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# **Eskom Operational Efficiency: An investigation of the productivity, financial and technical performance of resources**

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A major dissertation submitted to the University of Cape Town in partial fulfilment of the requirements for the award of the degree of Master of Philosophy in Energy Studies.

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## Declaration

I declare that this dissertation is my own original work. It is being submitted in partial fulfilment of the requirements for the degree of Master of Philosophy in Energy Studies at the University of Cape Town. It has not been submitted before for any degree or examination at any university.

signature removed

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M Mtepa

*8<sup>th</sup>* day of *Oct*, 2003

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# Chapter One

## Introduction

### 1.1 Introduction

This chapter outlines and introduces the framework and main issues covered in this research. Section 1.2 outlines the justification for this work while Section 1.3 sets out the objectives of the study. Section 1.4 structures the approach through which these objectives are to be achieved. Lastly, the chapter introduces the subjects covered in Chapters Two to Seven.

### 1.2 Rationale of the study

There have been major changes in the electricity supply industry in most parts of the world. In South Africa, the government intends to restructure and/or introduce competition in the ESI. The need to reform, to introduce competition and/or to privatise power utilities is primarily aimed at boosting their efficiencies, although other reform drivers such as facilitation of Black Economic Empowerment (BEE) and mobilisation of private capital should not be neglected.

There are, however, conflicting opinions concerning ESI reform and/or privatisation in South Africa. On the one hand, the advocates of power sector reform and privatisation argue that South Africa's existing ESI is not efficient and therefore must be restructured, thereafter competition must be introduced in the industry to boost its efficiency and the quality of its supply. On the other hand, the opponents of reform and competition argue persuasively that the ESI (particularly Eskom) is performing well, because Eskom is currently selling electricity at a lower price than many (if not all) other utilities in the world while nevertheless still earning a profit.

As performance improvements ultimately result in lower prices and high quality services, many attribute Eskom's comparatively low prices to an efficient operational performance and are of the

opinion that the organisation does not need to be restructured. However, low operational costs do not necessarily imply that all efficiency improvements have been realised and may, in part, be due to factors such as low fuel costs. Furthermore, whilst improvements in operational performance do indeed reduce operating costs, investment efficiency, which has an even longer-term impact, reduces the proportion of capital-related costs in the electricity price. In this regard, the South African government's intention to restructure the ESI should not be mistakenly ascribed to its aim of improving Eskom's operational performance only but rather to its wish to achieve a number of objectives including improved investment efficiency and also attracting foreign direct investment (FDI).

### **1.3 Objectives of the study**

An independent survey conducted by the Electricity Association Limited established that Eskom is the lowest-cost producer of electricity in the world (Eskom 2002: 5). Normally, low costs production translates into low prices to consumers. *Does this mean, though, that Eskom is efficient?* The main objectives of this study are to understand *why*, in fact, Eskom's prices are low and whether this means that Eskom is indeed efficient. A thorough investigation of its performance over a number of years (1980-2001) will provide insight as to whether Eskom's low electricity prices can be attributed to improvements in its performance or not. *If not, what other factors could have contributed to Eskom's low price? Is Eskom's low price ultimately sustainable?* In order to answer these questions, all the price components that have been included in Eskom's average price are subjected to close scrutiny to establish their proportional contribution to the price, and to analyse these changes over time.

Investment decisions, with regard to the installation of power plants, further provide an insight on Eskom's allocative or investment efficiency. The timing of such major investments is crucial when examining allocative efficiency.

### **1.4 Research methodology**

Both productive (operational) and allocative (investment) efficiencies and their impacts on the price have been considered in this study. To establish operational efficiency, indicators that range from the financial (profitability ratios, debt management ratios, asset management ratios and liquidity ratios), to the technical (capacity factors, system load factors, plant availability and overall thermal efficiency), to labour productivity have been analysed. To determine the impact of investment on price, trends of the

price components (particularly capital-related) and the price were all analysed during the period when most of Eskom's investments in power plants were initially installed and the period after such investments.

The timing of investments, and the choice of technology of power plants, are two other issues that have been briefly considered in this research to provide a broader view of Eskom's investment efficiency and its repercussions on the price. This also helps to establish whether decisions to install new plants were timeous and whether they matched increases in demand.

A brief comparison has also been made between Eskom's price and performance against a small, select sample of other large utilities, although this has not been a major focus of this study.

This research has considered a broad spectrum of information in order to achieve its objectives. Information sources include Eskom's Annual Reports, Statistical Yearbooks and other relevant sources such as the National Electricity Regulator (NER), Department of Minerals and Energy (DME) and the Department of Public Enterprises (DPE). Information on other utilities is from published information on their web-sites and personal communications.

## **1.5 Structure of the study**

**Chapter Two** explores micro-economic theory on efficiency where extreme market structures, which include pure monopoly and competitive markets, and their respective efficiency improvement potentials, are evaluated. A detailed outlook of the influence of market structures on operational and allocative performance is presented in this chapter to provide insights on firm's behaviour given the structure of the industry within which it operates. This serves as the theoretical foundation for a discussion of operational and investment efficiencies in the ESI. It also suggests necessary conditions that need to be taken into account when introducing competitive market in the ESI in South Africa.

**Chapter Three** provides a general overview of the South African ESI, focusing particularly Eskom. It highlights the historical background of the ESI and the path that led Eskom to gain its current international status in terms of generation and sales of electricity. Of particular importance are recent institutional and organisational reforms that were largely aimed at invigorating performance improvements in the company. In addition to describing the existing structure of the South African

ESI, the chapter also attempts to highlight the future of the industry as envisaged in South Africa's white paper on energy policy, and recent restructuring decisions.

**Chapter Four** provides an initial analysis of Eskom's electricity prices. It answers questions of the following nature:

- *Are Eskom's prices lower than those of similar utilities in the world?*
- *What appear to be the main factors impacting on Eskom's electricity prices?*

The chapter addresses these questions by providing a comparative analysis of South Africa's household and industrial electricity prices against those of selected countries. In addition to that, Eskom's average price is compared with prices from selected utilities to ascertain whether or not its price is indeed low. Eskom's price is broken down into components, which are subjected to scrutiny over a number of years to ascertain their trends and proportional contribution to the price.

**Chapter Five** provides an in-depth scrutiny of Eskom's operational performance from 1980 to 2001. The chapter assesses the productivity of Eskom's resources such as labour and raw materials over a number of years. A close examination of financial and technical indicators extends the investigation further. A comparative analysis of Eskom's performance is then made with comparable indicators from other large power utilities. The latter analysis is indicative only: it is clearly beyond the scope of this study to provide a thorough analysis of international utilities.

**Chapter Six** analyses Eskom's investment efficiency. It introduces the key drivers of investment in power plants in the late 1970's and early 1980s. The chapter discusses investment trends and financial requirements to finance capital expansion programmes. Eskom's choice of technology and timing of investments are highlighted as well as their resultant impacts on thermal efficiency and excess capacity respectively.

**Chapter Seven** concludes the research findings. Conclusions as to whether Eskom's low prices can be attributed to its operational performance or some other reasons are provided in this chapter. It also suggests the way forward towards achieving improved operational and investment efficiency to secure reasonably cheap and high-quality electricity provision in South Africa in the future.

## **Chapter Two**

### **Operational and allocative efficiencies in the ESI: A microeconomic perspective**

#### **2.1 Introduction**

This chapter reviews the micro-economic theory of allocative and operational efficiency. Section 2.2 provides an insight in understanding the meaning of efficiency. Section 2.3 gives a detailed outlook of the influence of the structure of the industry, within which an organisation operates, on allocative and operational performance. The extreme markets, pure monopolistic as well as perfect competitive, are discussed in order to provide an understanding of efficiency potentials available in respective market. Lastly, section 2.4 highlights the necessary conditions that should be observed clearly when introducing competition and efficiency improvements in the electricity industry and section 2.5 concludes the chapter.

#### **2.2 Economic efficiency defined**

Economic efficiency is concerned with the optimal use of scarce resources in such a way that wastage and misallocation of such resources are avoided. Resources are wasted if more are utilised in the production of a specific quantity of product than is necessary. Misallocation of resources is a situation where more goods are produced than are required. In an industry like ESI factors of production such as capital, labour, raw materials, fuel etc are employed to produce what customers want (electricity) and are willing to pay for. Optimal allocation and utilisation of such resources are central to enhance efficiency in the industry, which would normally lead to reduced prices – this has social benefits to the society in terms of access and affordability.

There are two approaches economists employ when analysing efficiency: these include *partial equilibrium* and *general equilibrium approaches*<sup>1</sup>. The *partial equilibrium approach* analyses efficiency at the level of the firm or sector, whilst the *general equilibrium approach* looks at the

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<sup>1</sup> For more detail on *partial and general equilibrium* see Mansfield (1997: 487).

economy as a whole. For example, efficiency can be improved in one sector of the economy whilst other sectors are being affected adversely. Welfare economics, characterised by the *general equilibrium approach*, places emphasis on efficiency gains in the whole economy with the primary objective of optimised social welfare. Moreover, the *general equilibrium approach* provides a framework that scrutinises efficiency in all sectors of the economy simultaneously. Due to practical limitations inherent in the *general equilibrium approach*, the *partial equilibrium approach* is more often used, especially when conducting a sector specific efficiency analysis (that is, holding the other sectors of the economy constant). This research work investigates efficiency in the ESI within the context of the *partial equilibrium approach*. The focus of the investigation covers both productive and allocative dimensions of efficiency. These are discussed in detail below.

### **2.2.1 Productive (operational) efficiency**

Lipsey *et al.*, (1993: 287) state that productive efficiency<sup>2</sup> is attained when a company employs the lowest cost production method available when producing a given amount of output. This implies the least cost combination of its factors of production (or method of production) to produce a given level of output. From the social welfare point of view, productive efficiency is achieved when the price of a good is equal to the minimum average cost. In most cases, a monopolistic market is productively inefficient because of producing that level of the goods which earns it the highest profit. This is discussed in detail in section 2.3 below.

### **2.2.2 Allocative (investment) efficiency**

Allocation<sup>3</sup> of resources is efficient when the social marginal utility<sup>4</sup> derived from the consumption of the last unit of a good is equal to the social marginal cost incurred to produce such a good (Church and Ware, 2000: 750). Social welfare is enhanced when the industry produces a level of goods that efficiently satisfies the entire market at a reasonably low cost-reflective price. Such a level of production of goods, for which the society is willing to pay, should be maintained for as long as the cost of production is less or equal to the market price. This scenario could be negatively affected if the level of production declines, in which case the market price will increase due to high demand on limited supply of goods.

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<sup>2</sup> Productive and operational efficiencies have been used synonymously in this study. Church and Ware (2000: 750) describe “cost efficiency” to mean productive efficiency whilst Stuart (1997: 4) introduces it as “X-efficiency”.

<sup>3</sup> Allocative and investment efficiencies have been used synonymously in this study.

<sup>4</sup> The level of satisfaction (benefits) derived from the consumption of an additional unit of a product.

Furthermore, if an industry produces goods which consumers are not willing to pay for the social marginal cost incurred to produce them then becomes a misallocation of resources. Generally, allocative efficiency is achieved when the price is equal to the marginal cost (McConnell and Brue, 2002: 473). It is an industry's equilibrium level where it is impossible to reallocate resources to make one firm better off without making another firm worse off. This means that all factors of production are optimally utilised in the production of goods and services, and in turn, goods produced satisfy consumers' wants and needs.

## **2.3 The influence of market structures on allocative and productive efficiencies**

Economists use theoretical principles governing different market structures to illustrate allocative as well as operational efficiencies. The structure of the industry / market within which firms operate plays a greatest role in shaping their behaviour as far as allocative and operational efficiencies are concerned. Thus it is of paramount importance at the outset to understand how different market structures function and influence market participants' operational and allocative efficiencies. In this regard, this section discusses how different market structures influence firms' behaviour when making allocation or production decisions. Attention is paid to pure monopolistic and perfect competitive market structures when assessing allocative and productive efficiencies of firms in an industry. Whilst pure monopolistic structure illustrates inefficiencies of the firm operating in such an industry, perfect competitive market structure serves to show efficiency of firms.

Black *et al.*, (1997: 88) insightfully note that the extremes of perfect competition on the one hand and pure monopoly on the other hand rarely exist in the real world; nevertheless, the principles governing these extreme markets do serve as a benchmark against which different forms of markets can be analysed. Other market structures include monopolistic competition, oligopoly and duopoly. However, these do not form part of the scope for this research.

### **2.3.1 Monopolistic market structure**

Lipsey *et al.* (1993: 242) put forward that the word monopoly originated from the Greek words, *monos polein*, which mean "alone to sell". Economists adopted the word monopoly to mean a market structure that consists of one supplier of a particular commodity in the entire industry.

A pure monopolistic industry structure is characterised by a single supplier. Under this market scenario regulatory authority restricts entry to the industry. The presence of patent rights, licences, copyrights, exclusive franchises and many other forms of entry restrictions give rise to government-created monopolies (Black *et al.*, 1997: 112). On the other hand, natural monopolies are the results of the existence of economies of scale in such particular industries (e.g. transmission and distribution of electricity, gas pipelines, telecommunication etc). Unlike the situation that prevails in competitive markets, where entry to an industry is motivated primarily by profits, in monopolistic markets, the conditions mentioned above constitute barriers to entry into the market.

The monopolist is not a price taker. This is due to the fact that it can either inflate prices or restrict quantity of supply so as to earn economic profits from its undertakings. As the monopolist is the only supplier of a product in a specific industry, consumers have no other alternatives to satisfy their needs and wants, and are hence forced to bear the cost of poor allocative decisions as reflected in prices charged to them. Simply put, consumers have no choice and are forced to accept what the monopoly demands.

The monopolist's demand curve<sup>5</sup> is downward sloping from left to right, indicating that more goods will be supplied when prices go down, and vice versa. Thus, the monopoly's demand curve has the same shape as the market demand curve (Mansfield, 1997: 305). Unlike a firm in a competitive market, the monopolist when making profit-making decisions can choose a price and quantity to be supplied that earns it the highest return (Colander, 1994: 222).

Both the short-run and the long-run<sup>6</sup> equilibrium of a firm in a monopolistic industry may be characterised by economic profits. If the monopolist makes losses in the short-run it will look for other alternative uses of its resources that would be more profitable (Mansfield, 1997: 311). In the long-run, the monopolist make profit as it will not be confronted with competitors. If the monopolist makes economic profits in the short-run, it is therefore expected that the monopolist will expand its production capacity so as to earn even larger economic profits in the long-run.

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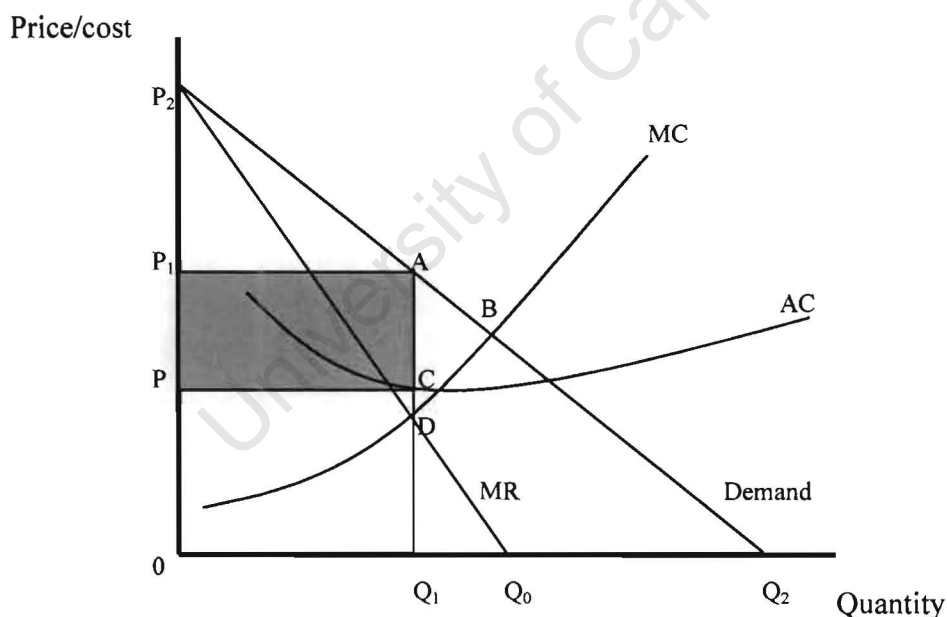
<sup>5</sup> Refer Figure 2.1 below. The demand curve slopes downward from left to right. It shows that price and quantity demanded are negatively related. As the price of the good declines the quantity demanded increases, and vice versa.

<sup>6</sup> The short-run is a period of time when fixed capital/resources (e.g. machinery and equipment) of a firm cannot be changed – thus, only variable resources can be increased to meet increases in demand. In contrast, the long-run is a period of time when all resources, fixed and variable, can be changed in response to changes in demand.

### 2.3.1.1 Allocative and productive inefficiencies in the monopolistic market

Allocative and productive inefficiency of a monopolist is illustrated by taking into account its allocation and production decisions as far as its main objective of maximising profit is concerned. In principle, the monopolist maximises profit when its marginal cost (MC) of producing an extra output is equal to its marginal revenue (MR) (Mansfield, 1997: 307; Colander, 1994: 221; Lipsey, 1993: 245;). Mansfield (1997: 307) clearly (and insightfully) explains how the optimal output<sup>7</sup> can be determined. He stresses that the level of output at which the MC of producing an extra product is equal to the MR derived from selling an extra product determines the optimal level. If a firm's MC is less than its MR, it can increase its profit by increasing its level of supply to the point where its MC is equal to its MR. Conversely, if the MC of producing an extra product is higher than the MR it is worth for the firm to reduce the output of such a product to the point where the two (MC and MR) are equal. By so doing, the firm increases its profits by cutting down additional costs resulting from excessive level of output.

**Figure 2.1. Equilibrium position of a monopolist.**



**Source:** Based on input from Colander (1994: 223) (Exhibit 4c).

The price-quantity combination at which the monopolist maximises its profit is neither productive nor allocative efficient. It is a point where the price that is charged for a good is higher than the AC and

<sup>7</sup> The level of output that maximises profit.

MC respectively. From the social welfare point of view, this constitutes maximised economic benefits at the expense of the society's welfare for the monopolist. By charging a price that is more than the social cost of producing a good, fewer goods and services will be consumed as a result. This is allocative inefficiency. As long as the price of a good increases over and above the social cost of production so does the decline in social welfare.

Figure 2.1 (above) shows how a monopolist makes decisions that lead to allocative and productive inefficiencies in the industry. Point D indicates a point where the monopolist's MC is equal to its MR. This point sets the price-quantity combination that earns it the largest profit. A rectangle  $PP_1AC$  shows the monopolist's economic profit<sup>8</sup>. Economic profits motivate potential investors to invest in the industry. But because of the existence of barriers, entry into the industry is restricted. The monopolist enjoys the market power. Fewer goods are supplied in the market such that the price remains high. As shown in the figure, the monopolist's profit maximisation point ( $MC = MR$ ) is not productively efficient because at this point the AC is not at its minimum level – it is still declining. The AC reaches its minimum level when the MC intersects it from below.

Furthermore, the firm is allocatively efficient when it supplies its products at a point where the social marginal cost is equal to the market price ( $P = MC$ ) – is the point where the allocation of scarce resources is optimal. This can be justified in a competitive market where in the long run average cost, marginal cost, marginal revenue and price are all equal. Scherer and Ross (1990: 23) argue that the monopolist allocates resources inefficiently to deliberately not satisfy consumer's wants. Although, consumers are willing to spend their incomes, they fail to get satisfaction because of the price and quantity that the monopolist fixes. By fixing a price at  $P_1$ , consumers' surplus is reduced due to the fact that less goods/services are consumed due to high price<sup>9</sup>. Or by only producing  $Q_1$  quantity of goods (a planned shortage), the price rises to  $P_1$  due to high demand. Point B in the figure (above) is the optimal point where social welfare can be maximised. It is a point where the social marginal cost of producing an extra good/service is equal to the social marginal benefits that can be derived from the consumption of such a good/service.

As it was noted above that the monopolist has the ability to control either the price or the quantity of goods to be supplied. In this regard, it is likely that the monopolist (if not regulated) would supply that quantity of output at a price that earns it the largest amount of profit (Mansfield, 1997: 306). Since the

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<sup>8</sup> Also called 'abnormal profit'. It is a profit that is over and above a fair rate of return on invested capital or opportunity cost.

monopolist maximises its economic profits at the point where marginal cost is equal to marginal revenue, a point that is less than the price, the social welfare is jeopardised. Depending on the price elasticity<sup>10</sup> of demand of a given product, high price will drive away consumers from spending their incomes on such a product. By charging a high price less will be consumed and by supplying fewer goods, the higher will be the price, and vice versa. The income that would have been spent on that product will be spent on some other pressing needs that will provide consumers with higher satisfaction. Only those consumers that would value the product higher than the price charged will buy it regardless of the increased price resulting from a strategically planned shortage of a commodity.

Allocative and productive efficiencies can as well be described by using demand and supply curves. Demand and supply curves illustrate allocative and productive efficiencies based on social welfare concepts, namely, consumers' surplus and producers' surplus. These concepts have been widely used in economics to measure/show allocative and productive efficiencies. They are based on the demand and supply theory and borrow their supporting arguments from the theory of the firm that describes different market structures. The two concepts are discussed in detail below.

### **2.3.1.2 Consumers' surplus**

Consumers' surplus measures the benefits (social welfare) that consumers derive from the consumption of goods and services. Lipsey *et al.* (1993: 147) define consumers' surplus as "...the difference between the market price and the maximum price the consumer would pay to obtain that unit [good or service]". Rationally, consumers buy goods that they value or that would satisfy their needs and wants. The price of the good in question is always a decisive factor in terms of whether or not to go ahead with the involved transaction. Only that product that would provide a consumer with more utility (benefits) compared to its price will be purchased.

Figure 2.2 (below) shows demand and supply curves. The area below the demand curve ( $OP_2Q_2$ ) indicates consumers' willingness to pay for a product. A movement downward in the demand curve shows consumers' willingness to pay for additional quantity of the product brought in the market. Given the purchasing power, consumers are willing to spend their monies on any quantity of the

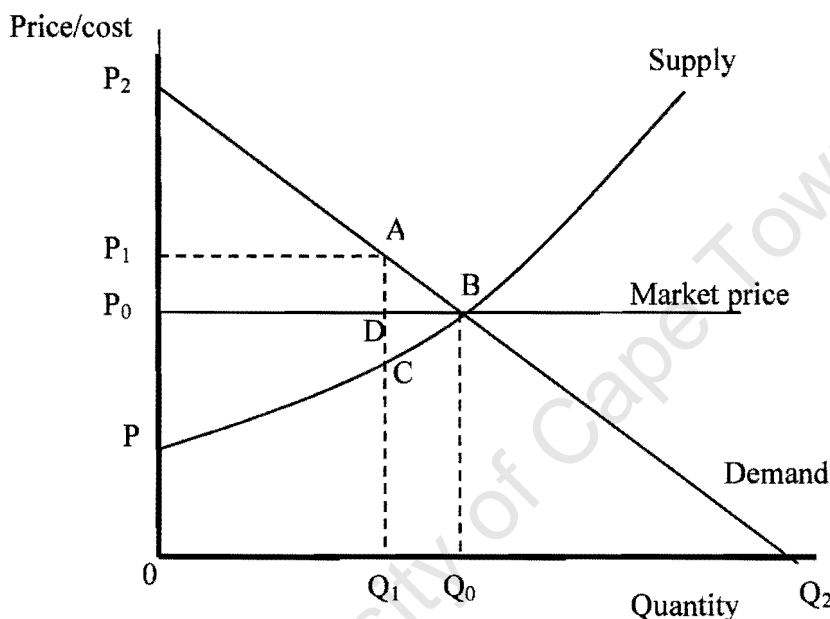
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<sup>9</sup> Discussed in detail below.

<sup>10</sup> The price elasticity of demand is the degree of responsiveness of changes in quantity demanded due to changes in price. The higher the degree of responsiveness the higher is the elasticity. Goods of this nature can either be normal goods or luxury goods. These are elastic. On the other hand, the degree of responsiveness of necessities to changes in price or income is very low; they are inelastic.

product below the demand curve due to the fact that they derive more satisfaction from them. If the price charged for a commodity is zero (at  $P=0$ ), consumers' would spend their monies to buy  $Q_2$  quantity of a commodity due to the fact that the benefits that would be derived will be higher than the cost they will incur (zero costs). This would be consumers' surplus if there were no social costs attached to a product. From the curve, the area  $OP_2Q_2$  shows this.

**Figure 2.2: Consumers' and producers' surplus**



**Source:** Based on input from Lipsey *et al.*, (1993: 293).

However, in principle, consumers' surplus is the difference between social benefits derived from a good or service and social costs incurred in its production. In other words, consumers' surplus is the difference between what consumers are willing to pay for and what they are actually paying (Colander, 1994: 212). The higher the social benefits compared to costs the higher will be consumers' surplus and vice versa, *ceteris paribus*. From Figure 2.2 (above) triangle  $P_0P_2B$  indicates consumers' surplus when the social cost is  $P_0$  and it declines to  $P_1P_2A$  when the price charged increases to  $P_1$ . At price  $P_0$  consumers are willing to pay a total cost that covers the area  $OP_2BQ_0$  that is equal to social benefits that would be derived from the consumption of that quantity of the product. Since the social cost of producing the quantity of a good is equal to the area  $OP_0BQ_0$  (price  $P_0$  times quantity  $Q_0$ ), it implies that the area represented by triangle  $P_0P_2B$  indicates consumers' surplus. In competitive markets consumers' surplus is maximised in the long run – this is part of latter discussion in the study.

### 2.3.1.3 Producers' surplus

Producers' surplus is the excess of what producers get from selling their goods to the actual costs of supply (variable costs) Lipsey *et al.*, (1993: 290). The area  $0PBQ_0$ , in Figure 2.2 (above), shows the variable costs<sup>11</sup> that producers would incur if the output,  $Q_0$ , was produced. By selling their goods at price  $P_0$  producers would earn total revenue of about  $0P_0BQ_0$ . Hence, the difference between total revenue ( $0P_0BQ_0$ ) generated from selling quantity  $Q_0$  of goods and the total variable costs ( $0PBQ_0$ ) indicates producers' surplus as represented by triangle  $PP_0B$ .

