hydro scheme.

7.3 Market Comparisons

For market reforms to be truly worthwhile, it must ensure that effective competition is introduced. In this regard, the structure of the market that is established to replace the current state utility model must recognize the requirements for effective competition.

There is no universally correct or ideal choice of market structure and the preferred arrangements at a particular time will be influenced by the stage of development of the system and its operating performance. Governments shall not be tempted to jump "into the band wagon of power pool" simply for the sake of deregulation. For developing countries, there is still a need for a high degree of involvement from the state authority to underwrite contracts and returns. For the more "advanced" utilities, competition can be introduced in stages for improving operational efficiency.

It should be kept in mind that the transition to a competitive market is not an instantaneous process. Market participants will be exposed to risks which they have no experience in mitigating. For this reason, getting the right market structure is only the beginning of a long journey. Managing the transition to the new structure could posed many challenging "dilemma" to all the participants of the process.

The Table 7.1 below is designed to illustrate some of the key features of each model and shows a qualitative relationship between cost, investment rating and security.[51]

Structure	Generation Competition	Integrated Planning	Monopoly Inefficiency	Cost Rating	Investment Rating	Security Rating
Gross Pool	100%	20%	0%	+12	Low	Low
Net Pool	100%	10%	0%	+11	Low	Low
Single Buyer	100%	100%	50%	+15	Med	Med
Zonal Pool	70%	50%	30%	+9	Med	Med
Mixed Gen.	60%	60%	50%	+7	High	High
State Utility	10%	100%	100%	0	High	High

Table 7.1: Qualitative Relationship between Cost, Investment Rating and Security of Each Model.[52]

[51] Reproduced from "Electricity Markets – Investment, Performance and Analysis", Murray, B. , John Wiley & Sons Ltd, 1998.
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