Consumers' surplus and producers' surplus can be maximised when the market structure in which consumers and producers operate is a perfectly competitive one. In such a market the ruling market price will be at  $P_0$ . It is an equilibrium price where total surplus (consumers' surplus plus producers' surplus) is maximised; social wellbeing is at the maximum level, so to speak. However, in a monopolistic market structure a producer, being the one and only supplier, has a market power and thus can make supply decisions that would maximise his economic profits regardless of their social welfare repercussions.

Furthermore, Figure 2.2 shows how suppliers earn excessive profits at the expense of consumers (in a monopolistic industry). Suppose a supplier charges price  $P_1$  for his commodities instead of the market price,  $P_0$ , a number of consumers will not buy such a product and that would consequently lead to a drop in the equilibrium quantity from  $Q_0$  to  $Q_1$ . The area  $P_0P_1AB$  as shown in the figure indicates the extent to which consumers' surplus will be reduced. The producers' surplus will be increased by  $P_0P_1AD$  (the value which is less by  $ABD$  compared to what consumers would lose) and part of producers' surplus (area  $BCD$ ) will be lost as well. However, a producer would gain more than what he will lose. From a social welfare point of view there is a loss in welfare because what is collectively lost is more than what a producer would gain. Collectively, a loss in consumers' and producers' surpluses (total surplus) is called a *deadweight loss*<sup>12</sup>, as represented by a triangle  $ABC$ . This illustrates the

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<sup>11</sup> Firms make their decisions either to produce or shut down their operations depending on their marginal costs of production. Only when their selling prices are higher than their variable cost should a firm continue with production. Otherwise it is better to shut down operations if the revenue generated cannot even cover variable costs. Thus, a marginal cost curve above a variable cost curve is as good as a supply curve. The supply curve shows the marginal costs of producing an extra unit of a good.

<sup>12</sup> Deadweight loss is a net loss of surplus resulting from a producer decision to reduce the quantity of goods supplied (Lipsey *et al.*, 1993: 292). It is a measure of allocative inefficiency in that "willingness to pay exceeds cost of production or cost exceeds willingness to pay" (Hodge, 2002).

general behaviour of private producers whose aim is to maximise their profit at the cost of the public interest.

#### **2.3.1.4 Economic justification of monopoly in the ESI**

Why did most countries in the world adopt a monopolistic structure in the ESI given inefficiencies of the structure as discussed above? For the past number of years the adoption of monopolistic structure in the ESI was assumed to be ideal for the industry. This was based on the fact that the industry required large sums of money that were tied up in infrastructure development (fixed costs) and intrinsically possessed economies of scale that it was cost-effective if there was only a single supplier of electricity. Industries such as water supply, telecommunication and electricity, to mention but a few, required large amounts of initial capital resources to finance the establishment of their infrastructure. Large capital requirements made it difficult for the private sector, especially in developing countries, to invest in power sectors. Thus, governments in most countries in the world took over the responsibility to assume ownership of electricity supply network industry so as to ensure reliable power supply in their respective countries.

Because of inherent social (public) implications related to the industry, it was inevitable for governments to intervene by providing for funding for such public investment. The services they provided were needed by virtually everyone in society – the rich and the poor alike. Given large capital investment in these industries (fixed costs), the average cost tends to decrease as more and more goods are produced, *ceteris paribus*. This assumption holds true in a constant variable cost industry<sup>13</sup>. Because of economies of scale<sup>14</sup> associated in network industries, suppliers who are already established have competitive advantage. They will be in a position to increase production as demand for the product increases that would consequently reduce their average price. This, however, effectively prevents the entry of other companies into such an industry unless the government actively encourages it and legislates it.

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<sup>13</sup> It is possible for the price of resources used in the production of a good to increase due to its increased demand. If this happens, it is likely that the average total cost of production might increase instead of decreasing depending on the increase in the cost of resources. Thus, if the costs of these resources are held constant, the average cost of production will decrease as more and more goods are produced.

<sup>14</sup> An industry is said to have economies of scale when the average price of a good produced by a specific company in such an industry decreases as its total production increases. That is, cost per unit decreases with increases in the level of production.

### **2.3.1.5 Natural monopolies and the need for government intervention to enhance efficiency**

Church and Ware (2000: 752) describe a *natural monopoly* as an industry that minimises average costs of products when a single firm is involved in production. This occurs when the industry in question has relatively high fixed costs compared to variable costs of production. Increasingly, it becomes more cost-effective the more items of a certain good it produces.

According to Church and Ware (2000: 753) and Kim and Horn (1999: 1), natural monopolies bring about a conflict between productive efficiency and allocative efficiency. They note clearly that productive efficiency requires a single firm in the entire industry whilst allocative efficiency requires many firms. If it is not subjected to regulation, a single firm will charge monopoly prices and earn economic profits at the expense of social welfare (this causes allocative inefficiency). Kim and Horn (1999: 2), also, pointed out that natural monopolies would lead to socially undesirable outcomes if allowed to set the prices by and for themselves, as they would not sell their products at an efficient price<sup>15</sup> due to losses they would encounter. If there is neither a price nor entry regulation put in place in a natural monopolistic industry, two possible outcomes are likely to happen as highlighted by Hodge (2002):

- Many companies will enter the market, which would lead to productive inefficiency in the industry.
- If only one company serves the entire market it will dominate the industry and therefore charge unfairly higher prices (monopoly prices).

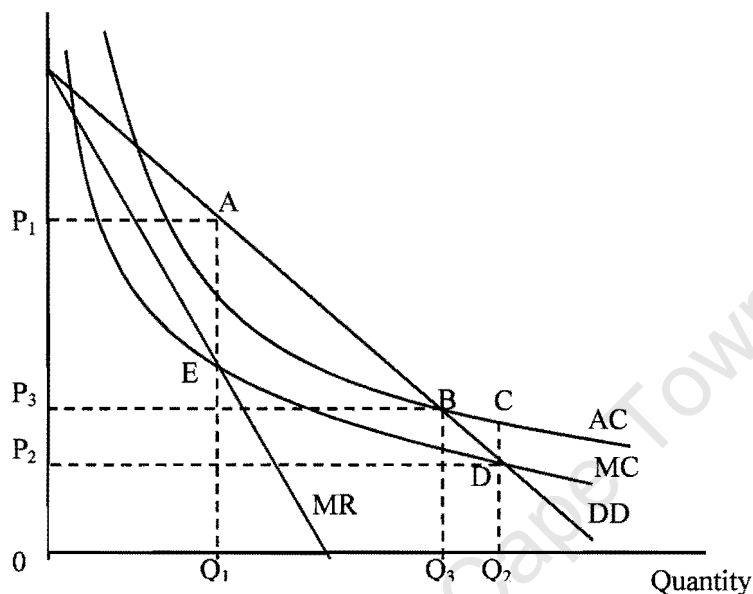
As many companies enter the market there is an increase in average cost of production (productive inefficiency). Furthermore, as the average cost increases relative to increases in the number of participants in the industry, the maximisation of allocative efficiency becomes questionable. This is due to the fact that the average cost would be higher compared to the social marginal cost of producing the last unit of the product and its market price. If many companies are allowed to compete in a natural monopolistic industry, they will produce up to the point where their average cost per unit is equal to price and not where their marginal cost equals the price. If they produce more products beyond this point they will incur losses that will drive them out of business. Thus, less quantities of a product for

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<sup>15</sup> It is an optimal price at which social welfare is maximised – a price at which social benefits derived from an additional good is equal to social marginal cost of supply. That is, it is a long-run equilibrium price where both consumers' and suppliers' surpluses are maximised.

which consumers are willing to pay for will be produced and as a result consumers' surplus will be jeopardised.

**Figure 2.3. Natural monopoly – Decreasing cost industry**



**Source:** Based on input from Rowley (1972: 53)

Figure 2.3 (above) shows a company in a natural monopolistic industry. If not regulated, the company will produce  $Q_1$  quantity of the product and sell it at price  $P_1$ . At this price-quantity combination the company maximises its economic profits since its marginal cost of producing an extra product is equal to its marginal revenue. Furthermore, it is a point where social welfare tends to be jeopardised because consumers are still willing to pay for extra goods up to the point where the marginal cost is equal to price (at point D). However, if many producers are allowed to compete, they will not produce at that quantity ( $Q_2$ ) which will maximise social welfare as well. Instead the maximum quantity that will be produced will be  $Q_3$ , a quantity at which their average cost is equal to price. Consequently, the market fails to allocate resources efficiently. This necessitates government intervention for the equitable provision of such a good to the benefit of the society as a whole. With the underlying objectives of allocative efficiency, Maphiri (1997: 4) argues that it requires the government to be involved in the production such that consumers will pay a price that equals the marginal costs. This being the case, social welfare will be maximised at point D where the quantity demanded is  $Q_2$  and the price is  $P_2$ . To enforce this, the regulatory authority will have to device means to foster allocation of resources in favour of the society. However, if a company produces  $Q_2$  and charges  $P_2$  it will be making a loss due

to the fact that its average cost of production is higher than the regulated market price. To ensure its effectiveness and durable existence in rendering such an essential public service, the government will have to use fiscal resources to subsidise such a company at the level of the distance between point C and D which is the difference between its price and its average costs. Even though the use of fiscal resources to subsidise loss-making industries should be undertaken with much caution. It is possible to enhance efficiency in one sector of the economy and worsen other sectors quite severely (in terms of efficiencies) compared to what has been gained. A decision to tax other sectors of the economy in order to subsidise the loss-making industries should be thoroughly investigated if the “second-best” problems have to be avoided to the society’s advantage.

### **2.3.1.6 Regulation and efficiency improvement in the ESI**

As has been discussed above, the monopolist would normally maximise its profits at the expense of the society. Given the value placed on the product by the society, the government has to intervene and correct such market failures. The inherent existence of markets failure and related externalities in the industry justify economic regulation such that all socially undesirable outcomes a market can bring are accounted for in the furtherance of social welfare.

Regulation of power utilities has been and is still being practised in most countries in the world, (particularly, in South Africa), in an attempt to control undesirable practices by such public utilities that can jeopardise social welfare. A number of tools have been used to ensure that public utilities provide what is expected of them, given the large sums of fiscal resources invested in them. By understanding the nature and dynamics characterising and influencing the operational behaviour of utilities in the ESI, the regulatory authorities apply different regulatory tools to control the utilities. Tools such as “rate of return” and “price cap” have been most commonly used to control the monopolistic power exerted by the utilities for regulating such a monopolistic environment so as to restore and maintain social wellbeing.

#### **2.3.1.6.1 Price cap regulation**

To induce innovation and cost-cutting behaviour on the part of the monopolist, the regulatory authority determines the maximum price (ceiling price) which the monopolist can charge on its customers. As pointed out above, the monopolist may, if not regulated, have the powers to restrict the quantity supplied so that it can charge high prices and earn abnormal profits, even though there might be an increase in demand. With the “price cap” regulatory measure put in place, the only option for a

(natural) monopolist to have its business remaining economically viable, would be to emphasise on cutting the cost of production: this would assure the firm of realising its envisaged profit.

Apart from leading to cost-cutting, “price cap” regulation has a negative impact on the quality and reliability of services. Berg (2001:3) indicates that the use of price cap can lead to a poor quality of services as well as limitation on infrastructure development due to the fact that incentives to over-invest in power plants would be low.

#### **2.3.1.6.2 Rate of return (cost-of-service) regulation**

This is a regulatory tool which is aimed at enhancing efficiency in the industry by allowing the monopoly to earn a reasonable amount of profit, based on the invested capital. Given the likelihood of socially undesirable practices by the monopoly, the regulatory authority sets the expected profit that a monopoly would earn, which will be reflected in prices to be charged on customers.

The use of “rate of return” as a regulatory tool has brought many undesirable outcomes from the social welfare point of view. The major problem has been the tendency for regulated utilities to overcapitalise because their profits are determined based on their capital resources. Berg (2001: 3) argues that the “rate of return” provides utilities with an opportunity to cover their costs on the one hand, and incentivizes them to over/under invest in plant, inflate costs, and cross-subsidise, on the other hand. This could be the case for Eskom, that is, over-investing in its power plants<sup>16</sup>.

Theoretically, if the “rate of return” is higher than the cost of capital (market interest rate)<sup>17</sup> it is not surprising for utilities to over invest in their plants. Conversely, if the rate of return is less compared to the cost of capital, it is possible for the utilities to under-invest in plant and instead may invest in other business ventures for which the return is substantially higher.

Although their structural behaviour was and is still regulated, inefficiencies in power utilities in terms of both allocation of resources and operational performances are being questioned worldwide. Because of asymmetry of information, it was difficult for regulatory authorities to regulate the utilities effectively and efficiently in such a way that social welfare (under the umbrella of lower electricity

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<sup>16</sup> Before 1987 Eskom operated as a non-profit making organisation where it was legally allowed to cover its costs of production. Due to over-investment in power plants during the late 1970s and early the 1980s, the government instituted business practices in the utility where it was allowed to earn a reasonable rate of return on its invested capital. Refer section 3.2.5 in Chapter Three for more detail.

prices and better services) is maximised. The use of regulated electricity prices in both methods, that is, price-cap regulation and rate of return has been ineffective in rendering allocative as well as operational efficiencies in the ESI mainly due to information asymmetry that hinders the regulatory authorities from determining an optimal price. The regulator is supposed to be aware of the production processes and associated costs as well as the way the market behaves for it to determine the optimal price. For social welfare to materialise, there is no doubt that the regulator must be in a position to negotiate (set) a price equal to point B (Figure 2.1) or  $P_0$  (Figure 2.2 above).

Thus, the restructuring and the introduction of competition in the industry is a possible way forward to improve performance and thereby reduce the electricity price in order to enhance social welfare.

### **2.3.1.7 Changes in the role of regulation as market reforms are adopted**

Clark (2001: 10) opposes a notion that structural reforms of the ESI have reduced the need for regulation. The author advances that this has rather vitalised the need to regulate the industry differently. A change in the role of regulatory authorities is inevitable as market reforms are adopted. Changes in ownership and market structures in the ESI, are geared to unbundle the industry vertically and horizontally. This allows for competition which in turn, introduced in the electricity generation and supply (retail) segments of the industry whilst transmission and distribution retain their monopolistic status. As markets change, the need to introduce new regulatory regimes in the ESI in South Africa that would efficiently and effectively meet the needs of future competitive electricity market is essential.

Due to these changes the National Electricity Regulator has to pursue regulatory oversight on the natural monopolistic segments of the ESI, transmission and distribution, on the one hand and play an assistance role to the competition regulatory authority on competitively feasible elements of the industry on the other hand. Once again, the use of incentive-based tools described above would be very critical to boost efficiency of transmission and distribution sectors of the industry. Clark (2001: 10) adds that although technical regulation on quantity of supply and safety will not necessarily be overly affected by the changes taking place in the ESI, new systems of incentives over prices, concessions and third party access are very important to ensure effectiveness and efficiency of the industry. On the other hand, the existing Competition Commission will be responsible for monitoring and intervening when any anti-competitive practices in the market-based competitive activities (generation and supply/retail) persist.

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<sup>17</sup> The market interest rate determines the cost of capital. It is an opportunity cost sacrificed when the amount of

Moreover, there must be a clear demarcation between these two authorities in order to avoid the overlapping of activities that might occur during the course of pursuing their responsibilities. In practice, during the transition to a competitive market, an overlap of responsibilities between these regulatory authorities is expected, and in most cases the electricity regulator is expected provide professional assistance to the competition regulator. Furthermore, the regulator should take a proactive role in ensuring that the ESI reforms promise efficiency gains. This requires not only independence of regulatory authorities from political interference but also enough resources ranging from machinery to human capital.

## **2.3.2 Competitive market structure**

Having discussed monopolistic market structure and how it influences firm's productive and allocative behaviour, this section discusses the other extreme market structure (competitive market) in order to scrutinise efficiency potentials inherent in the market.

A competitive market is a market that is composed of many suppliers and buyers. Many suppliers and buyers are necessary for the competitive market to allocate resources efficiently and in such a manner that social welfare is maximised. The larger the number of suppliers and customers, the higher will be the effectiveness and efficiency of the market. This feature is very important as it influences the behaviour of both suppliers and customers since these are both price takers. Neither a single supplier nor customer would be able to influence the price of the product due to the presence of numerous suppliers and customers. Thus, production or consumption decisions of an individual supplier or customer, respectively, are insignificant to influence the market price.

### **2.3.2.1 Allocative and productive efficiencies in the competitive market**

#### **2.3.2.1.1 Competitive markets in the short term**

In the short run companies respond to any changes in demand by changing their supplies through the use of variable resources (e.g. materials, labour, fuel etc) or utilising their excess capacities. As the demand increases so does the utilisation of variable inputs when producing additional products to cater for an increase in quantity demanded. In the short-run any increases in the quantity demanded would consequently lead to an increase in the quantity supplied. The industry is at equilibrium when the

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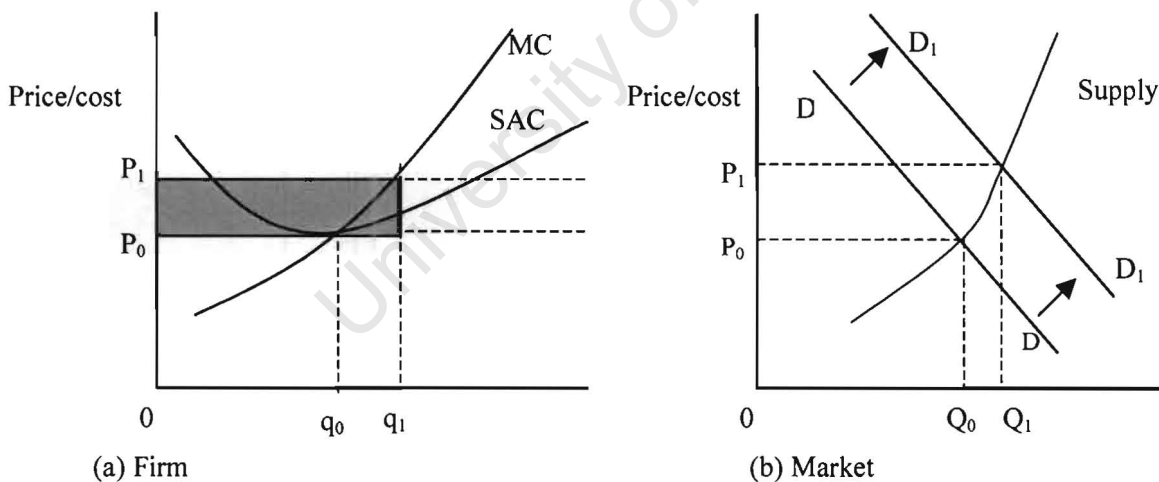
capital is invested in some other investments.

quantity demanded is equal to the quantity supplied. Mansfield (1997: 256) argues that in the short-run, the equilibrium price and output tend to increase as long as there is an increase in demand. There will come a point where the companies utilise all their full capacities and hence the use of variable resources to respond to increases in market demand would not be feasible.

As a result, an increase in demand in the short run will lead to an increase in market price due to the fact that quantity supplied will be less than what is actually demanded. An increase in price will lead existing companies (those that operate cost-effectively) in the industry to earn economic profits, over and above the socially desirable rate of return of their invested capitals.

Companies in a competitive market face a perfect elastic<sup>18</sup> demand curve due to the fact that no any individual company can change the market price regardless of its production decisions. As shown by Figure 2.4 (below), straight horizontal lines ( $P_0$  and  $P_1$ ) indicate that a firm can only change its quantity of supply and not the price. Since all firms are price takers, it is therefore important to notice that firms' marginal revenues will be equal to the market price.

**Figure 2.4. A competitive market in the short-run**



**Source:** Based on input from Colander (1994: 209)

Figure 2.4(a) (above) shows the firm's costs curves in the short-run and Figure 2.4(b) (above) shows the industry's demand and supply curves in the short-run as well. At first, both a company and the industry were at an equilibrium price of  $P_0$  and quantity of  $q_0$  and  $Q_0$  respectively. Figure 2.4(b) shows

<sup>18</sup> In other words, a "horizontal" demand curve. See Mansfield (1997: 248) for further detail.

an increase in industry (market) demand from  $D$  to  $D_1$ , which as a result led to an increase in equilibrium price from  $P_0$  to  $P_1$  and equilibrium quantity from  $Q_0$  to  $Q_1$ . Because of a shift in demand in the short-run, the existing companies will utilise their excess capacities (if any) and variable resources to cater for an increased quantity demanded (a difference between  $q_1$  and  $q_0$ ). Since price  $P_1$  is higher than  $P_0$  and short-run average costs (SAC), a company will earn economic profits in the short-run as shown by a shaded rectangle in Figure 2.4(a). As long as there are economic profits in the industry, new companies will enter into the industry and supply more products.

The presence of economic profits in the industry is very important if such an industry has to attract new investments. Apparently, the price of electricity in South Africa is very low compared to many countries in the world due to low production cost (Eskom 2002). This is mainly due to the use of cheap coal, debts that were used to finance most power plants now in use have been paid, no taxes are paid (before 2000) and that most power plants are located near coal mines<sup>19</sup>. Due to lower prices (that might be uneconomical) it is likely that profit-oriented companies will not be attracted to invest in the ESI unless their costs of production are lower than market price. Thus, the government as well as other stakeholders, when restructuring the industry should make sure that the price of electricity is economical in such a way that new investors would be attracted to invest in the industry. If the price is higher than the cost of producing electricity in the short-run, it is expected that new investors (local and foreign investors) will be attracted in the industry.

#### **2.3.2.1.2 Competitive markets in the long run**

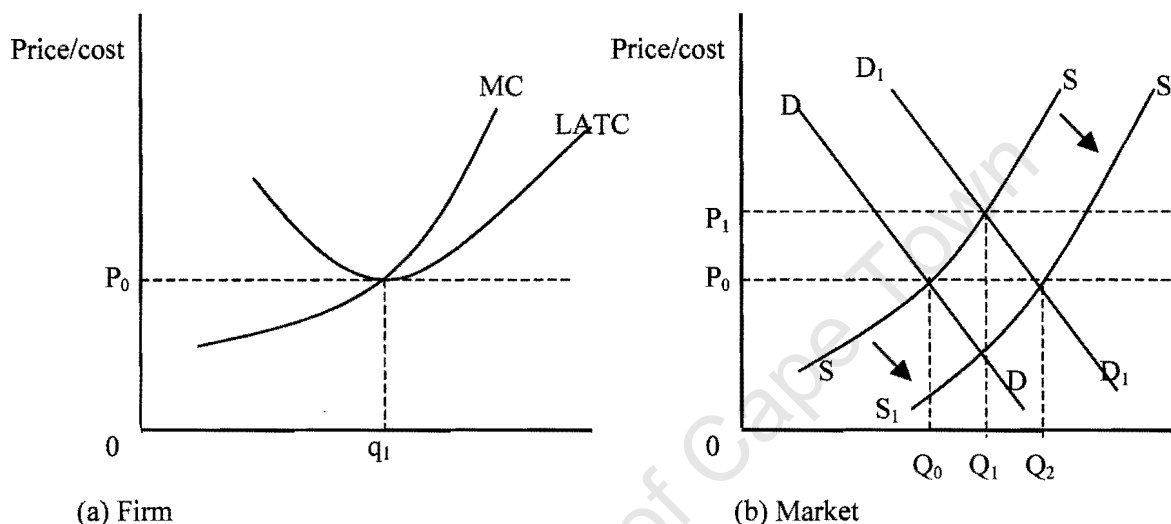
In the long-run the proportion of all factors of production, fixed as well as variable, utilised in the production process can be changed. As the demand for a product increases, both variable and fixed resources can be changed to respond to changes in market demand and increased short run economic profit as highlighted above. The existing companies in the industry can increase their capacity by installing new plants as well as using variable resources. Due to profit motives, new producers will continue to enter into the industry, which in turn will increase total supply of the product. Consequently, the higher the supply of a given product, the lower the price will be and vice versa, *ceteris paribus*. This will lead to a decline in market price and economic profits and ultimately, the economic profit will be zero, and thus some of the companies will exit the industry and invest somewhere else where they will expect to reap more returns from their investments.

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<sup>19</sup> Discussed in detail in Chapter Four.

In the long-run, the industry attains its equilibrium when price, marginal revenue, marginal cost as well as average cost are equal ( $P=MR=MC=LAC$ ). It is a point where social welfare is maximised. Producers sell their goods at the price that is equal to the social cost of producing them (that is,  $P=MC=MR$ ). Total surplus is maximised in the long-run.

**Figure 2.5: A competitive market in the long-run**



**Source:** Based on input from Mansfield (1997: 262)

Figures 2.5(a) and 2.5(b) (above) show a company's cost curves and an industry's demand and supply curves in the long-run respectively. As shown in Figure 2.4(b) above that the existing firms respond to the short-run increases in demand in the industry by increasing their production up to quantity  $Q_1$  given their fixed and variable resources. However, in the long-run all factors of production vary as noted above. In conjunction with expanding their production facilities on the part of the existing companies, profit-oriented companies will enter the market, given the existence of economic profits in the industry. Ultimately, as more suppliers enter the market so does the increase in quantity supplied that would consequently reduce the market price and associated economic profits. This is shown in Figure 2.5(b). A shift in supply curve from  $S$  to  $S_1$  indicates an increase in quantity supplied from  $Q_1$  to  $Q_2$  and a decline in market price from  $P_1$  to  $P_0$ . By driving down the market price consumers will benefit from the competition. In the long-run the company attains its equilibrium price ( $P_0$ ) which is equal to its MC as well as its long-run average cost (LAC) as shown in Figure 2.5(a) above. This is synonymous with the maximisation of total surplus (consumers' and producers' surpluses) as discussed above.

Scherer and Ross (1990: 20) summarise the advantages of competitive markets in rendering social welfare as follows:

- Since the price of goods paid by consumers is equal to the marginal cost of producing them, then there is efficient allocation of resources. That is, consumers' and producers' surpluses are maximised in the long-run as shown in Figures 5(a) and 5(b) above.
- There is no any company earning economic profits in the industry due to the fact that in the long-run the average costs are equal to the market price. A profit received by companies in the industry is just sufficient to cover the cost of capital investments used in the production of industry's output. A competitive market provides incentives for participants to innovatively strive to cut their costs of production so as to gain competitive advantages over rivals (this enhances operational efficiency).
- Companies that fail to operate at the minimum level of their average total costs will be driven out of the industry. All loss making companies will have to invest in some other industries where the return on their capital will be sufficient to at least cover their costs of capital.

It is therefore expected that the introduction of competition in the ESI in South Africa will bring about increased efficiency in the industry.

## **2.4 Introduction of competition in the ESI and potential for efficiency improvements**

### **2.4.1 Technological developments and decline in economies of scale in the ESI**

Recent technological developments all over the world have vitalised the feasibility and introduction of competition in the generation and supply segments of the ESI, whereas the transmission and distribution have remained natural monopolies that are subject to regulation. With increased technological developments and a decline in economies of scale, the ESI has undergone structural and ownership changes. New technologies have allowed for use of small and advanced electricity turbines that have, therefore, reduced capital requirements for new suppliers. This also makes it easy for the

private sector to invest in the electricity industry. All these reforms of the ESI are aimed at introducing competition and thereby enhance operational and investment efficiencies in the industry.

## **2.4.2 Necessary conditions for the introduction of an effective competitive market in the ESI in South Africa**

For the sake of efficiency improvement in the ESI, the restructuring and introduction of competition in the ESI in South Africa should enhance the following conditions necessary for competitive markets to be allocatively and productively efficient; (The market structure should provide incentives for participants to allocate their resources efficiently in such a way that social welfare is realised).

### **2.4.2.1 There should be excess supply capacity in the industry for the introduction of competition in the ESI to enhance efficiency gains: the role of many suppliers**

Many ESI around the world, particularly in developing countries, enjoy market power. The South African ESI provides one of the prominent examples. Although there are other electricity producers (for example municipalities and sugar industries), their contribution to the national electricity supply has been negligible and thus Eskom, until recently, enjoys a monopolistic role in the industry. The idea behind the restructuring of network industries is to enhance the effectiveness and efficiency of the industries. This outcome makes it prudent for having many suppliers who can compete for the already existing large numbers of customers. If its existing structure were to remain unchanged, the South African ESI would not realise the benefits of competition that would be reflected in lower prices charged to its customers.

The South African ESI is characterised by excess capacity<sup>20</sup>. This is a very important factor when a specific country considers introducing competition in the industry<sup>21</sup>. For the competition to be successful, the allocation of electricity production capacities among companies in the industry should be divided and shared among firms in such a manner that there is no single company that would be able to exercise exclusive market power. It is important to investigate exactly how such capacity is allocated to individual companies in the industry, so as to identify measures that would aid to minimise such firms' anti-competitive behaviour. The larger the extra capacity, the better the industry restructuring will be, and vice versa. If the existing capacity is less than the demand, introducing competition in such an industry will affect consumers negatively, since the suppliers will be able to control the market price

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<sup>20</sup> Refer Figure 6.3 in Chapter Six and Appendix IX.

by restricting their production and charging higher prices. (The case for a reduction in consumers' surplus as discussed above).

It is instructive in this regard to consider the 1998-2000 California power crisis, which provides useful insights and lessons in as far as power sector reform is concerned. There was a power shortage in California at that time, and one solution seemed to be the introduction of competitive markets. This turned out to be a disaster, however, because of market design flaws as highlighted by The World Bank (2001: 5) and Menlo Energy Economics (2001: 7-1). Some power utilities exercised their monopolistic advantages to reap their economic profits at the expense of consumers. In the case of South Africa, it is feasible to introduce competition in the ESI due to the existence of excess capacity.

#### **2.4.2.2 There should be no barriers to enter to and exit from the industry**

The principle of free entry and exit is of paramount importance for the effective operation of the competitive market. It highlights the sensitivity of market participants to changes in market forces (particularly demand and supply). In the short term, as the demand of the product increases, so does its price and associated profits to suppliers, *ceteris paribus*. The opposite is also true. Because there are no barriers to entering the market, higher levels of profit will attract new suppliers into the industry, which will increase the supply of the product in question. The higher the supply of a particular product, the lower its price will be. In the long run, as more and more suppliers enter the industry, the quantity supplied will increase and as a result the price will go down and so, too, will the economic profits. Intense competition will force suppliers to increase the quality of their services and to find ways of reducing their prices so as to attract customers. This might ultimately reach a point where it is uneconomical to supply the product in question and hence the loss-making supplier will exit from the industry.

Since entry into the industry (competitive market) is driven by profit motives, there is a need for an ESI structure that would make it possible for new entrants to enter and exit the market. Profit-oriented firms have to be attracted to invest in the market. Structural changes will make it possible for local and international companies to enter the industry and provide electricity in the country and thus government's intention to attract foreign direct investments (FDI) can be realised.

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<sup>21</sup> Thomas (2001) suggests an excess capacity of between 20-25% for an effective competitive market.

### **2.4.2.3 Product homogeneity**

For a competitive market to function effectively, products being traded in the market must be sufficiently similar so that no particular product is preferred to another. The phrase “product homogeneity” means that a specific product in an industry has the same quality, size and taste as products from another supplier, and thus no supplier has any competitive advantage. Also a distance from a source of supply to consumption is a determining factor and can negatively affect the effectiveness of competition. The longer the distance from a service the higher will be the cost of a product (particularly due to transportation costs). All the above factors need to be observed very closely and should eliminate any discrepancies arising amid consumers and suppliers. Thus, the only weapon a supplier will use to win more customers is the price. They will make cost-effective decisions to reduce their production costs and hence their prices. Since there is no product differentiation (i.e. there are no different brands), suppliers would strive to win more customers by charging lower prices. This will be compounded by the fact that customers’ decisions to buy a product from a particular supplier will be influenced by the price charged by such a supplier.

### **2.4.2.4 Buyers and sellers should have [access to] accurate information**

If suppliers and customers have access to accurate information, they will be able to make informed decisions as far as the allocation of scarce resources is concerned. Customers will not only be aware of the ruling price of a product in the industry at a particular point in time, but also of the future prices as well. This being the case, no supplier would price his product at a price higher than the industry’s ruling price. On the other hand, suppliers would also have enough information to make more cost-effective decisions when buying and allocating their resources in a way that will reduce their costs of production, and thus their prices, so as to gain a competitive advantage in the industry.

If the electricity industry is to be effective and efficient, there should be a way of keeping suppliers and customers properly informed of prevailing conditions in the industry, which would, to a great extent, influence their decisions. To this end, the regulatory authority in the electricity industry will have to play a significant role in an attempt to keep the market participants well-informed and up-to-date.

As discussed above, an individual firm in a competitive market faces a perfect elastic demand curve because the price is fixed and cannot be changed. This is due to the fact that it cannot charge more than other companies. The only decision it can make is therefore to change quantities of goods that it supplies, when it seems profitable to do so.

### **2.4.3 The need for effective regulation to enhance efficiency in the transmission and distribution sectors**

The introduction of competition in the ESI is feasible in the generation and supplying/retailing segments of the industry. In the natural monopolistic sectors like transmission and distribution, competition is not plausible, therefore, their operation should be left out of competitive market environment. Due to large capital investments required to build networks for transmission and distribution of electricity, it will be a misallocation of resources for two or more companies to own networks and compete for customers in one area. Take for example two or more companies building their networks to supply one suburb. This would be a wastage of resources in terms of both, money invested in extra and unnecessary networks and space used to install them that could have been used to cater for other needs. Thus due to efficiency reasons, transmission and distribution sectors are natural monopolies and are subject to regulation. The regulatory authority needs to provide incentives to enhance their efficiency and effectiveness.

## **2.5 Conclusion**

This chapter has discussed the ways in which market structures influence productive and allocative behaviours of firms operating in such industries. Whilst the monopolistic market structure is neither allocatively nor productively efficient, the competitive market is potentially efficient.

At a theoretical level, the poor performance of most power utilities in the world can be attributed to the structure of the industry (within which they operate) as well as institutional and market governance. The monopolistic structure of the ESI gave room for governments to interfere in the daily activities of the power utilities. Moreover, lack of managerial skills, lack of accountability and responsibility of the managers and the ability to pass on the burden of poor decisions to customers, among other things, have been the major attributes to the current under-performance of many utilities around the world, especially in developing countries. On top of these, lack of measures to induce high performance efficiency constitutes further negative apt and key concerns with regard to power utilities.

Although the ESI in most countries (South Africa in particular) have been characterised by monopolistic features some incentives have been made available to stimulate allocative and productive efficiencies in the industry. Due to information asymmetry, lack of accountability of management and ineffective regulatory authorities, incentives that have been put in place to boost the efficiency of

power utilities have been ineffective. Incentives that have been in wide application include *rate of return and price cap* and this is used in South Africa. The impact of this regulatory tool (incentive) has induced capital investment in the industry and thus led to excessive capacity. On the other hand, the *price cap* provides investors with an incentive to reduce their costs of production in an attempt to increase their economic profits.

Technological development, allocative and operational inefficiencies, the influence of international lending agencies, to mention but a few, are some of factors that have played a major role in the evolution of the ESI in the world. In most countries, the primary goal is to increase ESI efficiency and effectiveness, the quality of their services and security of supply. All these factors have, to a great extent, shaped the current trend of the ESI reforms. The pace is fast, with most of countries aiming at having an effective and efficient competitive market structure in the future, particularly South Africa.

# **Chapter Three**

## **The South African Electricity Supply Industry: Overview**

### **3.1 Introduction**

This chapter provides an overview of the South African ESI. Section 3.2 highlights the historical background of the South African Electricity Supply Industry with particular reference to Eskom. It shows the path through which Eskom used to gain its current status in terms of generation and sales of electricity. Of particular importance is the way Eskom underwent structural changes that were largely aimed at improving performance in the organisation. Section 3.3 reviews the existing structure and section 3.4 explores the possible future structure of the industry.

### **3.2 The historical background of the South African ESI and the emergence of monopolistic structure in the industry**

#### **3.2.1 Early developments**

The historical background of the South African ESI shows that towards the end of the 19<sup>th</sup> century (1880s) and the early 20<sup>th</sup> century (1900s) the industry was composed mostly of private companies that were not subjected to regulatory authorities. Initially, major developments in the South African ESI were fuelled by mining activities particularly after the discovery of diamonds in Kimberley and gold on the Witwatersrand. The demand for electricity escalated, which gave rise to the establishment of a number of independent power stations (Steyn, 1994: 3). Also the need to electrify streetlights increased the demand for electricity. In 1882, Kimberley introduced electric streetlights earlier than any town in South Africa and, more interestingly, before London (Eskom Annual Report, 1996). Moreover, in 1890 Kimberley's first reticulation system was commissioned, and other municipalities followed suit: Johannesburg was reticulated in 1891, Pretoria in 1892, Cape Town in 1895, Pietermaritzburg in 1896, Durban in 1897, East London in 1899, Bloemfontein in 1900 and Port Elizabeth in 1906 (*ibid*).

Tremendous developments in the ESI took place in 1906 when the Victoria Falls Power Company Limited (VFP) was registered. The company was aimed at utilising the hydro-electric potential of the Victoria Falls to cater for electricity needs of the industries based on the Witwatersrand and in Southern Rhodesia (Zimbabwe) (*ibid*). Unfortunately, technical and financial reasons hindered the development of the project and instead, the VFP focused on the utilisation of coal in the Transvaal. By 1915 it had four operating power stations under the name of the Victoria Falls and Transvaal Power Station (VFTPC) (*ibid*).

Furthermore, the need to electrify the railways contributed greatly to the development of the South African ESI. The South African Railways and Harbours Administration sought London-based experts on railway electrification, Merz and McLellan, to study and provide advice on the best way of electrifying the railway line that linked Transvaal and Natal (Steyn, 2001: 63). The South African High Commissioner requested Merz and McLellan to extend their study to address not only “how best railways could be electrified” but also to respond to the more “general question of electric power supply” (Steyn, 2001: 63) in the Union of South Africa. In April 1920 they recommended the need to have a central controlling authority mandated to oversee and coordinate the development in the ESI in order to reap the growing economies of scale that naturally existed in the industry. Due to the non-existence of a central electricity-controlling authority, there existed different technical standards from different producers that were composed of municipalities and private players.

### **3.2.2 Establishment of ESCOM**

Parliament enacted the Electricity Act of 1922, which was aimed at the establishment of a national power system that could eventually meet the country’s demand in its entirety (Eskom Statistical Yearbook, 1996). It was in March 1923 that the Electricity Supply Commission (ESCOM) was established (Steyn, 2001: 65) and began generating electricity in 1925. ESCOM was mandated to supply electricity to government departments, the South African Railways and Harbours Administration, local authorities, companies and other persons engaged in industrial activities in the Union of South Africa (Steyn, 2001: 64). Furthermore, ESCOM’s primary goal was to establish new electricity undertakings in cooperation with the existing generators to ensure a cheap and abundant supply of electricity (Steyn, 1994: 4).

The Electricity Act also established the Electricity Control Board (ECB) with a mandate to control ESCOM and private undertakings to supply electricity efficiently and effectively in the Union in order to meet government’s stated objectives as encapsulated in the above paragraph. The Act furthermore

authorised the ECB to issue licenses to ESCOM and private undertakings that intended to supply electricity in the Union (Steyn, 1994: 4). In contrast, municipalities were not obliged to apply for licenses issued by the Board for them to supply electricity. Steyn (2001: 64) summarises the responsibilities and powers vested in ESCOM as follows:

- To ensure the supply of ‘cheap and abundant’ electricity by investigating the establishment of new or additional facilities in any area of the country.
- To ensure a sufficient supply of electricity by establishing, maintaining and managing new undertakings.
- To co-ordinate and co-operate with existing undertakings to ensure a cheap and sufficient supply of electricity.
- To advise Provincial Administrators on the best course of action to be taken when municipalities proposed to either establish new electricity undertakings or extend their existing ones.

ESCOM used its powers and responsibilities to expand its generation capacity by funding and owning power stations, although at some stage some of its power stations were built and operated by the VFTPC. Steyn (2001: 68) puts forward that although the VFTPC was a large undertaking towards the ends of 1940s, it operated ESCOM-owned stations with generating capacity more than twice its own capacity. Furthermore, ESCOM interrupted all attempts to build power stations by other undertakings. This happened when the South African Railways and Harbours, the Durban municipality and the VFTPC applied to the ECB to build additional power stations.

### **3.2.3 ESCOM’s monopolistic powers after the expropriation of the VFTPC**

The year 1948 marked the end of the VFTPC, a privately owned electricity company. Among the reasons that initiated the end of VFTPC was the legislative right by the state to expropriate the VFTPC as stipulated by the 1910 Transvaal Power Act and the 1922 Electricity Act (Steyn, 2001: 69). The fact that ESCOM was supplying electricity on a “non-profit basis” consequently increased the need to expropriate the VFTPC. It was in July 1948 that an agreement to sell the VFTPC to ESCOM was reached (Steyn, 2001: 70).

Ever since then, ESCOM has mostly monopolised the South African ESI by investing massively in power stations to keep pace with the increased demand for electricity in the country following the mid-

seventies world oil crisis. This necessitated most municipalities previously running diesel generators to switch to ESCOM power as this had become cheaper and more reliable by comparison (Steyn, 2001: 75). These investments were funded by foreign and local debts. By 1973 ESCOM had linked all its separated undertakings to each other by establishing an integrated transmission system (national grid), a system that connected all major cities in the country (Eskom Statistical Yearbook, 1996). From 1981 onwards Eskom produced more than 90%<sup>22</sup> of the electricity requirements of the country. Furthermore, Eskom produced about 95.6% of total electricity produced in South Africa in 2000 (NER 2000: 2) and about 95.7% in 2001 (NER, 2001: 5).

### **3.2.4 The appointment of the De Villiers Commission**

Substantial increases in electricity prices between the mid 1970s and early 1980s raised political concerns. In 1977 the Board of Trade and Industries was instructed by the then Minister of Economic Affairs Chris Heunis to investigate tariff policy in South Africa and found that Eskom was making significant profits (Steyn, 2001: 93) which was contrary to the Act that established it. Steyn (2001: 94) adds further that:

Although ESCOM managed to scupper the Board's findings it could not escape the political pressure to keep prices down. With the start of the investigation ESCOM scaled back on its price increases, but instead of reducing contributions to the Capital Development Fund, it chose to reduce its surplus [and] in 1978 and 1979 onwards ran a net loss.

In May 1983, the then Prime Minister, P W Botha, instituted a "Commission of Inquiry into the Supply of Electricity in the Republic of South Africa" (the "De Villiers Commission" as named after its chairman, Dr J W L de Villiers) to investigate ever-increasing electricity prices. The Commission conclusively pointed out that ESCOM's managers' behaviour of over-investing in power plants had resulted in price increases as managers' poor investment decisions were passed on to customers.

### **3.2.5 Commercialisation of Eskom**

Commercialisation<sup>23</sup> has been the first step in restructuring utilities in most countries in the world. Many monopoly power utilities, particularly in developing countries, have been operating under high technical and non-technical losses, low quality of services, inefficient system operations, lack of

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<sup>22</sup> A ratio between electricity produced by Eskom and total produced in South Africa and expressed as a percentage. (see Eskom Statistical Yearbook, 1996: 20).

managerial skills and with insufficient responsibility and accountability. All the aforementioned factors necessitated the introduction of commercial disciplines in the power utilities in an attempt to restore their financial and productivity performances.

In most countries public utilities were established to provide social services rather than for profit motives. ESCOM electricity prices were regulated in such a way that the revenues collected enabled it to cover its production costs, contribute to the Interest Fund and to the Loan Redemption Fund. High electricity prices in the late 1970s and early 1980s necessitated the introduction of commercial disciplines to restore financial and productivity performance.

Eskom underwent major organisational and institutional changes in 1985 following the implementation of the De Villiers Commission's recommendations in 1984 by the then government. To institute both operational and allocative performances, the Commission (1984: 15-17) recommended *inter alia*:

- the use of the two-tier board system where the Board of Control, which was composed by electricity customers, oversaw the Management Board during the course of rendering its services for the social benefit;
- to abolish "the not-for-profit or loss" principle to encourage sound financial accounting; and
- to encourage energy conservation to avoid wastage from the part of the consumers.

As a response to the De Villiers Commission's recommendations, ESCOM was restructured "to meet the electricity demands of a changing South Africa" (Eskom Statistical Yearbook, 1996). In 1985 Eskom, a body corporate, replaced the Electricity Supply Commission. At the same time a non-executive body, the Electricity Council, composed of ESI stakeholders, was established with a mandate to control and appoint Eskom's Management Board which constituted the executive authority (Steyn, 2001: 103). The same year (1985) also marked the change of Eskom's name in order to reflect both the English and the Afrikaans version. Eskom (or Evkom in Afrikaans) (Steyn, 2001: 103) was changed to Eskom.

In 1987 the Eskom Act replaced the "fund accounting convention" with "depreciation accounting". The "not-for-profit" policy was abolished and Eskom could from that year earn a reasonable return on its invested capital – business behaviour stimulants were put in place to motivate managerial performance.

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<sup>23</sup> Commercialisation is that act where a power utility is required to operate on business principles (Marandu *et al.*, 1999:104).

Three years later (after the change of organisational structure in 1985), more changes in the industry were considered. The government commissioned a study to privatise and or introduce competition in the industry (Eskom) in an attempt to inherently invigorate operational and allocative efficiencies as the management becomes accountable and responsible to private owners. The study was managed by Eskom and involved other industry stakeholder. About 70 organisations, both electricity and non-electricity utilities, in eight countries, were interviewed on the matter (Eskom Annual Report, 1988: 38).

### **3.2.6 Eskom in the new South Africa**

In the 1990s, changes were fuelled by the democratic revolution that marked the end of the apartheid era in the Republic of South Africa. Changes were inevitable, particularly after the newly elected democratic government in 1994. The government wanted to address, among other things, poverty in the midst of disadvantaged communities particularly black South Africans. The Reconstruction and Development Programme (RDP) documented the policies to alleviate poverty in South Africa. More liberalised policies that favoured market-driven economic activities were later instituted – partly because of the adoption of the Growth, Employment and Redistribution (GEAR) policy which was aimed at increasing economic growth rates, reducing inflation and tariffs, and creating jobs.

Several negotiations among electricity stakeholders took place. The 1994 National Electrification Forum marked the end of the Electricity Control Board and the birth of the National Electricity Regulator (NER), an independent body with a mandate to encourage efficiency and effectiveness of the ESI. During the early days after its inception, the NER focussed attention on the electrification of more households that, during the apartheid era, were denied of the essential service. It was also a time when Eskom felt responsible to distribute electricity to small customers (households)<sup>24</sup>. More households were connected and Eskom agreed to reduce its electricity price in real terms to stimulate economic and social wellbeing of South Africans, particularly black communities<sup>25</sup>.

The 1998 “White Paper on Energy Policy for the Republic of South Africa” clearly highlights government’s objectives as far as the ESI is concerned. The following are government’s objectives:

- improvement of social equity by addressing the energy needs of the poor.

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<sup>24</sup> Before then Eskom was supplying electricity to large customers. Municipalities were primarily responsible to distribute electricity to households, although most of them were not financially viable due to inability to collect debts.

<sup>25</sup> Refer Eskom price compacts in Chapter Four (section 4.4.3) for more detail on real reduction of electricity price.

- provision of low-cost and high quality electricity services thereby increasing efficiency and competitiveness of the economy as a whole.
- enhance environmental sustainability.

(DME, 1998: 29).

To achieve the above stated objectives, the “White Paper” states further that:

- customers should have the right to choose their electricity supplier;
- competition should be introduced into the industry, particularly on the generation sector;
- there should be an open, non-discriminatory access to the transmission system; and
- participation of the private sector into the ESI.

(DME, 1998: 29).

The aforementioned objectives suggest the restructuring of the ESI. Structural reforms as well as ownership changes are awaiting implementation. The implementation of the suggested reforms would once again reintroduce the previously discarded structure of the industry that existed about 100 years ago, but this time with an excess capacity, one of the most important conditions for the effectiveness of competition in the ESI. The structure then was composed of independent power companies that were profit-motivated working together with municipalities. It was operated in a non-competitive environment due to a shortage in capacity, the absence of an integrated electricity grid and a lack of effective regulatory regimes to oversee improvement in efficiency of the industry for the benefit of the society at large.

### **3.2.7 Non-regulated businesses of Eskom**

Eskom was restructured again in January 2000 when Eskom Enterprises was established to cater for non-regulated businesses of Eskom<sup>26</sup>. Eskom Enterprises is primarily focused to explore opportunities in other countries of Africa. Together with its subsidiaries, associate companies and joint ventures, Eskom Enterprises pursues the following activities (Eskom Annual Report, 2000: 44):

- “Infrastructure development, which includes asset creation, project management, consulting services, and research and development

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<sup>26</sup> From 2000 onwards Eskom Annual Reports show Group’s financial statement and Eskom separately which before then they were included together.

- Management contracts for business operations, operating, maintaining and refurbishment contracts and the acquisition of operating entities
- Specialised energy utility services and equity investment in related services
- Related strategic businesses, including telecommunications and information technology
- Primary energy provision”.

### **3.2.8 Incorporation of Eskom**

The Eskom Conversion Act, Act 13 of 2001 converts Eskom<sup>27</sup> into a company with a limited share capital with effect from 1 July 2002. The government is the sole owner of all Eskom Holdings Limited shares. This entails that Eskom is liable to pay dividends to the government. A new management structure was introduced. The Electricity Council and the Management Board was replaced by a Board of Directors. By converting Eskom into a limited company means that management of the company (Directors) has more autonomy, responsibilities and accountability as far as daily operations of the company are concerned. Their main objective is to increase shareholder’s value by paying dividends to the government.

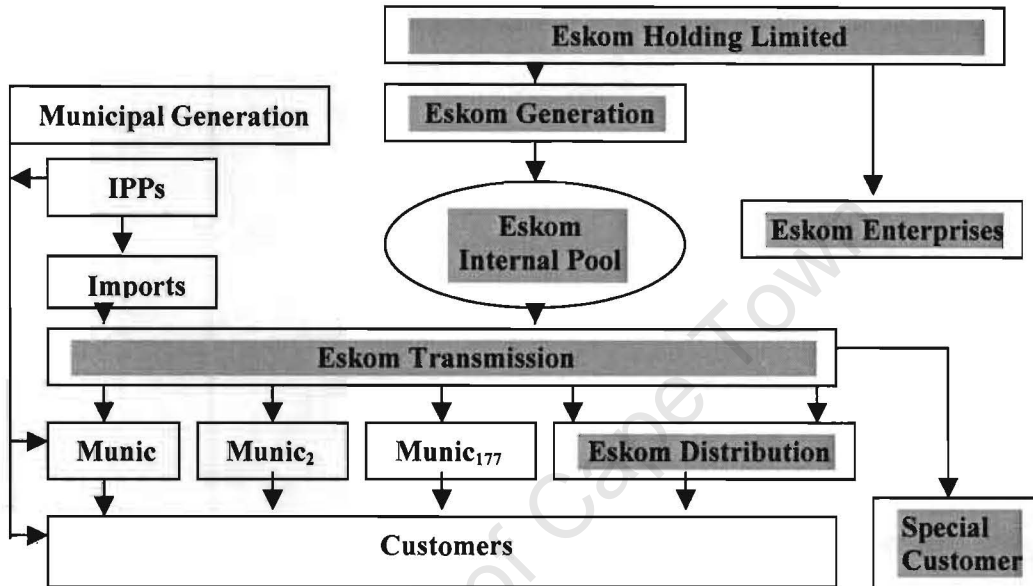
Furthermore, corporatisation simplifies the transferability of ownership/shares. Thus, the government is in a position to meet its objective of empowering blacks economically through transferring its share capital to historically disadvantaged blacks and also attracting other local and international investors to buy shares when listed in the local and international stock markets respectively.

## **3.3 The existing structure of the South African Electricity Supply Industry**

The South African electricity supply industry can be divided into three main divisions according to their functional activities. These are generation, transmission and distribution of electricity. Generation of electricity involves the transformation of fossil fuels or any other energy source into electricity. Transmission involves the transfer of electricity from the generator (through a high-voltage national network) to the distributor, whereas distribution makes electricity available to consumers in a usable form (low voltages). The distribution function also includes the supply of electricity to customers. All activities ranging from marketing, supply, metering and billing are included in the retailing/supplying segment of the ESI.

Transformers provide the link between generators, transmission and distribution networks. Power generated is stepped up to high voltages so that it can be transmitted over long distances to distribution centres, and from these the voltages are stepped down when distributed to customers.

**Figure 3.1: The existing South Africa's electricity supply industry**



Source: Adapted from Eberhard (2001: 16)

### 3.3.1 Electricity generation in South Africa

Electricity generation includes the state-owned and vertically integrated power utility namely Eskom and private and municipal generators (though in a negligible percentage). Private generators involve few industries (e.g. Sasol, and sugarcane mills) which own and operate generating facilities for their own use. Municipalities and local distributors, also own power stations although most of them have not been operated on a full-time basis due to running costs, only being operated during times of emergencies and/or peak hours as a backup to Eskom supply (Steyn, 1994: 7).

The NER issues electricity generation licenses in South Africa. By the end of 2001, there was a gross total licensed capacity of about 43,165 MW of which 39,870 MW was granted to Eskom, 1,836 MW to municipalities and the remainder 1,458 MW to private generators (NER 2001: 10). Coal plays a

<sup>27</sup> Named Eskom Holdings Limited.

dominant role in electricity generation in South Africa. Coal-fired plants generate about 93% of South Africa's electricity requirements (NER, 2001: 9). Of the total 21 coal-fired fully operational plants in South Africa, Eskom owns 10, municipalities own 7, and the rest by private generators (*ibid*). Other sources of electricity include nuclear<sup>28</sup> which contribute about 5.4% of total electricity generation, pumped storage (1.1%), hydroelectric (0.8%), baggase (0.15%) and gas (0.1%) (*ibid*).

### 3.3.1.1 Eskom's generation capacity

In 2002, Eskom had a total nominal capacity of about 42,011MW of which coal-fired plants accounted for 37,678MW, 1,930MW nuclear, 1,400MW pumped storage, 661MW hydroelectricity and 342MW contributed by gas power stations (Eskom Annual report, 2002:132) as shown in Tables 3.1 and 3.2 below. In the same year Eskom's total net maximum capacity was composed of 32,066MW from coal-fired plants, 1,800MW nuclear, 1,400MW pumped storage, 600MW hydroelectric and 342 from gas stations (*ibid*). Due to old age of plants, the use of low quality coal and auxiliary power consumption, Eskom's total net operating capacity was 36,208MW (Eskom Annual Report, 2002:132), reduced by about 5,803MW when compared with its total nominal capacity.

**Table 3.1: Eskom's Coal-fired power stations in commission at 31 December 2002**

Name of station	Number and capacity of generator sets	Total nominal capacity (MW <sup>1</sup> )	Total net maximum capacity (MW <sup>1</sup> )
Arnot	6 x 350	2,100	1,980
Camden	8 x 200	1,600	-
Duvha	6 x 600	3,600	3,450
Grootvlei	6 x 200	1,200	-
Hendrina	10 x 200	2,000	1,895
Kendal	6 x 686	4,116	3,840
Komati	5 x 100; 4 x 125	1,000	-
Kriel	6 x 500	3,000	2,850
Lethabo	6 x 618	3,708	3,558
Majuba	3 x 657; 3 x 713	4,110	3,843
Matimba	6 x 665	3,990	3,690
Matla	6 x 600	3,600	3,450
Tutuka	6 x 609	3,654	3,510
Total		37, 678	32,066

**Source:** Eskom Annual Report (2002: 132).

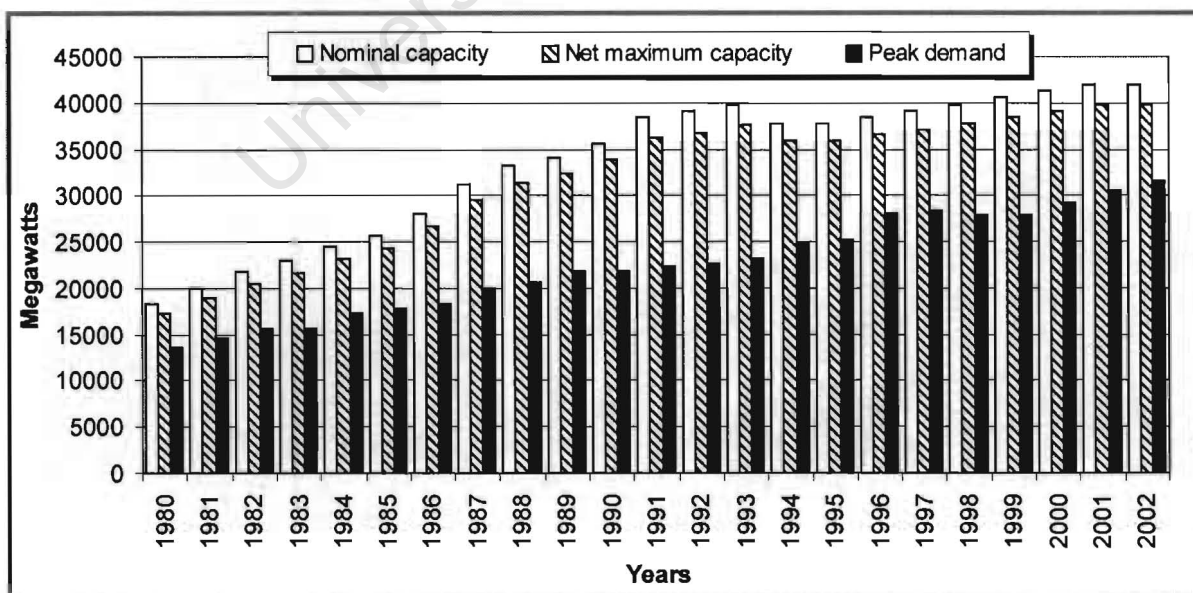
<sup>28</sup> Eskom owns the only nuclear power station in Africa, Koeberg. It is situated 30 km north of Cape Town (Eskom, 1989: 2; Eskom Annual Report, 1980: 22).

**Table 3.2: Eskom's Gas turbine, hydroelectric, pumped storage schemes and nuclear power stations in commission at 31 December 2002**

Name of station	Number and capacity of generator sets	Total nominal capacity (MW <sup>1</sup> )	Total net maximum capacity (MW <sup>1</sup> )
<b>Gas turbine</b>			
Acacia	3 x 57	171	171
Port Rex	3 x 57	171	171
<b>Hydroelectric</b>			
Colley Wobbles	3 x 14	42	
First Falls	2 x 3	6	
Gariiep	4 x 90	360	360
Ncora	2 x 0.4; 1 x 1.3	2	
Second Falls	2 x 5.5	11	
Vanderkloof	2 x 120	240	240
<b>Pumped storage</b>			
Drakensberg	4 x 250	1,000	1,000
Palmiet	2 x 200	400	400
<b>Nuclear station</b>			
Koeberg	2 x 965	1,930	1,800
		4,333	4142

Source: Eskom Annual Report (2002: 132).

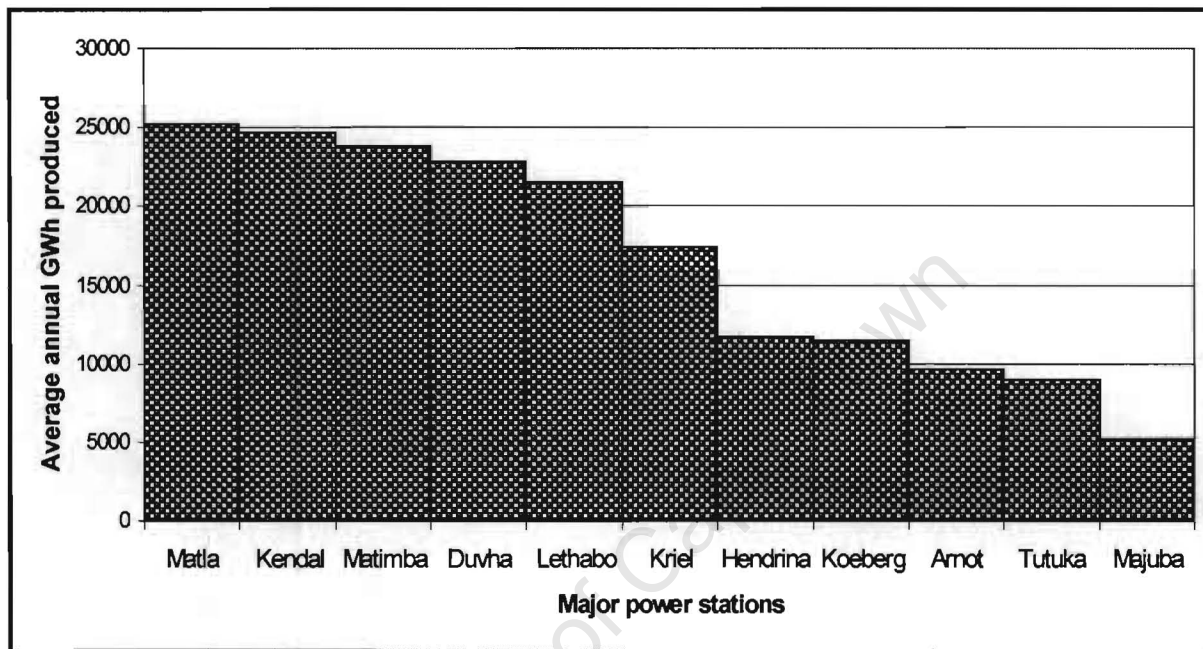
**Figure 3.2: Nominal capacity, net maximum capacity and peak demand**



Source: Eskom Annual Reports (1980 - 2002)

Figure 3.2 (above) shows Eskom’s nominal capacity, net maximum capacity and peak demand<sup>29</sup>. In 1980 Eskom had a nominal capacity of 18,349MW which grew by 129% to 42,011MW in 2002. Net maximum capacities shown by the graph include reserves stored and Transkei generators.

**Figure 3.3: Average production over last three years**



Source: Eskom (2003).

Figure 3.3 (above) shows average annual production of Eskom’s major power station over the last three years. Whilst Matla generated more GWh than other power stations over the last three years, Majuba’s production was the lowest in average although it has the highest net maximum capacity. This is due to the closure of the Majuba colliery in 1993 due to “geological problems” which as consequently led to high coal costs (Eskom Annual Report, 2001: 62). Thus, the plant was not operating on its fullest capacity.

### 3.3.2 Transmission

Eskom has been licensed as the National Transmitter for South Africa – all transmission lines are wholly owned and controlled by Eskom. Recently the Mozambique Transmission Company (Motraco), a private company, was offered a license to provide specific transmission services to supply points in

<sup>29</sup> Appendix IX shows net maximum capacity, peak demand and reserve margin of Eskom from 1950 to 2002.

Mozambique and Swaziland. Table 3.3 (below) shows Eskom's transmission lines for the years 2001 and 2002.

**Table 3.3: Eskom's transmission lines**

Transmission lines	2002	2001
	Kilometres	Kilometres
765kV	870	870
533kV DC	1 031	1 031
400kV	15 204	15 204
275kV	7 254	7 379
220kV	1 336	1 336
132kV	815	797
<b>Total</b>	<b>26 510</b>	<b>26 617</b>

**Source:** Eskom Annual Report (2002: 134).

### 3.3.3 Distribution

In South Africa, electricity distribution involves both Eskom and municipalities. By 2001 there were 214 licensed electricity distributor as opposed to 376 of 2000 (NER, 2001: 22). Table 3.4 (below) shows distribution lines and cables for 2001 and 2002. The number of distributors is likely to decrease in the near future as discussed in section 3.4 below.

**Table 3.4: Distribution lines and cables**

Lines:	2002	2001
	Kilometres	Kilometres
165 – 132 kV	20 932	20 681
88 – kV	21 159	21 144
<b>Total distribution lines</b>	<b>42 091</b>	<b>41 825</b>
Reticulation lines		
22 kV and lower	256 409	247 897
<b>Total (distr &amp; reticulation)</b>	<b>298 500</b>	<b>298 722</b>
<b>Cables:</b>		
165 – 132 kV	77	77
88 – 33 kV	240	243
22 kV and below	6 999	6 738
<b>Total distribution cables</b>	<b>7 315</b>	<b>7 058</b>

**Source:** Eskom Annual Reports (2002: 134; 2001: 130).

### **3.4 The future of the South African ESI**

Throughout the world, state-owned, vertically structured monopolistic power utilities, characterised by operational and investment inefficiencies, are undergoing structural and/or ownership changes. Structural changes involve a move away from the historical monopolistic structure of most power utilities in the world towards more competitive markets; changes in ownership generally entail the privatisation of public utilities. The ultimate objective of this paradigm shift is to enhance both operational and investment efficiencies in the ESI in order to maximise the social welfare of the community at large – improvement in efficiencies lead to the provision of high quality and low priced services to the general community.

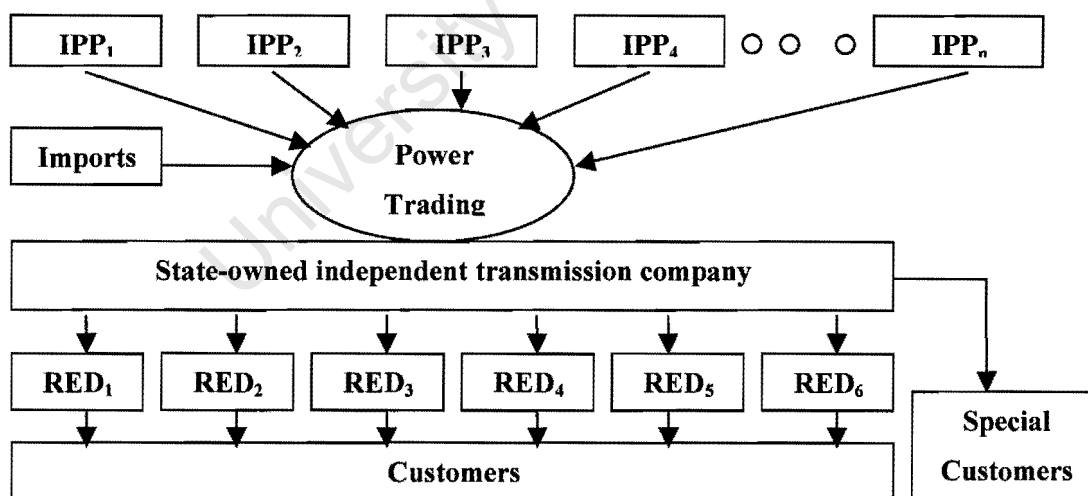
The South African government is currently considering implementing substantial changes into the ESI. As noted in section 3.2.6 (above), the 1998 “White Paper on Energy Policy for the Republic of South Africa” sets the policy direction for the future structure of the industry. South Africa’s electricity supply giant, Eskom, faces changes, although the pace is still slow. The government intends to establish a competitive wholesale market in the ESI where Eskom will initially be unbundled vertically and horizontally. Vertical unbundling of Eskom involves a separation of Eskom into three corporate entities according to their functional activities, that is, generation, transmission and distribution. On the other hand, horizontal unbundling involves the separation of generation and/or supply segments of the ESI into several independent entities that will stimulate competition into the industry and thereby significant improvement in efficiency. The separation of generation companies is essential in order to avoid market dominance by any company that may negatively affect the spirit of competition. Eskom generation capacity will be broken down into separate competing generation companies in stages. Currently, Eskom has created new generation clusters to stimulate competition in the industry. Different plant clusters bid to supply their electricity into the established ‘internal power pool’. There have been promising improvements in Eskom’s costs that can be attributed to the established competitive behaviour in the company.

Furthermore, the other two segments of the ESI, distribution and transmission, will retain their natural monopolistic status but in a different ownership separate from Eskom. These two segments need to be independent from any electricity producer or supplier if efficiency in the industry has to materialise. In light of this, the South African government has taken preliminary initiatives to achieve this.

In 2000, the Department of Minerals and Energy (DME) appointed a consortium which was led by PricewaterhouseCoopers (PwC) to advise the government on the future of the distribution sector. The consortium conducted a series of workshops with the ESI stakeholders/lobby groups (including Eskom, organised labour, SALGA, the Energy Intensive User Group, etc) in order to obtain their views on the whole issue of restructuring the sector. Financial viability, provision of efficient customer services, potential for competition and stakeholder acceptance were taken into consideration when suggesting the new structure REDs (PwC, 2000: 4). A series of workshops resulted in a number of different options, among which the government could choose in restructuring the sector. In 2001 the Cabinet approved a six Regional Electricity Distributors (REDs) option to be the future of the South African distribution sector to replace the current fragmented one.

Furthermore, the future of transmission will see the sector becoming an independent state-owned company and subjected to regulatory scrutiny. Before establishing an independent state-owned transmission company, the transmission sector will be separated from other segments of the ESI thereby forming a subsidiary of Eskom (Eskom Annual Report, 2002: 76).

**Figure 3.4: The possible ESI structure after maximum separation of generators in competing markets.**



Source: Adapted from Eberhard (2001: 20)

Figure 3.3 above shows the possible ESI in South Africa. This model allows the free entry and exit of private investors in the generation and/or retail businesses. Intensive competition could, in principle, lead to lower prices, increased access and improved quality of service than otherwise would have been

the case. Different generators (IPPs) will compete for the market by bidding to the ‘power trading pool’; the “market operator” and the “system operator” (the state-owned independent transmission company) choose low-price bidders (in an ascending order up to the point where total demand is satisfied) to supply their electricity to the grid. The system operator balances demand and supply of electricity at any point in time, and is independent of generators but still subject to regulation. This model will not only attract local investors, but also encourage FDI and provides customers with a broader choice of power suppliers. However, an effective regulatory body is essential to oversee any abusive behaviours and to encourage efficiency improvements in the naturally monopolistic elements (transmission and distribution) of the ESI.

### **3.5 Conclusion**

This chapter has examined the historical background of the South African ESI. The industry presents a useful example when describing the extent to which the monopolistic powers vested in the then Electricity Supply Commission (ESCOM) led to a more monopolised structure of the existing ESI. Although ESCOM was mandated to ensure the efficient supply of electricity in the country, it also had powers to restrict the expansion (in terms of their generation capacity) of other private utilities in response to increases in demand.

In the mid-1980s South Africa’s ESI underwent major institutional and organisational changes with the prime objective of enhancing efficiency and effectiveness in the industry. Commercial behaviour was institutionalised at Eskom, and the Electricity Council, which was composed of consumers, monitored the accountability and responsibility of the Management Board. There have been significant improvements in operational performance that have contributed significantly to its current low electricity price.

Some changes have taken place already, but more are on the way. The White Paper clearly sets out the direction of South Africa’s ESI. Irrespective of its performance, the government is of the opinion that Eskom should be restructured in order to institute not only its operational performance, but also to advance other social and macro-economic underpinnings that range from the facilitation of black economic empowerment to the attraction of foreign direct investment (FDI). It is not surprising for the ESI to be liberalised such that Eskom’s market power would be diluted, thereby instituting a competitive spirit amid market participants that would consequently improve the efficiency and effectiveness of the industry to enhance social wellbeing of the nation.

## **Chapter Four**

### **Eskom's average cost and price of electricity**

#### **4.1 Introduction**

How efficient is Eskom? This question can partly be answered by international comparison of electricity prices. Thus, section 4.2 compares South Africa's household and industrial electricity prices with those of other selected countries and also compares Eskom's average price with those of other major utilities in the world. For ease of international comparison, each company's and country's electricity price for the year 2000 is expressed in U.S dollars and this is converted with Purchasing Power Parity<sup>30</sup> (PPP) so as to avoid misleading results market exchange rates can bring.

However, it has to be recognised that these simple international comparisons give only a rough indication of efficiency. A much more in-depth investigation is necessary. The rest of the chapter looks at the historical trend in Eskom's costs and prices and identifies some of the chief cost drivers. Whilst sections 4.3 and 4.4 highlight briefly Eskom's average cost and price trends respectively, section 4.5 provides an in-depth analysis of Eskom's main price components that include primary energy, interest expenditure, wages and salaries, depreciation, income tax and net income.

Normally when the price at which a product is sold is low it portrays the impression (particularly to the customers) of effectiveness and efficiency of a company in question. This is not necessarily true due to a number of circumstances beyond the company's ability that, directly or indirectly, can impact on the price positively or negatively. Company's decisions on capital investment and operating activities are within management's control – thus management is directly responsible and accountable for operational and allocative performances of the organisation. These two aspects, depending on their accuracy and magnitude, can, positively or negatively, impact on the level of the company's price. On the other hand, since the company does not exist in a vacuum, the external environment can favourably

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<sup>30</sup> A purchasing power parity (PPP) is defined as “the number of units of a country's currency required to purchase the same amount of goods and services in that country as compared with another” (World Bank, 2003: 1).

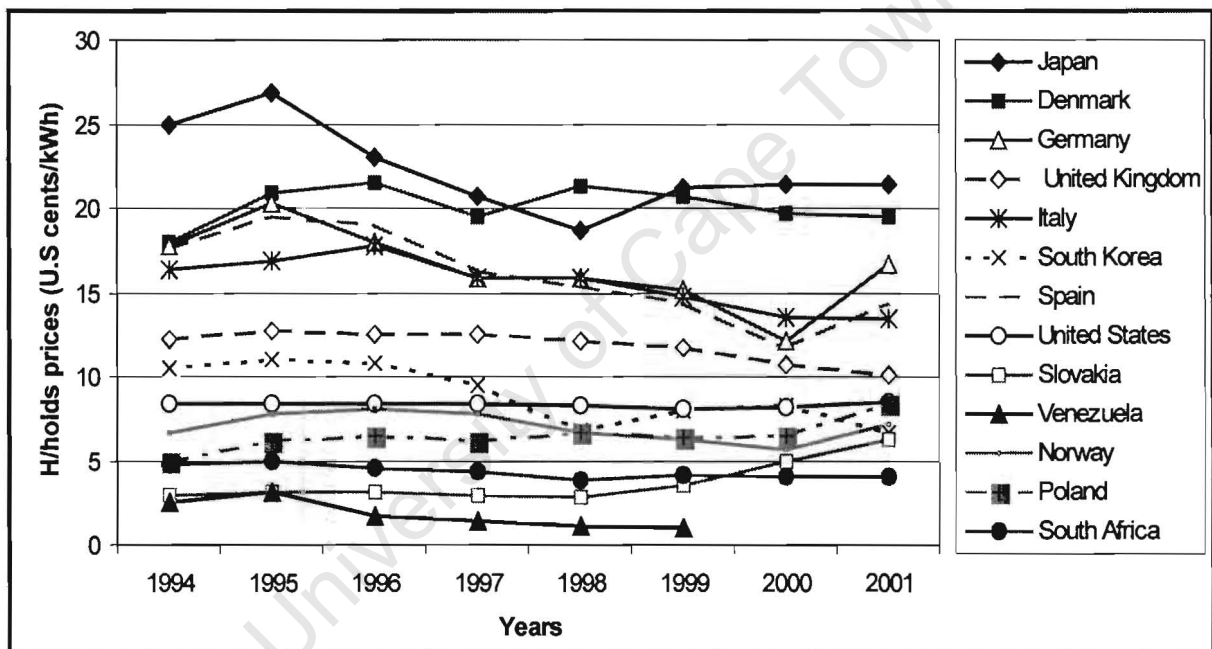
enhance or catastrophically affect the company’s performance and therefore its price, be it directly or indirectly, the magnitude of which is uncertain. The external environment is beyond management’s control. This being the case, this chapter also explores the reasons behind Eskom’s low electricity prices other than operational performance over the past number of years.

## 4.2 International Comparison of electricity prices

### 4.2.1 Comparison of South Africa’s electricity price with other countries

#### 4.2.1.1 Retail electricity prices for households

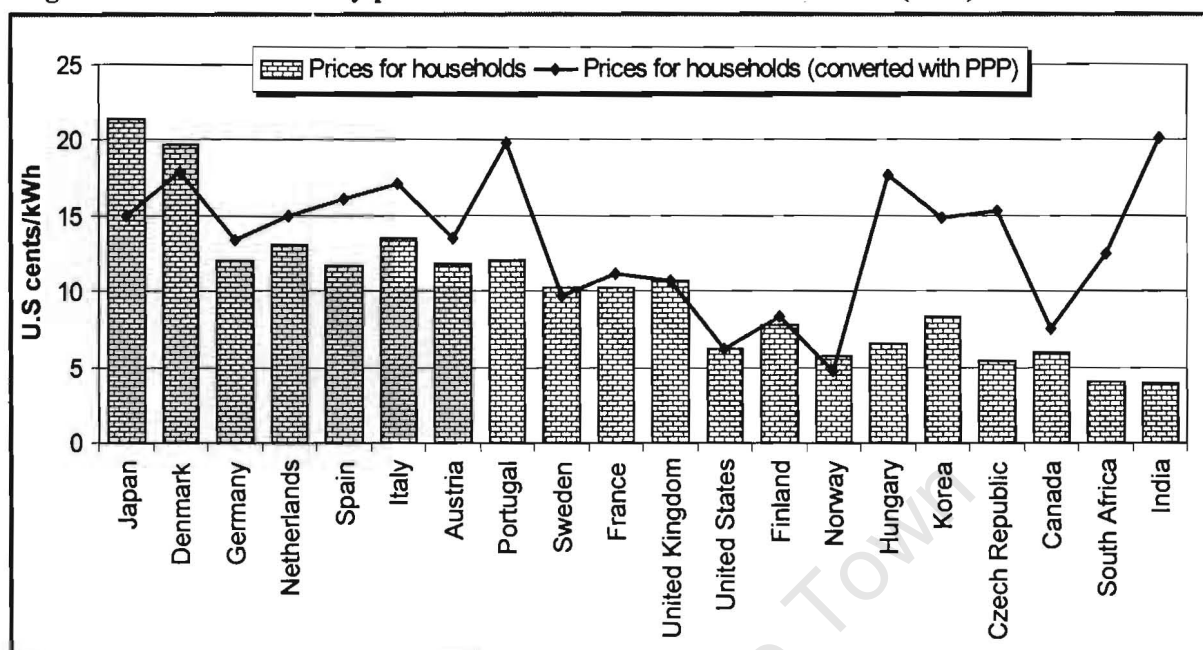
Figure 4.1: Retail electricity prices for households in selected countries



Sources: IEA (2002; 2001; 2000: 1.63) & EIA (2003b).

Figure 4.1 (above) shows retail electricity prices for residential customers in selected countries from 1994 to 2001. The figure shows Venezuela and Slovakia have lower household electricity prices than all other countries under consideration. In 1999, for instance, Venezuela’s price stood at 1 U.S cent per kWh compared to 3.50, 4.12 and 21.20 (in U.S cents per kWh) of Slovakia, South Africa and Japan respectively. Furthermore, in 2001 South Africa’s price was 3.99 U.S cents per kWh while Slovakia’s price increased to 6.28 U.S cents per kWh in the same year. Appendix IV shows household electricity prices of other countries.

**Figure 4.2: Retail electricity prices for households in selected countries (2000)**



Sources: IEA (2001) & EIA (2003b).

Note:

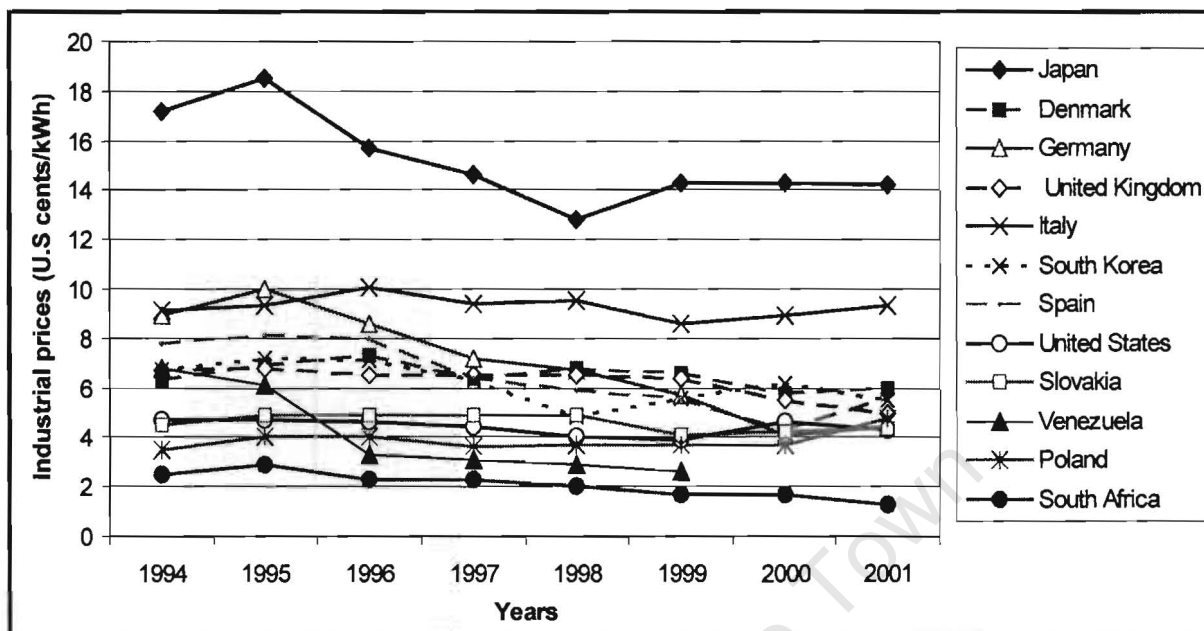
Prices are for the 4<sup>th</sup> Quarter of 2001 or latest available. Price excluding tax for the United States.

Furthermore, Figure 4.2 (above) shows retail electricity prices for households in selected countries in the year 2000 in U.S Dollars and then converted with purchasing power parities. Whilst Japan had the highest electricity price (21.4 U.S cents per kWh) in 2000, which is about 5.5 times compared to that of South Africa (4 U.S cents per kWh), India recorded the lowest price in that year (3.9 U.S cents per kWh). When the prices are converted with purchasing power parities, the prices in India, South Africa, Czech Republic and Hungary increase more than twice. Although the electricity price for households in India seems to be the lowest in the world, in monetary comparisons, however, it is the most expensive when the purchasing power of the currency is taken into consideration.

#### 4.2.1.2 Retail electricity prices for industrial customers

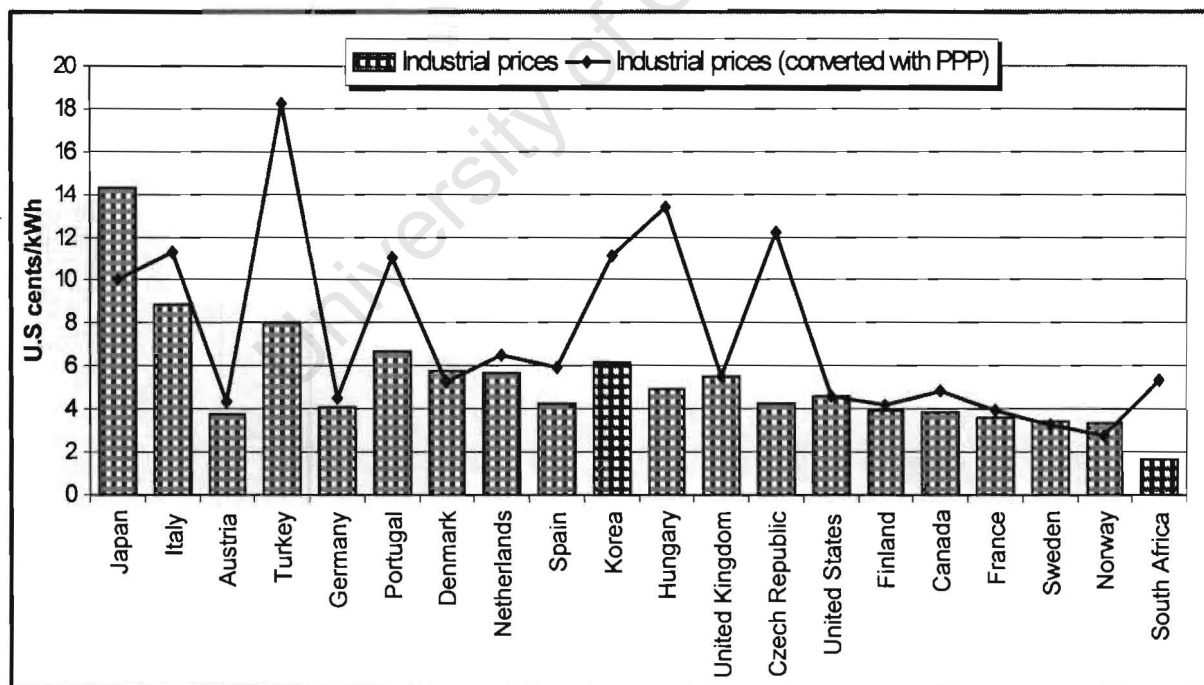
Figure 4.3 (below) illustrates industrial electricity prices in selected countries. Of all the countries under review, South Africa has the lowest price while Japan has the highest price. Whilst in 1995 Japan's industrial electricity price was about 6.4 times as higher as South Africa's; in 2001 it was about 11 times as much. South Africa's industrial electricity price has been below 3 U.S cents per kWh and constantly declining. Prices for other countries under consideration (except Japan) ranged between 3 – 10 U.S cents per kWh.

Figure 4.3: Industrial electricity prices in selected countries.



Sources: IEA (2002; 2001; 2000: 1.62) & EIA (2003c)

Figure 4.4: Retail electricity price for industrial in selected countries (2000)



Sources: IEA (2001) & EIA (2003c).

Note: Prices are for the 4<sup>th</sup> Quarter of 2001 or latest available.

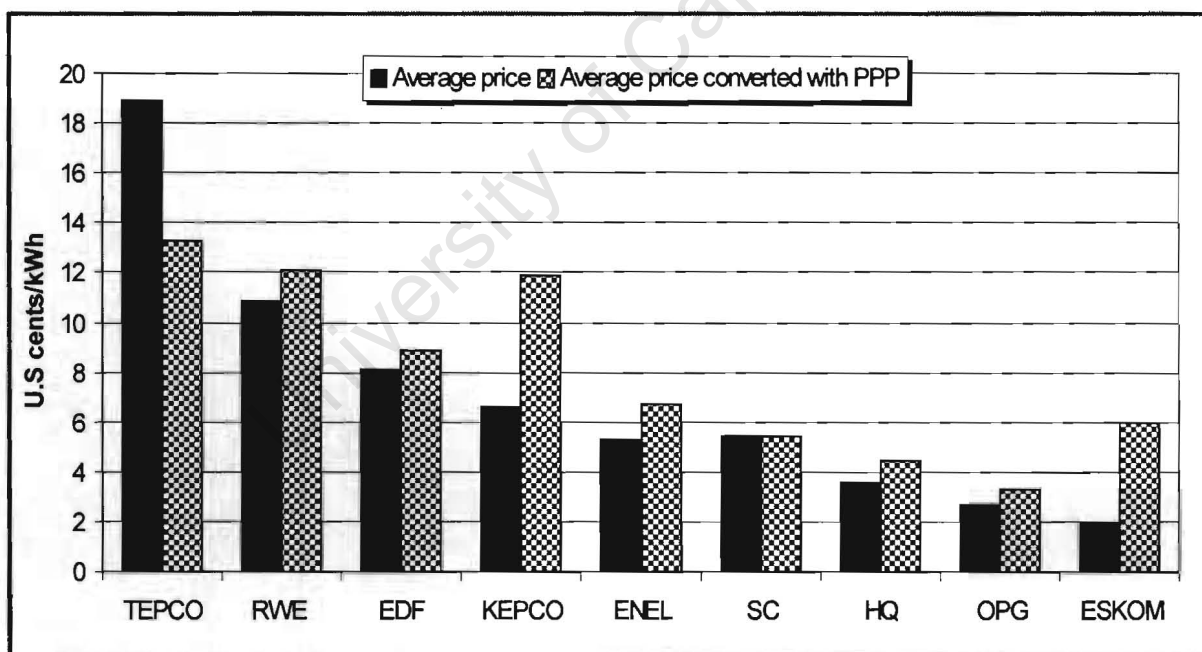
Price excluding tax for the United States.

Figure 4.4 (above) illustrates world industrial electricity prices. As shown in the figure, the industrial electricity price in South Africa is the lowest compared to other countries under review. Japan's electricity price (in U.S c/kWh) is about 8.4 times that of South Africa. Furthermore, the South Africa's price is not the lowest when converted with the purchasing power parity - it is roughly twice that of Norway and slightly higher than that of Sweden, France, Canada, Finland, the United States, the United Kingdom, the U.S.A, Denmark, Germany and Austria. Turkey marked the highest industrial electricity price (in PPP) of about 18.22 U.S cents per kWh, which is about 3.4 times that of South Africa.

#### 4.2.2 Comparison of Eskom's electricity price with those of other utilities

Electricity prices from the following utilities are considered for comparative analysis:- TEPCO (Japan), RWE Energie AG (Germany), EDF (France), KEPCO (South Korea), ENEL (Italy), Hydro Québec (Canada), Ontario Power Generation (Canada) and Southern Company (USA).

Figure 4.5: Average electricity prices for the year 2000



Source: Compiled from each company's respective Annual Report for 2000.

**Note:**

- (a) Average electricity prices for RWE, EDF, KEPCO, ENEL, HQ and OPG were ascertained by dividing each company's revenue from electricity sales by kilowatt-hours sold.
- (b) Financial year for all companies ends on 31<sup>st</sup> December except for TEPCO (31<sup>st</sup> March 2001).

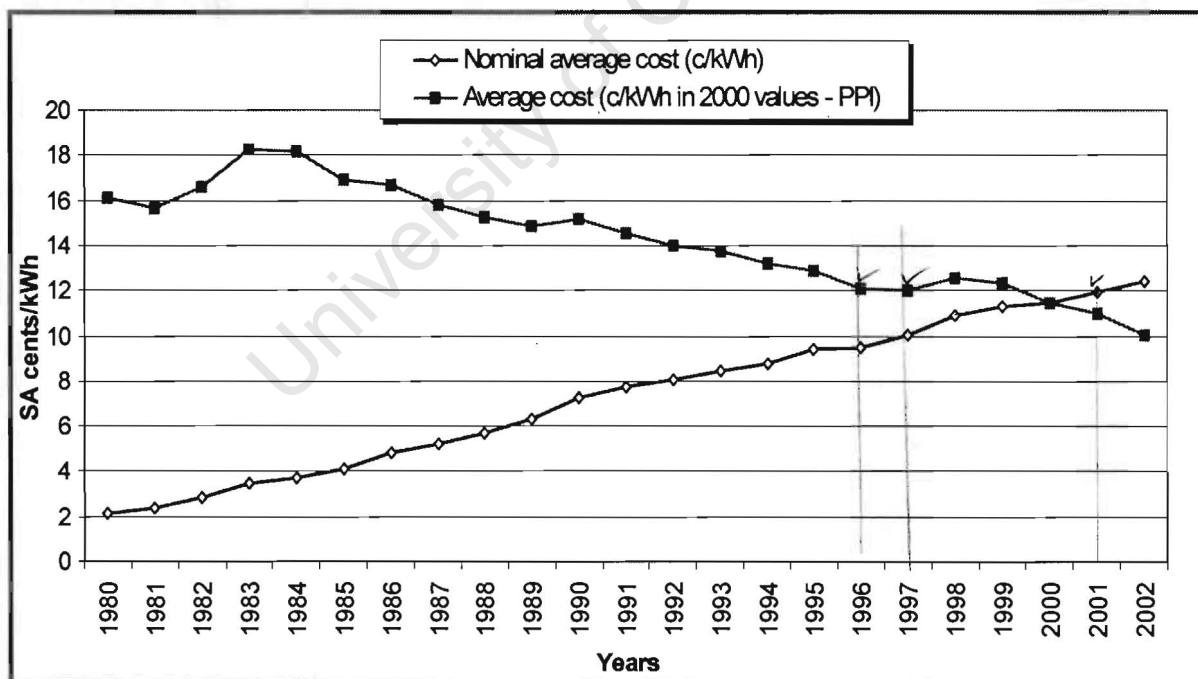
Figure 4.5 (above) shows the average electricity price of major utilities in the world. Of the nine companies illustrated in the figure, TEPCO's price is the highest (about 18.93 U.S cents per kWh) whereas Eskom's price is the lowest (1.92 U.S cents per kWh). However, when the prices are converted with the purchasing power parities, Eskom's price turns out to be higher than those of Ontario Power Generation (OPG), Hydro Québec (HQ) and the Southern Company (SC).

This is admittedly a rough and crude comparison. Eskom's price appears to be competitive, but the utilities have different histories and face different regulatory regimes.

### 4.3 Eskom's average cost of electricity

Eskom's average cost of electricity has generally decreased in real terms<sup>31</sup> from 1980 to 2002 as shown in Figure 4.6 below. Between 1985 and 2002 the average cost of electricity decreased by about 3.2% per annum. In 1982 and 1983 the real cost of electricity increased by 6.4% and 9.8% respectively.

Figure 4.6: Eskom's nominal and real average cost of electricity sold



Source: Compiled from Eskom Annual Reports (1980 – 2002).

Note:

<sup>31</sup> Using Production Price Index (PPI), base year; 2000: 100.

*Average cost values from 1988 to 1991 were not available in either Eskom's Annual Reports or Statistical Yearbooks. Therefore, values for such years have been calculated based on other reported data<sup>32</sup>.*

## **4.4 Eskom's average price of electricity**

In a competitive market environment the market forces (demand and supply) determine the price of electricity. However, in a regulated monopolistic market (e.g. the South African ESI) the regulator sets the electricity price. The expected total cost that would be incurred in the production process, operating expenditures that are paid to make electricity available to users and a reasonable return on assets are all considered when determining the electricity price.

### **4.4.1 The general trend of Eskom's price**

It is important to highlight briefly the trend of Eskom's average electricity price. The trend is observed in the period after the mid 1970s until the early 1980s and the period after 1985 until recently. This provides an insight into understanding the magnitude and direction of changes in the price and the reasons ascribed to these changes.

Figure 4.7 (below) shows Eskom's electricity price in nominal and real terms. Between 1976 and 1985 the price increased in real terms<sup>33</sup> by 4.8% on average per annum. This was a period when most of Eskom's power plants that are currently in use were being ordered<sup>34</sup>. De Villiers (1984: 5) mentions the reasons, among others, that contributed to rapidly increases in the price during the period 1974 – 1982.

These are:

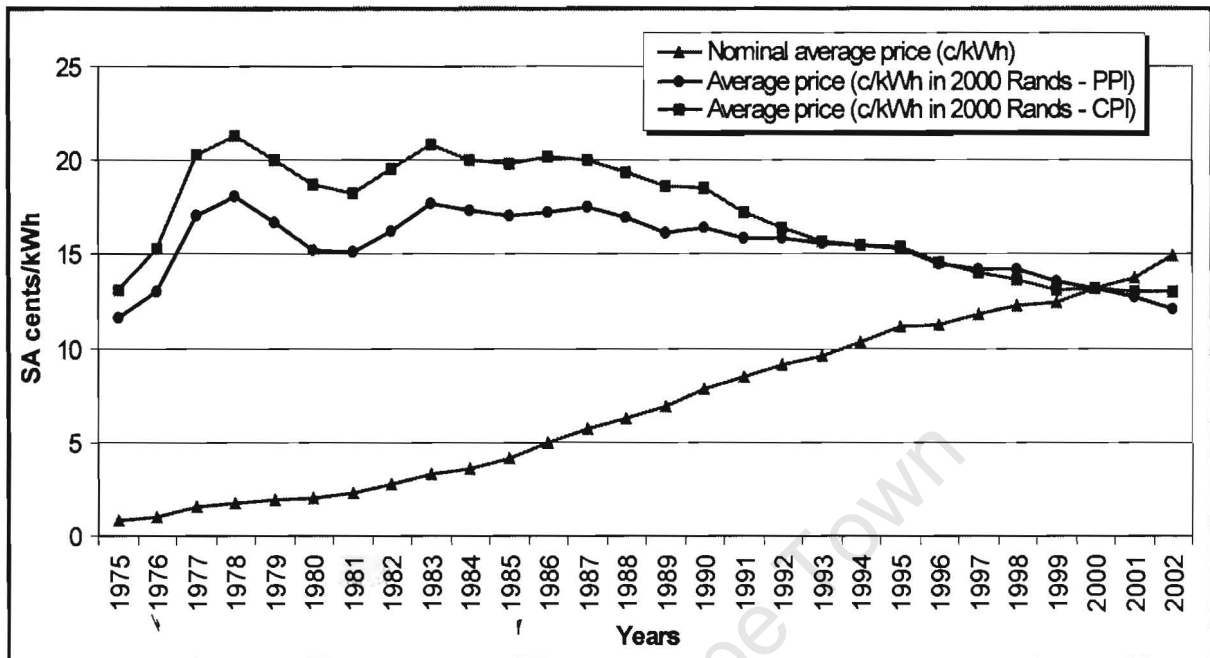
- the significant increase in the price of coal;
- the considerable escalation of inflation and interest rates;
- wage increases;
- thermal efficiency improved very slowly; and
- contributions to the Capital Development and capital costs to finance new plants

<sup>32</sup> The average cost has been calculated by deducting a 'profit element' from the average price per kWh.

<sup>33</sup> Using Consumer Price Index (CPI), base year; 2000: 100

<sup>34</sup> Section 6.3.2 in Chapter Six provides more detail.

**Figure 4.7: Eskom's nominal and real average electricity prices**



**Source:** Compiled from Eskom Annual Reports (1980 – 2002) & Statistical Yearbooks (1985 – 1996).

In 1977 the price increased by about 32.4% in real terms whereas the Capital Development Fund rose threefold. However, from the mid 1980s until recently Eskom's electricity price has generally declined in real terms. From 1984 to 2002, for instance, Eskom's electricity price declined at the average rate of 2.4% annually. There has been a significant reduction in the price particularly in the 1990s where it declined by about 3% per annum in a period between 1990 and 2000.

#### 4.4.2 Regulation of the electricity price

In South Africa the National Electricity Regulator approves Eskom's average tariff increases. Eskom increases its tariffs on 1 January of every year (Eskom, 2002: 6). However, due to tariffs structural changes and customers usage pattern, the granted price increase generally differs from the effective price increase. Table 4.1 below shows Eskom's requested price increase, granted price increase, its effective price increase and inflation rates for the past 8 years. The rate at which Eskom increases its price (effective price increase) is generally lower than inflation. This is partly due to Eskom's commitment to reducing the real price of electricity in recent years as discussed in the next section.

**Table 4.1: Eskom's requested, granted and effective price increase**

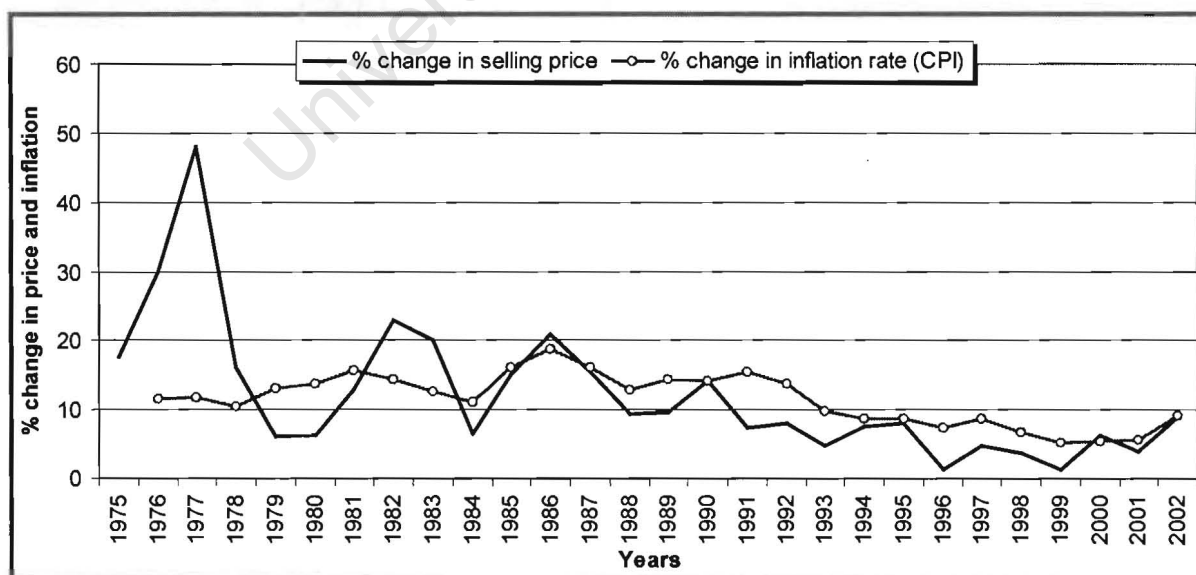
Year	Requested price increase (%)	Granted price increase (%)	Eskom effective price increase (%)	Consumer Price Index
1995	4.00	4.00	7.60	8.70
1996	4.00	4.00	2.10	7.30
1997	6.00	5.00	4.60	8.60
1998	5.00	5.00	2.90	6.90
1999	4.50	4.00	1.18	5.20
2000	7.00	5.50	6.35	5.40
2001	6.20	5.20	3.90	5.70
2002	7.40	6.20	8.90	10.10
2003	9.00	8.43		n/a

Source: NER, 2003

### 4.4.3 Eskom price compacts

Eskom committed itself to reducing its electricity price in real terms in early 1990s. There were two compacts with customers. The first one was in 1991 where Eskom planned to cut down its real price by 20% in the course of about five years from 1992 (Eskom Annual Reports, 1996:12; 1991: 18). However, by 1996 Eskom managed to reduce its price by 16.8% in real terms (Eskom Annual Report, 1996: 12). Eskom attributes its failure to achieving its price cutting target to debts in arrears and its significant contribution to electrification programme (Eskom Annual Report, 1996: 12).

**Figure 4.8: Changes in nominal average selling price and inflation rate (CPI).**



Source: Compiled from Eskom Annual Reports (1980 – 2002); Statistical Yearbooks (1985-1996) & Statistics South Africa (2003a).

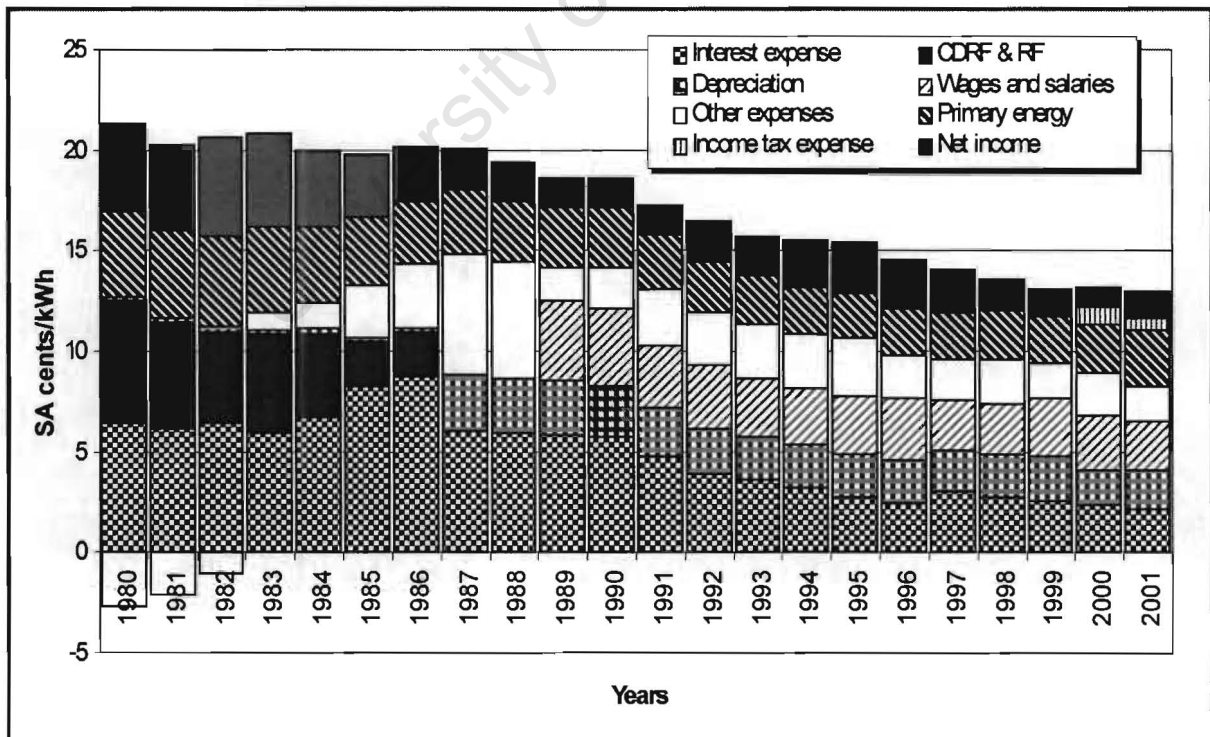
Another compact was in 1994, where Eskom committed itself to reduce the electricity price by 15% in real terms from 1995 to 2000 (Eskom Annual Reports, 2000: 48; 1996: 12). The real price decreased by about 14.1% and 13.4% using the CPI and PPI respectively. Figure 4.8 (above) shows from 1987 to 1999 the rate at which the nominal average price increased was somewhat below the rate of inflation (CPI), which eventually contributed to a decline in the average price in real terms.

Apart from Eskom’s commitment to reducing the price, other factors that contributed to its low prices are discussed in the next section.

### 4.5 Components of the electricity price

Eskom’s electricity price is mainly composed of elements such as primary energy, wages and salaries, materials, depreciation and interest expenditure. Figure 4.9 (below) shows proportional contributions of price components to Eskom’s real average price in each respective year from 1980 to 2001.

Figure 4.9: Real average electricity price components (using CPI)



Source: Compiled from Eskom Annual Reports (1980-2001) and Statistical Yearbooks (various years).

**Note:**

*“Other expenses” includes materials, research and development, contracts and all other expenses not shown by the figure.*

Between 1980 and 1990 the proportional contribution of interest expenditure to the price of electricity was higher compared to other elements. Generally, from 1980 to 1986 capital-related costs<sup>35</sup> contributed more than 50% of the electricity price. All price components have generally declined in real terms. Interest expenditure declined significantly from 7.52 SA cents per kWh in 1986 to 2.11 c/kWh in 2001, representing a decline of about 70 percent.

It must be borne in mind that between 1980 and 1986 the Capital Development and Reserve Fund (CDRF) and the Redemption Fund (RF) were still in existence before being abolished in 1987. Moreover, due to a lack of data for wages and salaries between 1980 and 1988, the values for ‘other expenses’ includes these amounts too in the respective years before 1989. A detailed analysis of price components is given below. Appendix XI illustrates trends of both Eskom’s price as well as its main components from 1980 to 2001.

#### **4.5.1 Primary energy (coal)**

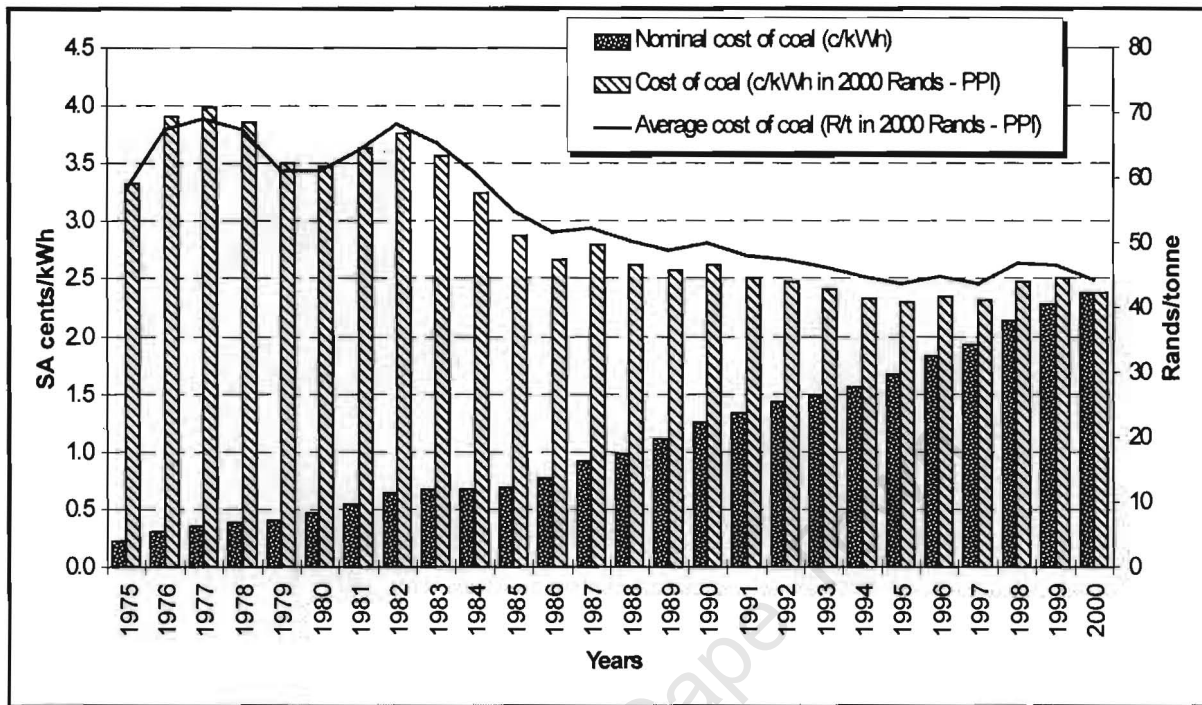
Eskom depends on coal as its largest source of primary energy. Whilst in 1980 coal-fired plants contributed about 98.8% of the total electricity produced in that year, 1988 recorded the lowest level with about 89.2% (shown in Appendix I). The quantity of coal burnt has consistently increased in the years under review except for 1986, 1988 and 1998 where it declined marginally. Basically, Eskom produces electricity by utilising cheap low-grade coal<sup>36</sup>. This has, to a great extent, reduced its fuel costs as compared to many other major coal-dependent utilities in the world.

Coal contributes a substantial amount of the total cost of electricity production at Eskom. In 2001 the cost of coal accounted for about 25% of the average cost per kilowatt-hour produced by coal-fired plants, whereas in 1986 it had been only 15.9% (shown in Appendix II). Whilst between 1976 and 2000 the cost of coal burnt per kWh produced increased (in nominal terms) by 11.2% per annum, there has been a declining trend (in real terms) in the cost of coal for the past two decades as shown in Figure 4.10 (below). From 1980 to 2000 the real cost of coal per kWh decreased at an annual rate of 1.7% (using PPI).

<sup>35</sup> Include interest expenditures, Capital Development and Reserve Fund (CDRF) and Redemption Fund (RF).

<sup>36</sup> For example, Lethabo power station was designed to burn bituminous coal with a caloric value of 16MJ/kg, which is the lowest in world standards (Eskom Annual Report, 1992: 24).

**Figure 4.10: Nominal and real costs of coal burnt for electricity generation**



**Source:** Compiled from Eskom Annual Reports (1980 – 2000) & Statistical Yearbooks (1985 – 1996).

Consequently, the uses of low grade coal on the one hand, and a considerable reduction (in real terms) in costs of coal on the other hand, has contributed to Eskom’s low electricity price. What must also be borne in mind is the fact that most Eskom coal-fired plants are situated near the coalmines, thereby avoiding additional costs related to transportation. Coal is transported by conveyor belts from the collieries to the power plants. Two other factors that need to be considered when investigating the magnitude of Eskom’s costs of coal are coal supply contractual agreements and abundance and easily accessible coal supplies in South Africa compared to many countries. They reduce Eskom’s costs of coal by a substantial amount. These are discussed in detail below.

#### **4.5.1.1 Eskom’s coal supply contracts**

Eskom buys most of its coal at lower prices from Eskom-tied collieries following contractual agreements between Eskom and the suppliers. There are two kinds of contracts that Eskom entered with coal suppliers. The first one is called a *cost-plus* contract. This is a contract where both Eskom and the coal supplier provide capital for the establishment of a colliery. According to the contract, Eskom pays all operating costs as well as a payment of net profit, which is determined on the basis of

capital (return on capital) to the supplier. The second is a *fixed price* contract. The price paid by Eskom based on this contract is therefore fixed and can only be changed on agreement with the supplier.

**Table 4.2: Eskom's average cost of coal and local market's price of coal.**

Years	*Eskom's average cost of coal (Rands/tonne)		**Local market's price of coal (Rands/tonne)		The difference between Eskom's average cost and the local market's price (in 2000 values)
	Nominal cost	Real cost in 2000 values using PPI	Nominal price	Real price in 2000 values using PPI	
1980	8.12	61.05	10.00	75.19	14.14
1981	9.71	64.30	12.00	79.47	15.17
1982	11.75	68.31	13.00	75.58	7.27
1983	12.44	65.47	13.00	68.42	2.95
1984	12.55	60.92	14.00	67.96	7.04
1985	13.25	54.98	16.00	66.39	11.41
1986	14.87	51.63	17.00	59.03	7.40
1987	17.11	52.16	20.00	60.98	8.81
1988	18.67	50.32	22.00	59.30	8.98
1989	20.90	48.93	28.00	65.42	16.50
1990	23.91	49.92	31.00	64.72	14.80
1991	25.70	48.13	34.00	63.67	15.54
1992	27.47	47.53	39.00	67.47	19.95
1993	28.48	46.23	39.00	63.31	17.08
1994	29.98	44.95	40.00	59.97	15.02
1995	31.99	43.82	43.00	58.90	15.08
1996	35.05	44.88	46.00	58.90	14.02
1997	36.52	43.68	49.00	58.61	14.93
1998	40.69	46.99	52.00	60.05	13.06
1999	42.79	46.71	53.00	57.86	11.15
2000	44.40	44.40	57.00	57.00	12.60

Source: \*Eskom Annual Reports (1980-2000); \*Statistical Yearbooks (1985-1996) & \*\*DME (2003).

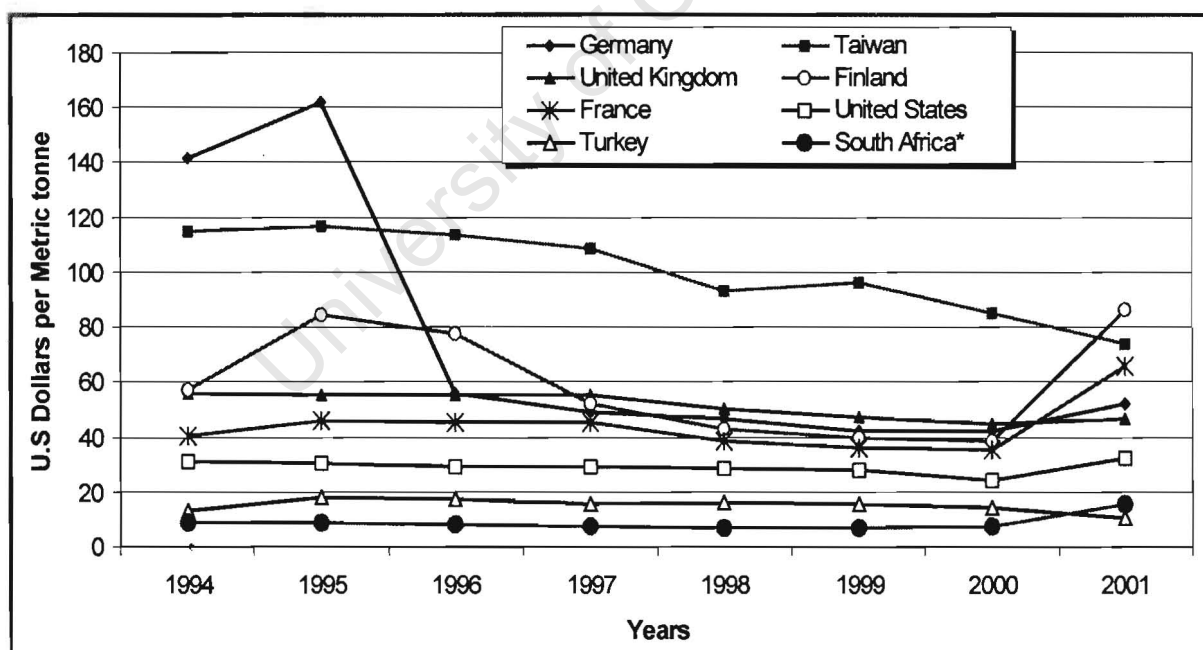
Table 4.2 (above) shows Eskom's average cost of coal per tonne and the local market's price of coal per tonne from 1980 to 2000. On average, from 1980 to 2000 annually, Eskom's average cost of coal per tonne (in real terms) was R12.52 lower than the local market's price, a saving of about 19.5 percent<sup>37</sup> per annum. In 1992 the local market's price increased by about 6% in real terms whereas Eskom's average cost of coal declined marginally. This is because of contractual agreements that make the market forces incapable of influencing the average cost of coal Eskom incurs. Had Eskom purchased coal from the market, it is not surprising for the electricity price to increase considerably.

This, for example, was revealed in 1981 and 1982 when Eskom had to buy coal from other suppliers far from Eskom-tied collieries after its suppliers experienced problems – particularly a shortage of skilled manpower (Eskom Annual Report, 1982: 22; 1981: 22). Thus, the cost of coal soared in 1981 and 1982 as shown in Figure 4.10 (above).

#### 4.5.1.2 International comparison of coal prices

Eskom enjoys a comparatively international advantage through having access to much cheaper coal. Figure 4.11 (below), compares coal prices in different countries. Of the countries illustrated, South Africa's coal price has been the lowest. In 1995 a tonne of coal was sold at 161.83 U.S Dollars in Germany, which was about 18 times as much as South Africa's price. Moreover, In 2001 the price of coal per tonne in Finland was 86.16 U.S Dollars compared to only 15.22 U.S Dollars in South Africa in the same year. South Africa's price of coal has been below 20 U.S Dollars per tonne from 1994 - 2001. Generally, there is a declining trend in coal prices in almost all countries under consideration over the years considered except for 2001 where the price increased in Finland, France and Turkey. Appendix III provides additional information on coal prices in other countries.

Figure 4.11: Steam coal prices for electricity generation



Sources: IEA (2002; 2001; 2000: 1.62); EIA (2003a) & \*DME (2003)

<sup>37</sup> A difference between the annual average of local market's price of coal per tonne and Eskom's average annual cost of coal per tonne expressed as a percentage of local market's price of coal per tonne. All in 2000 constant values using the Producers Price Index (PPI).

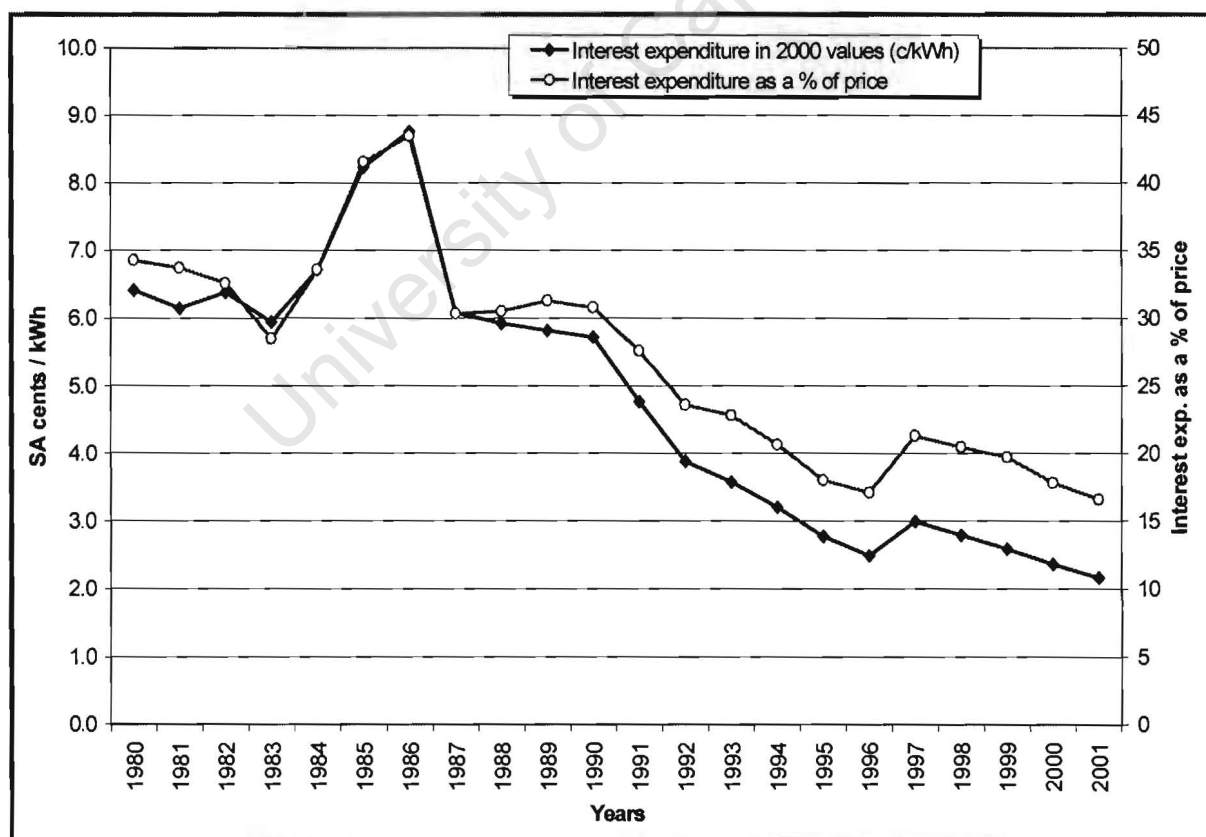
\*South Africa's coal prices from 1997-2000 were not available. To ascertain values for these years, local market's coal prices (data from DME) have been converted into U.S Dollars.

## 4.5.2 Interest expenditure

### 4.5.2.1 Proportional contribution of interest expenditure to the price

Interest expenditure is one of the largest ingredients of Eskom's price. Between 1980 and 1994 interest expenditure contributed a substantial amount to the price of electricity compared to the other elements. The composition of interest expenditure in the price has generally declined in real terms from 1986 to 2001 as shown in Figure 12 (below). Expressed as a percentage of the average price of electricity per kWh, interest expenditure contributed about 33.7% of the price from 1980 to 1990 per annum and it declined to about 20.5% annually from 1991 to 2001. Furthermore, in 1986 the interest expenditure contributed about 43.5% of electricity price per kWh sold, whereas in 2001 it was a mere 16.6%.

Figure 4.12: Interest expenditure per kWh (in 2000 values using CPI)



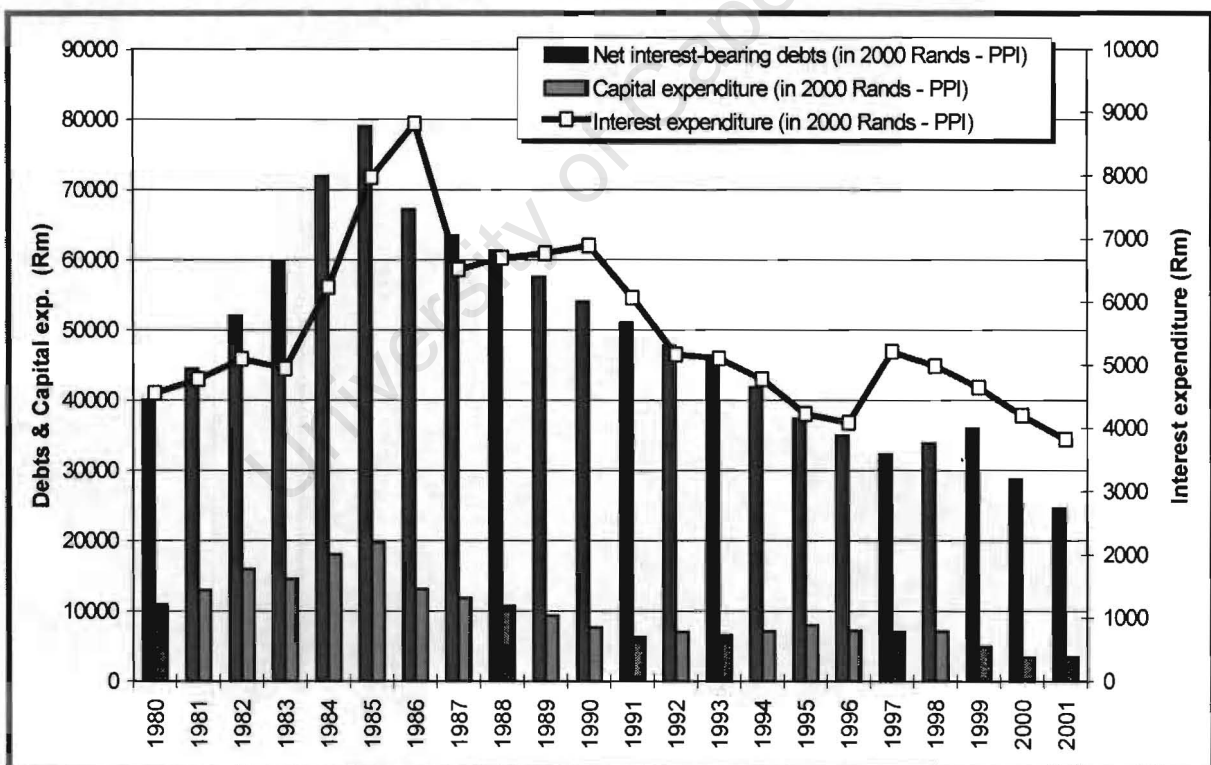
Source: Compiled from Eskom Annual Reports (1980 – 2001).

#### 4.5.2.2 Reduction in capital expenditures and debts

Eskom depended on local as well as external debt to finance its assets, particularly the construction of power plants. There has been a direct relationship between capital expansion programmes and the composition of interest expenditure in the price. As capital expansion programmes peaked, so did the percentage contribution of interest expenditures and vice versa. Eskom has reduced its capital expansion programmes over the past 15 years, which in turn reduced its real capital expenditures and interest-bearing debts quite considerably. This led to a substantial reduction in financing charges which in turn contributed significantly to Eskom's apparently low price as stressed by Steyn (2001: 124) hereunder:

The reduction in finance costs per kWh was clearly the largest contributing factor to the improvement in Eskom's financial position and the reduction of its prices since the post De Villiers reforms.

**Figure 4.13: Net Interest-bearing debts, Capital expenditures and Interest expenditures**



Source: Compiled from Eskom Annual Reports (1980 – 2001).

Figure 4.13 (above) shows net interest-bearing debts, capital expenditures and interest expenditures from 1980 to 2001, all in real terms (using PPI). From 1980 to 1985 the real net interest-bearing debts,

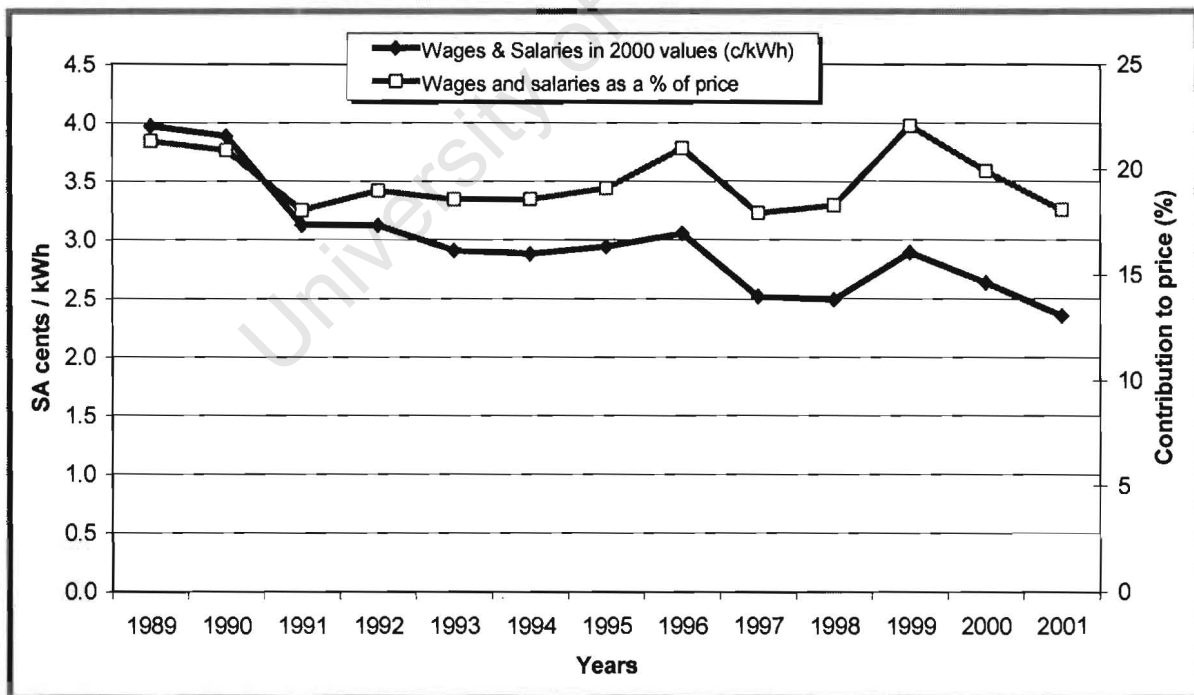
capital expenditures and interest expenditures increased at an average of 12.2%, 9.5% and 12.5% per annum respectively. Whilst all the three variables decreased quite significantly between 1985 and 2001 – where the net interest-bearing debts<sup>38</sup> decreased by 68.8%, capital expenditures by 82.7% and interest expenditures by 52.1%, the electricity price decreased quite convincingly by about 27% in real terms over the same period. Furthermore, on average, the interest bearing debt increased by 3.4% annually from 1980 to 1990 and it decreased by 6.6% from 1991 to 2001 per annum. Over the same periods, interest expenditure increased by 5.9% per annum in real terms and decreased by about 4.7% per annum respectively.

### 4.5.3 Wages and salaries

#### 4.5.3.1 Proportional contribution of wages and salaries to the price

Wages and salaries, among others, constitute another element that contributes considerably to Eskom's operating expenditures and therefore the electricity price as a whole. In 1990 wages and salaries contributed about 35.2% of operating expenditures, whereas this figure declined to 28.8% in 2001.

Figure 4.14: Proportional contribution of wages and salaries to price



Source: Compiled from Eskom Annual Reports (1980 – 2001).

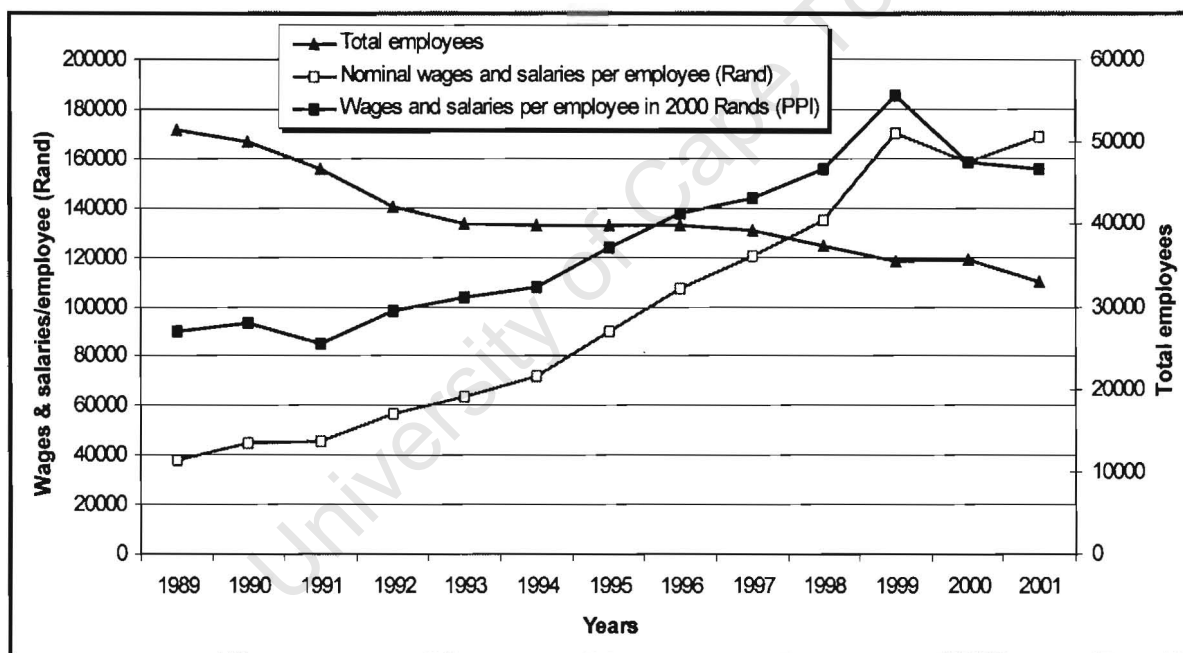
<sup>38</sup> Figure 5.15 in Chapter Five illustrates a significant improvement in Eskom's debt/equity ratio from 1980 to 2001, which indicates its dependency on debt to finance its assets declined consistently.

Furthermore, wages and salaries per kWh of electricity sold were about 20.9% and 18.1% of the average price in 1990 and 2001 respectively as shown in Figure 4.14 above. The annual proportional contribution of wages and salaries to the price averaged at 19.3% from 1990 to 2001.

### 4.5.3.2 Increased wages and salaries per employee

Figure 4.15 (below) shows that nominal and real wages and salaries per employee have generally increased between 1990 and 1999 and declined slightly thereafter. From 1990 to 2001 wages and salaries per employee increased in both nominal and real terms (using PPI) by 14.7% and 5.6% annually respectively, although the number of employees declined by 3.6% annually over the same period. This means that employees received better wages over the same period.

Figure 4.15: Nominal and real wages & salaries and total employees (1990 – 2001)



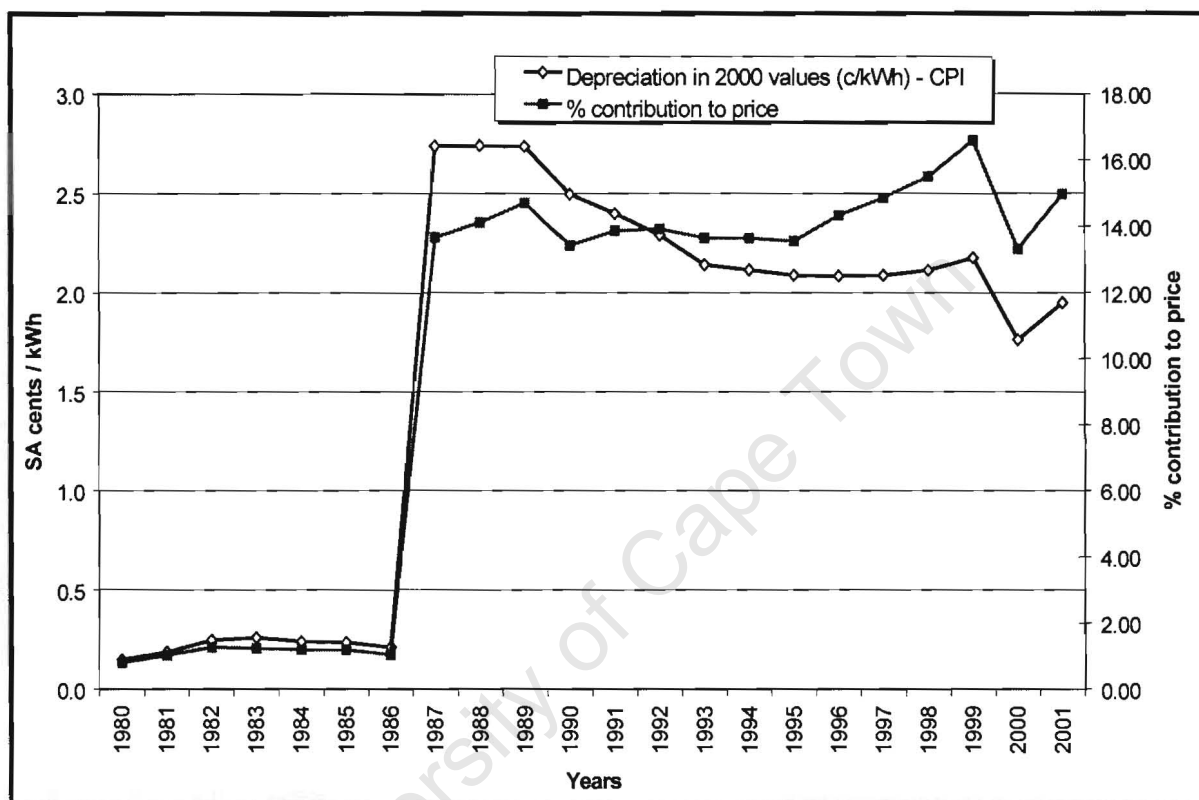
Source: Compiled from Eskom Annual Reports (1980 – 2001).

### 4.5.4 Depreciation

Depreciation of fixed assets also contributes significantly to a company’s annual operating expenditures, especially among companies that are highly capital-based – such as Eskom. Before 1987 Eskom had an accounting policy of not depreciating its fixed assets, but rather amortising the debt that was used to finance these assets. This accounting policy is called a “fund accounting convention” and is contrasted with using “depreciation accounting terms”, which exposes a company to conventional

business accounting practices (Eskom Annual Report, 1986: 3). Subsequent to the amendments in the new Eskom Act of 1987, Eskom implemented a depreciation accounting policy thereby charging depreciation on its fixed assets.

**Figure 4.16: Depreciation expressed as a percentage of operating expenditure**



Source: Compiled from Eskom Annual Reports (various years).

Figure 4.16 (above) depicts the depreciation charges and their contribution to the electricity price. On average, from 1980 to 1986 depreciation charges accounted for 1.1% of the price, whilst from 1987 to 2001 they averaged 14.3%. A significant decline in the percentage of depreciation on the price in 2000 was due to a change in the useful lives of generation plant from 25 years to 35 years which eventually reduced depreciation by R641 million in that year (Eskom Annual Report, 2000: 109).

#### 4.5.5 Redemption Fund, Capital Development and Reserve Fund

Eskom’s electricity price was also composed of Redemption Fund, Capital Development Fund and Reserve Fund which consequently increased the electricity price (discussed in details in Chapter Six, section 6.3.6.2). The Redemption, Capital and Development and Reserve Funds (all together)

accounted for about 32.7% of the real price (per kWh) of electricity sold in 1980, which amount declined to 10.9% in 1986, as shown by Figure 4.9 (above) and Appendix XI.

#### **4.5.6 Net income – Return on assets (ROA)**

Return on assets is a reward for the use of assets. In actual fact, the return on assets represents the opportunity cost (cost of capital) of investing a significant amount of money in the generation and sale of electricity at the expense of other investments. Thus, the return on assets should be at least equal to the cost of capital to attract investors into the industry.

In a regulated ESI (such as the South African one), the return on assets is reflected in the estimated price that a supplier should charge its customers. This means that the expected profit is ascertained in advance and is guaranteed, given that other things remain constant.

Furthermore, the price per every kilowatt-hour sold by Eskom is composed of an element of profit to compensate for the large volumes of capital tied-up in assets. Figure 5.14 in Chapter Five shows Eskom's ROA ranged between 8% and 12% from 1980 to 2001. There is small range on ROA amid years under review due to the fact that Eskom's electricity price is regulated, hence its ROA is ascertained before hand.

#### **4.5.7 Income tax**

Since its inception in 1923, and until 2000, Eskom's electricity prices contained neither a tax element nor a dividend, in contrast with many utilities in other countries. This is because of the then underlying legal set-up that established it as a non-profit making entity and thus not eligible to payment of income tax. Although in 1987 the amended Electricity Act enabled Eskom to earn a reasonable profit on its assets, however, it was still not legally bound to pay tax and dividends. Admittedly, non-payment of taxes and dividends contributed considerably to Eskom's low price.

From 1<sup>st</sup> January 2000 Eskom is legally bound to pay tax and thus from that date the electricity price includes taxes as well. In that year income tax contributed about 6.2% (0.82 SA cents per kWh sold) of the electricity price whereas in 2001 it decreased marginally and accounted for about 4.9% per every kilowatt-hour sold in that year. Until recently, dividends are not a component of Eskom's price.

## **4.6 Other factors contributing to Eskom's low prices**

### **4.6.1 Environmental costs/charges**

Energy production contributes substantially to environmental degradation. Electricity production using fossil fuels (particularly coal) increases greenhouse gases in the atmosphere, which results in global warming and its associated detrimental effects. Eskom management is aware of the consequence of electricity production using coal, particularly low-grade coal, have on the environment as noted hereunder:

Eskom power stations have been designed to burn low-grade coal. While this supports South Africa's coal export capabilities, it results in challenges for air quality and efficiencies. (Eskom Annual Report, 2001: 62).

All the detrimental impacts of electricity production that range from health-related to environmental degradation that are not included in the electricity pricing system, are referred to as external costs. These have not been included in the electricity price in South Africa. This may be another reason for lower electricity price in South Africa compared to most other countries in the world, particularly European countries where pollution/carbon taxes are common and where emission standards require additional investment in technology.

Carbon taxes can be imposed on the amount of coal used in the production of electricity or on the estimated emissions expected from the production of electricity. The rate at which taxes will be charged depends largely on the estimated external costs/damage resulting from power generation.

Electricity prices in South Africa provide no incentives for the efficient use of power on the one hand, or the installation of efficient energy production technologies on the other. The exclusion of external costs of electricity generation and the inclusion of subsidies in tariffs distort the market prices of electricity, a situation that reduces tariffs to the extent that no economic incentives exist to influence investors' and consumers' behaviours to allocate their resources efficiently.

### **4.6.2 Operating efficiency**

Operational and investment efficiencies have a direct impact on electricity costs on the one hand and electricity prices on the other. Theoretically, as efficiency increases, costs and prices should decline and vice versa. Efficiency gains are reflected in lower electricity prices and reliability and quality of

services. Generally, Eskom's operational performance is good, which as a result enabled it to cut down some of its operating and financing costs. This is discussed in detail in Chapter Five.

## **4.7 Conclusion**

This chapter has scrutinised whether Eskom's electricity prices are lower or not compared to those of other utilities in the world and the reasons for this. Generally, research findings show that Eskom's electricity prices are among the lowest in the world.

There has been a significant decline in the price in real terms, particularly from the mid-1980s until recently. The findings have attributed Eskom's low price to a substantial decline in capital-related costs such as interest expenditures that have resulted from a decline in capital expansion programmes. Also, together with other components of price, the costs of coal have dramatically declined too. The use of cheap and low-grade coal as well as contractual agreements with coal suppliers (Eskom-tied collieries) have contributed significantly to Eskom's low costs of coal that consequently have reduced its electricity price in comparison with many other utilities in the world. Other factors that must also be taken into account when questioning Eskom's low price are the non-payment of taxes and dividends and the exclusion of external costs of electricity production.

The need for new capital investment in the ESI, as the current capacity is eroded, poses a threat to the current low price of Eskom's units of electricity. Given the influence of capital-expansion programmes on the level of the price, it is most likely that the price will increase considerably due to a consequential increase in the capital-related costs. To avoid exorbitant increases in price, as those experienced in the late 1970s and the early 1980s, it is particularly important to slowly account for the cost of new capital investment, thereby slowly increasing the electricity price in real terms.

## Chapter Five

### Eskom Operational Performance

#### 5.1 Introduction

This chapter examines Eskom's operational performance from 1980 to 2001, specifically examining productivity and other financial and technical parameters. The chapter provides results obtained from analysis of data that has been extracted from various Eskom annual reports, as well as from other sources, such as Eskom statistical yearbooks, the NER, DME and DPE. Section 5.2 provides a general overview of productivity before embarking on an in-depth analysis of Eskom's productivity in resource utilisation (mainly labour, raw materials/fuel and water). Section 5.4 scrutinises its financial performance. Financial indicators have been grouped into four: profitability ratios, debt management ratios, liquidity ratios and asset management ratios. Generally, profitability ratios indicate 'how profitable' the investment is, whereas debt management ratios show the capital structure of an organisation and the underlying consequences on interest charges. Liquidity ratios show how effective the organisation is in meeting short-term maturing obligations, and asset management ratios measure the efficiency with which a company's assets are utilised. Section 5.5 highlights Eskom's technical performance for the past two decades.

Comparative analyses of different operational efficiencies of selected large power utilities from other countries have also been included in this chapter (in section 5.6). Characteristics of specific power plants, such as size (capacity) and fuels in use have been taken into consideration in the choice of utilities to be compared with Eskom. The availability of data for the utilities in question also restricted the choice of comparisons.

Performance indicators have been observed over time and/or compared with other utilities to ascertain if there is any improvement or deterioration. Three approaches commonly used to analyse whether or not the company's performance is improving or deteriorating are *time series (trend) analysis*, *cross-sectional analysis* and *industry analysis* as highlighted by Pandey (1999: 110) and Higgins (2001: 57).

*Time series analysis* shows a company's yearly changes in performance indicators, specifically as to whether there was an increase or a decrease, or whether it remained constant over time. Thus, Eskom's performance indicators have been compared from one year to another throughout the years under consideration in order to determine whether there has been any improvement, deterioration or constant performance and the reasons that gave rise to these. This approach has widely been used in this study when analysing Eskom's performance.

*A cross-sectional analysis* seeks to investigate the performance of a particular company by comparing it with another company or companies in the same industry (competitors). However, since companies differ in one aspect or the other, there is a possibility of having noticeable differences. In the case of the South African ESI, it would not be useful to compare Eskom with either municipalities or other private electricity producers in South Africa due to the fact that Eskom enjoys a dominant generation role in the industry and the scale of plants differ so widely. That being the case, efforts were made to compare Eskom's performance indicators with those of other giant power utilities in the world in order to determine the extent of its performance in relation to others.

*Industry analysis* helps to ascertain a company's performance by comparing its performance indicators with established average ratios of the industry within which it operates. In this study, this type of analysis has not been used when investigating the performance of the South African ESI. This is mainly due to lack of established industry ratios to which comparison could be made when ascertaining the extent of performance of a company in question.

Chapter Two highlighted the economic meaning of the word 'efficiency' as the optimal utilisation of scarce resources in the production of goods and services such that it is not possible to improve the resource's productivity by any reallocation of factors of production without affecting other resources' productivity. However, at a practical level, efficiency of resources is determined by comparing outputs and resources utilised in the production process expressed as a ratio. This is generally called "productivity" and is discussed in detail in section 5.2 below.

## **5.2 What is productivity and how is it determined?**

Different scholars have defined productivity in somewhat diverse ways, although the essential meaning is virtually the same. Cooper (2002: 12), for instance, defines productivity as a ratio obtained by dividing the product quantity by the resource quantity. Render and Heizer (1997: 15) describe

productivity as the transformation of resources into goods and services in such a way that there is a favourable comparison between resources employed (inputs) and goods and services produced (outputs). Wild (1990: 395) defines productivity as a ratio obtained by dividing output by a factor utilised in the production. Similarly, Heap (1992: 9) defines productivity as “the relationship between output and one or more of the associated inputs used in the production process”. Riggs and Felix, (1983: 4), also, defines productivity as a ratio of goods and services produced to resources consumed. According to CZI (2003), the SADC productivity movement defines productivity as “the ratio between goods and services produced within a national economy, economic sector, industry or individual organisations, on the one hand, and the resources used to produce them on the other hand”. Resources used in the denominator must be those that were fully utilised during the production of the products. Productivity improvement occurs when the resource quantity decreases while product quantity remains constant or increases. Furthermore, productivity improves when the quantity produced increases whilst the resources utilised remain constant.

As can be seen from these diverse definitions, different professionals, as well, define productivity in accordance with – and to suit –the professions or fields in which they are involved. Nevertheless, all definitions do essentially give the same meaning. For instance, Wild (1990: 395) contends that from an engineer’s point of view, productivity means efficiency, and can be determined by dividing output by a factor of production which can either be capital or raw materials. Economists, however, often relate productivity to labour and thus place a greater emphasis on labour productivity rather than on capital (Wild, 1990: 395). On the other hand, an accountant uses financial ratio analysis to measure the productivity and effectiveness of organisations (*ibid*). This being the case, this research assesses productivity, financial and technical indicators to provide a wider view of Eskom’s performance. As discussed below, productivity has a direct relationship with the profitability of an organisation (if other factors remain constant). It is, therefore, important to show how productivity can impact on profitability by assessing different financial indicators.

From the above definitions it is clear that productivity indicators show the physical relationships between outputs and inputs that were utilised to produce such outputs. Inputs are those factors or resources that are utilised in the production process to give out intermediate or finished goods (outputs). These include land, labour, capital, materials, energy (fuel), buildings, equipment and many others, depending on the nature of the business. Inputs and outputs differ from one industry to another due to differences in the nature of the businesses. Eskom’s core business is the production and sale of electricity in South Africa as well as in neighbouring countries such as Lesotho and Zimbabwe.

Therefore, it is necessary to ascertain the productivity of Eskom's resources such as labour, raw materials (fuels), fixed and current assets etc.

Productivity can be determined either separately for each individual factor/resource utilised in the production of a given output (partial factor productivity) or alternatively for all factors included in a denominator (total factor productivity). If productivity is determined separately for every factor, it becomes easier to monitor this and to employ means of improving each factor's productivity rather than determining total factor productivity. Accurate determination of total factor productivity is difficult, however, due to the fact that the various factors of production are measured and valued differently. For example if a company employs three factors of production, viz. machines, human resources and raw materials (fuel), to establish total productivity, you will need to determine the total numbers of machines utilised, employees and raw materials, or find another measure to establish their common denominator. This high degree of complexity and variability will create both practical and theoretical difficulties and may thus give rise to unreliable conclusions reached due to the different measures given to each factor. Another reason for the danger of using total factor productivity is that it is most likely that the number of some of the factors will be higher compared to others, although their contribution to total output might be insignificant.

Furthermore, the determination of productivity for each factor involved in the production process helps the management of a company or organisation to scrutinise the extent to which each factor contributes to an organisation's profits and to determine the relationships between the various resources. For example, labour productivity may increase not because of an increase in its effectiveness but perhaps rather because of an increase in one or more other factors (e.g. the installation of computers in an organisation will increase labour productivity). Consequently, the productivity of the increased factor or factors will in fact decrease due to an increase in its quantity (when physical relationships or costs are considered) if total production remained constant or increased insignificantly. Thus, this will help management to judge each resource's specific productivity and thus make more sound and well-informed decisions regarding improving the productivity of such resource, than if the total factor productivity approach were used.

Thus, productivity improvement programs for a given resource should not be undertaken in isolation from others because there is a risk of jeopardising the organisation's profitability. The need to conduct a sensitivity analysis of the programs/actions that are aimed at improving the productivity of the resource is of paramount importance. This will help to assess the impact on both the productivity of

other resources and the profitability of the company as a whole. In 2001, for example, there were productivity improvements for some of Eskom's resources, such as primary energy, operating manpower and capital (saving the business R379 million), whilst other operating resources recorded a negative productivity valued at R400 million due to an increase in maintenance-related activity (Eskom Annual Report, 2001: 49).

Furthermore, productivity can be determined at different stages of the production process or in different divisions of the organisation depending on the organisation's structure and nature of business. Heap (1992: 8) explicitly highlights the fact that:

The overall productivity of the organisation is dependent on [the] productivity of each division, department, section and individual and it is possible (though not necessarily desirable...) to measure at each level to build a hierarchy of measures that allow analysis of a range of activities and functions that make up the total work of the organisation.

Moreover, Renda and Heizer (1997: 15) describe the relationship between input and output and their ultimate effect in improving the standard of living of human beings. They argued that, for labour, capital and management to receive additional payments (higher salaries / wages), there must be an increase in productivity, otherwise prices of goods and services would be higher to compensate for any additional payments. The National Productivity Institute (2003) adds further that:

From an economic perspective, productivity is a wealth-generating process that drives economic growth. At the organisational level, wealth generation offers distinct strategic opportunities in terms of distributing such wealth to all stakeholders. The wealth could be used to compensate investors, offer higher wages and salaries to the suppliers of labour, or hold down selling price increases to the consumers. Improving productive capacity in South Africa is a true source of a competitive advantage that would create long-term economic viability and a better standard of living for all.

Table 5.1 below summarises different productivity indicators discussed in this chapter. It describes objectives that need to be achieved for each indicator if productivity improvement has to materialise. Productivity indicators examined in this chapter are grouped into labour productivity indicators, raw materials utilised (fuel) and water resources. Efforts were made to establish productivity indicators expressed in both quantity and monetary values (nominal and in 2000 Rands) to allow for a meaningful comparative analysis between the years. The results obtained from each year are compared with other years' results when assessing whether there were any productivity improvements in the year under consideration or not. Effectively, productivity improvement occurs when outputs increase more than inputs.

**Table 5.1: Measurement of resource productivity**

<b>Resource</b>	<b>Productivity Indicators</b>	<b>Productivity Objectives</b>
1.Labour	i. kWh produced per employee	Maximise kWh produced per employee Reduce idle times and over-employment
	ii. kWh sold per employee	Increase kWh sold per employee Optimise the number of employees
	iii. Revenues generated per employee	Maximise revenue per employee
	iv. Revenue generated per labour cost	Maximise revenue per Rand invested in employees Minimise labour costs
	v. Customers per employee	Increase the number of customers which will, as a result, increase revenue
2. Raw materials (Fuel)	i. kWh produced per kilogram of coal utilised	Maximise kWh produced per kg of coal utilised Reduce wastage
	ii. Revenue generated per cost of coal used	Increase revenue per coal costs Minimise the cost of coal
3. Water resources	i. kWh generated per a litre of water consumed in power plants	Reduce the amount of raw water used in the production of kWh

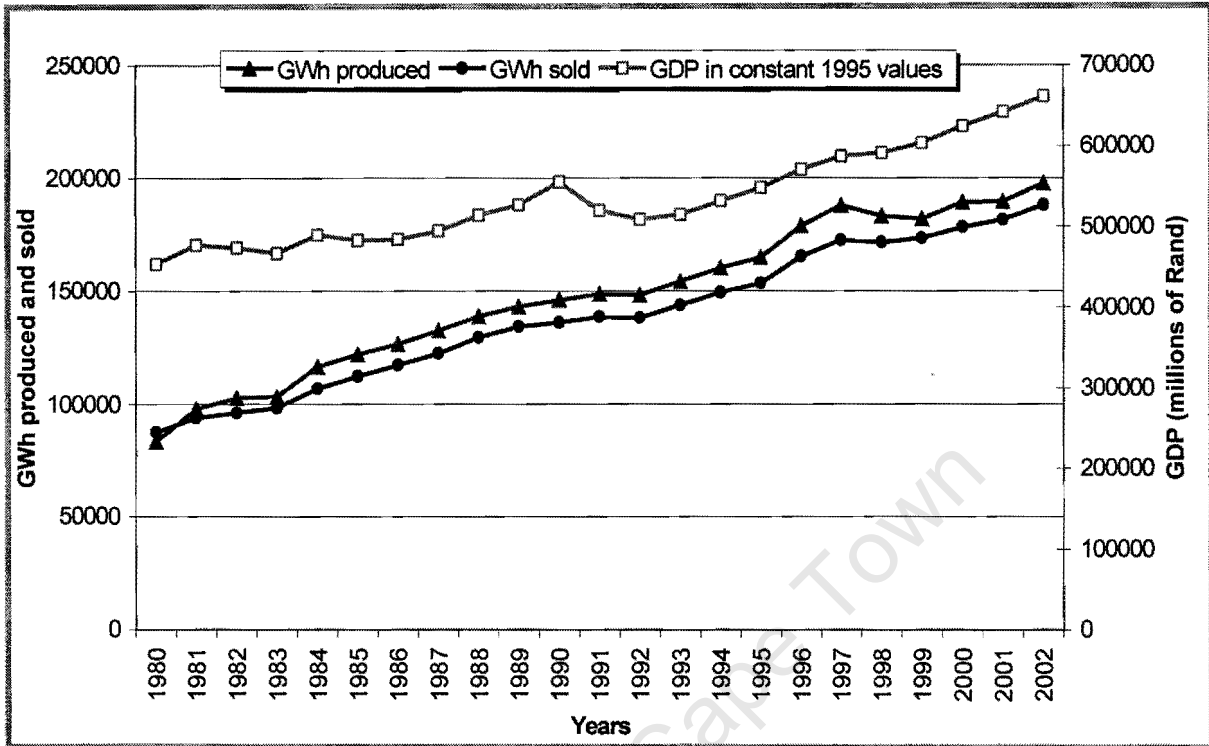
Before providing a detailed analysis of productivity indicators, it is important at the outset to provide an overview of outputs that include GWh produced and sold, revenues generated and the number of customers served by Eskom.

## **5.2.1 Eskom's outputs**

### **5.2.1.1 GWh produced and sold**

Eskom resources are employed in the production and sale of electricity. Before indulging into an investigation aimed at ascertaining the extent of each resource's contribution to the final output (electricity), it is of paramount importance to scrutinise how GWh produced and sold by Eskom changed over the years under review.

**Figure 5.1: Electricity produced & sold by Eskom and South Africa's GDP**



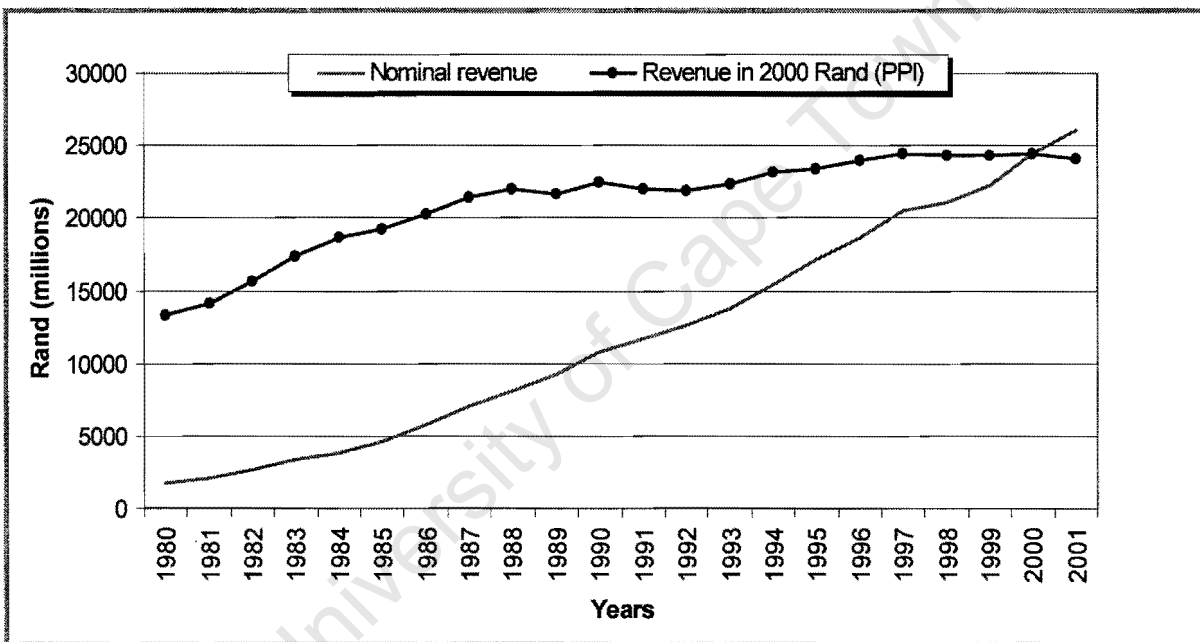
**Source:** Compiled from Eskom Annual Reports (1980 – 2002); Statistical Yearbooks (1985 – 1996) & IMF (2003: 876; 2000: 890).

Figure 5.1 above shows GDP (in real terms) GWh produced and sold from 1980 to 2001. The graph shows a substantial decline in GDP in 1992 while GWh produced increased consistently over the years under review except for 1992, 1998 and 1999. Despite a substantial increase in the number of customers in 1992, Eskom's GWh produced and sold declined by 0.3% and 0.4% respectively (shown in Appendix VII). A 1992 decrease in sales was the first time since World War II and it was attributed to poor performance of the economy and low prices of gold and base metal at the world market that led to the decline in sales to mining customers (Eskom Annual Report, 1992: 16). Similarly, a downturn in the economy affected Eskom adversely thereby leading to a 2.5% and 0.6% decline in electricity produced and sold in 1998 (Eskom Annual Report, 1998: 15). Generally, GWh produced and sold increased by an average rate of 6.3% and 4.9% from 1980 to 1990 and 2.4% and 2.7% from 1991 to 2001 respectively. Overall, an increase in GWh produced and sold in the years under review averaged at 4.4% and 3.8% respectively. Eskom could have produced more – it had over-capacity. Output was constrained by demand, which is largely a function of GDP growth.

### 5.2.1.2 Revenue

In conjunction with other sources, Eskom generates its revenue from the sale of electricity to its customers: these include redistributors (municipalities), commercial, industrial, mining, rural/farming, as well as traction and domestic and street lighting. It also exports electricity to neighbouring countries such as Botswana, Mozambique, Namibia and Zimbabwe (Eskom Statistical Yearbook, 1996: 23). Eskom sells its electricity in bulk to municipalities, industrial and mining customers. From 1980 to 1996, on average, redistributors, industrial as well as mining customers bought about 38.5%, 29.5% and 25.2% of electricity sold respectively<sup>38</sup>.

**Figure 5.2: Eskom's nominal and real revenues (1980 – 2001)**



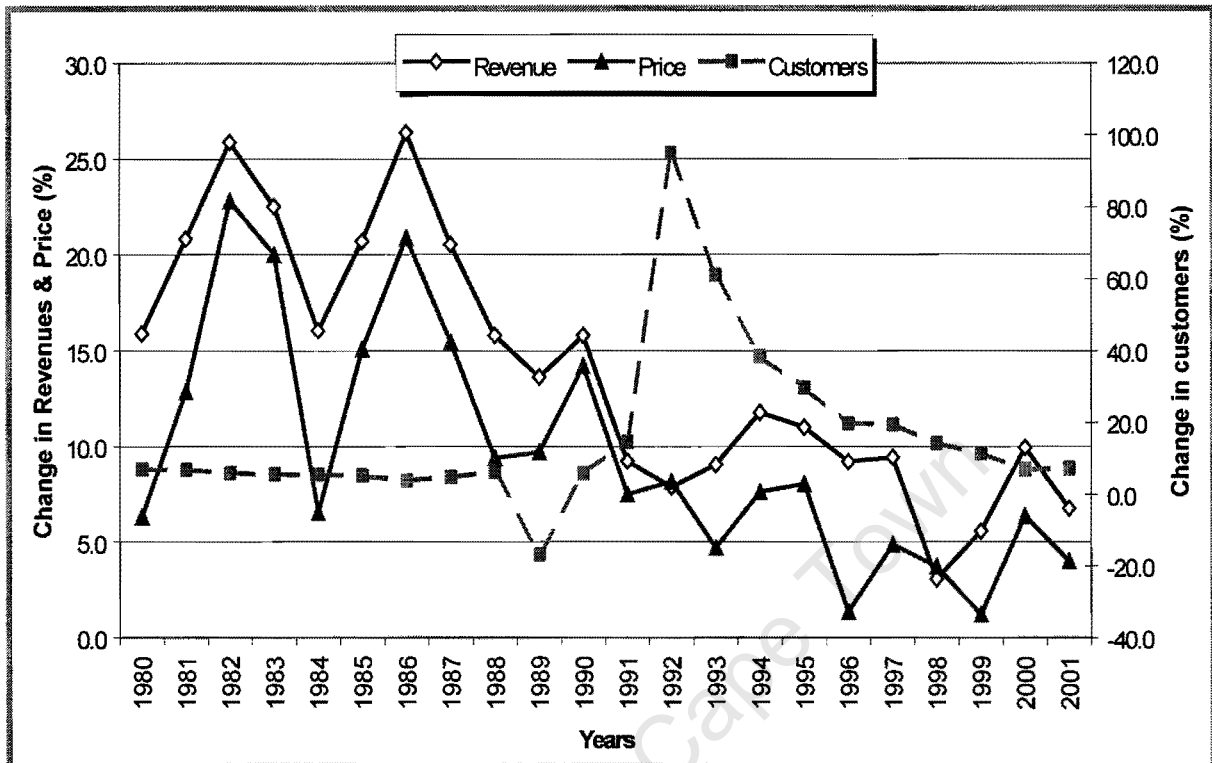
Source: Compiled from Eskom Annual Reports (1980 – 2001).

Figure 5.2 (above) shows the revenue in nominal and real terms (in 2000 Rands). From 1980 to 2001 revenue has increased consistently in nominal terms, although it increased only modestly in real terms, with some of the years experiencing negative growth rates. From 1980 to 1990 it increased by 19.5% on average (nominal), whereas this diminished to about 8.5% from 1991 to 2001. However, the overall rate of increase (nominal) from 1980 to 2001 averaged 14%. On the other hand, on average, revenue increased by 4.3% in real terms from 1980 to 1991 and it increased insignificantly by 0.7% in average (in real terms) in each subsequent year under review<sup>39</sup>.

<sup>38</sup> Average percentages have been calculated from yearly data provided in Eskom Statistical Yearbook (1996: 25)

<sup>39</sup> Percentage changes in revenue have been shown in Appendix VIII.

**Figure 5.3: Nominal changes in revenue, average selling price and total customers**



Source: Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

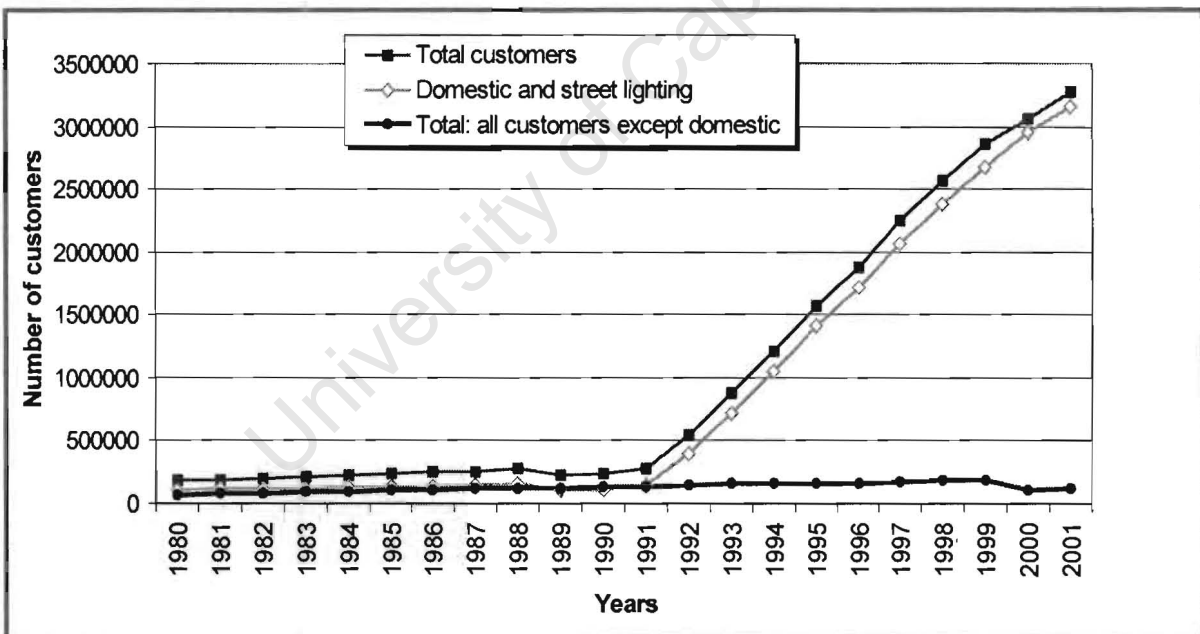
Figure 5.3 (above) shows the relationships between Eskom’s revenue, selling price and the number of customers. A strong relationship (in terms of their trends) exists between revenue and the selling price, although the rate at which each one changed differs. As the price increases, so does revenue and vice versa. This is because regulatory authorities regulate Eskom’s total revenues by using the rate of return. That is, the total revenue required to cover all costs including the cost of capital used in generation (rate of return) is ascertained up-front, and from this the price capable of generating the estimated revenue requirements is determined. However, the price has to be approved by the National Electricity Regulator before any changes to the existing electricity prices are undertaken.

The figure above also shows that in 1992 Eskom’s customer base increased significantly (about 95%), whereas revenue increased only modestly. This is because most of these new customers were domestic customers. As discussed above, Eskom depends largely on three bulk customers for its revenues. Hence, although the number of domestic customers increased dramatically, the total GWh produced and sold in that year in fact decreased as described above (GWh produced and sold).

### 5.2.1.3 Number of customers

Figure 5.4 (below) shows the number of customers from 1980 to 2001. Before the early 1990s Eskom was selling its electricity in bulk to municipalities (which sold to households and other small scale consumers) and some few special customers. There has been a dramatic increase in the number of customers from the early 1990s to 2001 because of the policy highlighted in the Reconstruction and Development Programme (RDP) document, which placed an emphasis on providing electricity to disadvantaged communities. By 2000, about 2.5 million households had been targeted for electrification, a target that was expected to increase access to electricity by approximately 72% of the entire South African population (NER, 1997/8: 3). The National Electrification Forum, which included representatives from Eskom, the government, the ANC, Trade Unions and the private sector, established annual connection targets. The number stood at 450,000 households per annum; Eskom was responsible for 300,000 of these households every year, whereas local government was responsible for the remaining 150,000 households (NER, 1997/98: 3).

**Figure 5.4: Eskom's number of customers from 1980 to 2001**



Source: Compiled from Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

Following a massive electrification programme, the number of customers soared as shown in Figure 5.4 (above). An increase in the number of customers led to an increase in sales (although not significant compared to the increase in customers). One of the reasons for this is the fact that household

customers contribute only a small amount to Eskom's revenues compared to other categories of customers, such as redistributors, industry and mining.

Hence caution should be attached to time series and productivity data involving the number of Eskom customers. It should also be remembered that Eskom does not have direct access to all electricity customers as many of these are supplied by municipalities.

### **5.2.2 Labour productivity**

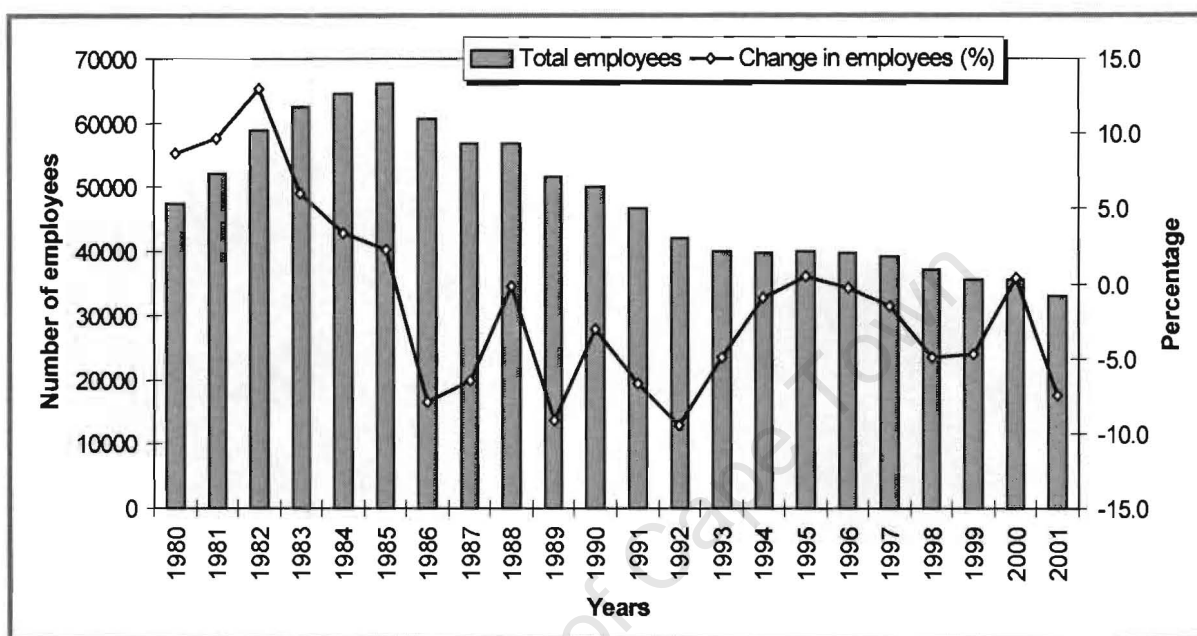
This section establishes the extent to which employees contributed to the production and sales of electricity by Eskom from 1980 to 2001. Different labour productivity indicators have been taken into consideration when analysing labour productivity. Attention is given to changes that have taken place (particularly in real terms) to establish any productivity improvement in the years under consideration. Since changes in the number of employees may have major labour productivity implications, it is of paramount importance to discuss the trend of total number of Eskom employees before analysing their productivity.

Employees form one of Eskom's most important resources. In conjunction with other resources, employees are expected to generate electricity that would eventually increase revenues and shareholders' wealth. As discussed in Chapter Four, labour costs form one of the most significant ingredients in Eskom's total production costs. It requires the most effective and efficient use of labour to significantly produce electricity at the lowest possible economic cost while reliably ensuring not only high quality customer services but also increasing the industry's competitiveness. The determination of labour productivity helps the management of a company to monitor and control the required number of employees on the one hand and to ascertain their capability in meeting the set objectives of the company on the other.

There has been a declining trend in the number of employees in many companies in South Africa, particularly in Eskom. It should be borne in mind that a decline in the total number of employees would not necessarily enhance the productivity objectives of an organisation. For example, if a decline in the total number of employee is accompanied by an increase in the assets of the company, there could be an increase in labour productivity (as measured in physical terms) at the expense of asset productivity, unless the increased assets in fact produce more goods. This also has financial implications. Because of increased labour productivity resulting from a decline in the total number of employees, it is not surprising for the existing employees to demand an increase in their salaries. At the

same time, the value of the assets that replace the retrenched employees would have cost implications as well. Thus, if the productivity improvement for a given resource is determined in isolation from others, there is a risk of jeopardising the organisation's profitability.

**Figure 5.5: Eskom's total employees and changes in the number of employees**



**Source:** Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

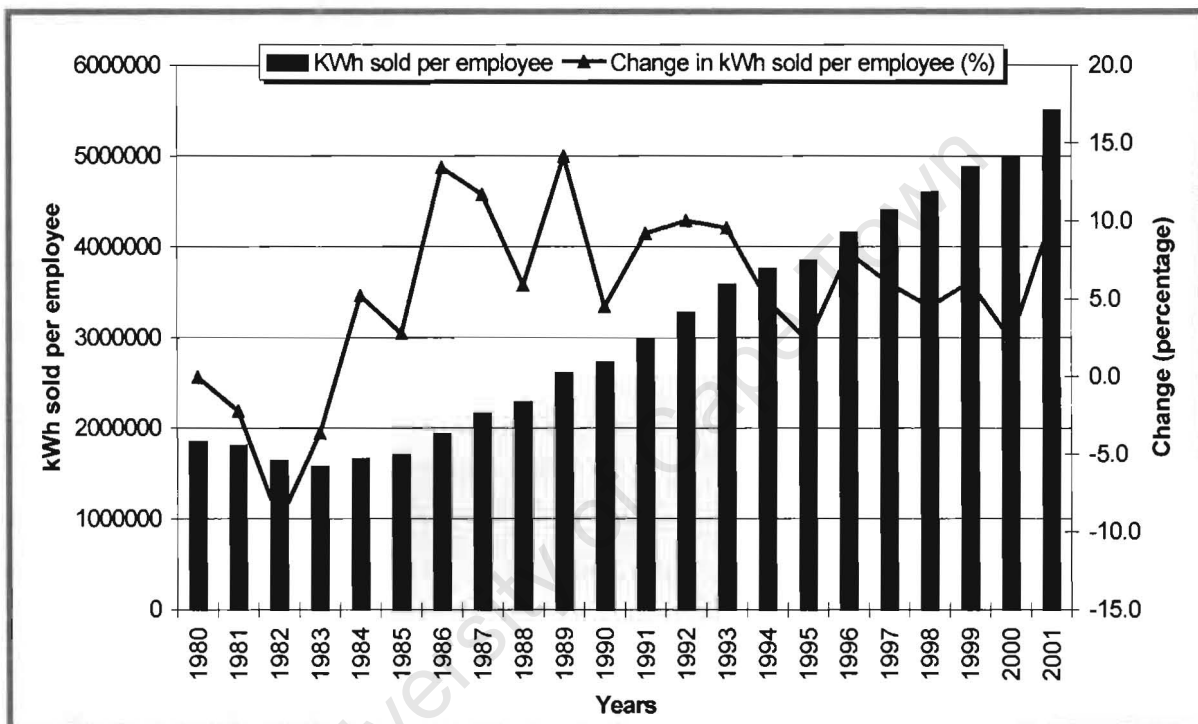
As shown in Figure 5.5 (above) the number of employees increased from 1980 to 1985. However, from 1985 to 2001 there was a noticeable decline in the number of employees, although it increased slightly in 1995 (about 0.5%) and 2000 (0.4%). This contributed markedly to the improvement of different labour productivity indicators as described below. There were 66,000 employees in 1985 (Eskom Annual Report, 1985: 58), the level that is the highest in Eskom in the years under review. In 2001 Eskom had only 33,032 employees (Eskom Annual Report, 2001: 3), representing a roughly 50% decrease in the total number of employees between 1985 and 2001.

As stated above, given that electricity production is one of Eskom's core activities, it is expected that the number of employees employed by Eskom should be productively sound. Labour productivity indicators show the extent to which human resources were utilised to generate revenues for Eskom, either directly or indirectly. An in-depth analysis of labour productivity follows below.

### 5.2.2.1 Kilowatt-hours sold per employee

To determine kWh sold per employee, the total kWh sold in each year were divided by the total number of employees in the respective years. Productivity improvement can thus be noticed if kWh sold per employee increases from one year to another. The opposite indicates the deterioration in labour productivity.

Figure 5.6: Kilowatt-hours sold per employee from 1980 to 2001



Source: Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

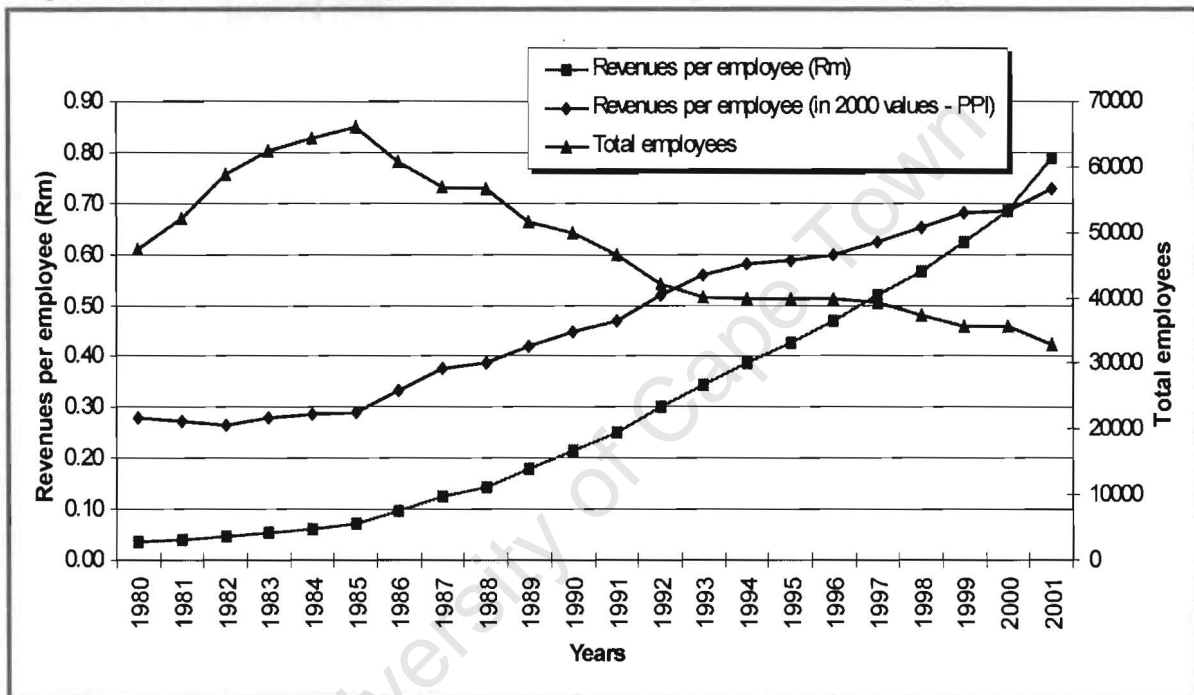
\*kWh sold per employee have been determined based on available data.

Kilowatt-hours sold per employee have consistently increased from 1983 to 2001, with the highest percentage increase of about 14.2% in 1989 as shown in Figure 5.6 (above). Kilowatt-hours sold per employee increased dramatically by 3,651,690 (about 198%) between 1980 and 2001, whilst the number of employees decreased from 47,490 to 33,032, representing a roughly 30.4% decrease. The year 1983 recorded the lowest kWh per employee because about 3,000MW of generating capacity was lost (three-fifths of the lost capacity was due to the drought whilst the remainder was attributed to the unreliable supply of power from the Cahora Bassa scheme in Mozambique) (Eskom Annual Report, 1983: 7). The average annual rate at which kWh sold per employee was increasing from 1980 to 2001 stood at 5.3% as compared to 3.9% noticed from 1980 to 1990 and about 6.6% in 1991 to 2001.

### 5.2.2.2 Nominal and real revenues generated per employee

Labour, just like other Eskom resources, is expected to generate enough revenue to accomplish the objectives of the company. The analysis has considered both nominal and real values (in constant<sup>40</sup> 2000 Rands) in order to determine if there were any real productivity improvements in the years under review. To determine revenue per employee, total operating revenues were divided by the number of employees in each respective year.

**Figure 5.7: Nominal and real (in 2000 Rands) revenue generated per employee**



Source: Compiled from Eskom Annual Reports (1980 – 2001).

\*Revenues generated per employee have been calculated based on available data.

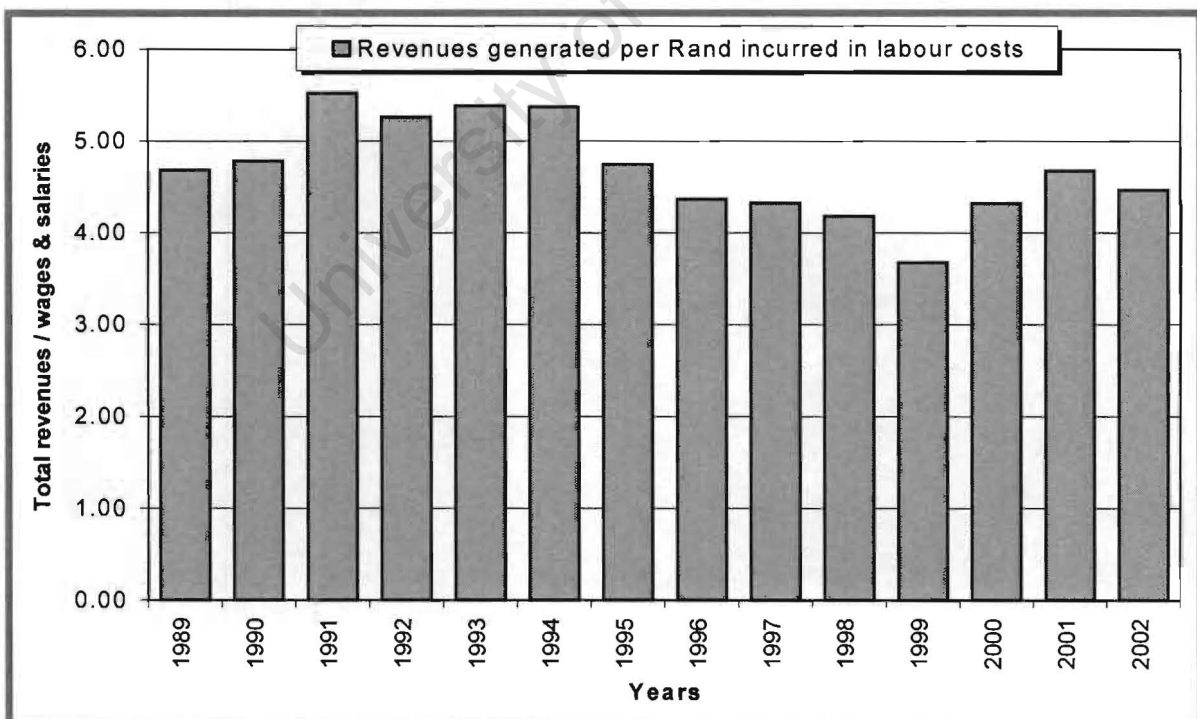
Figure 5.7 (above) shows nominal and real revenues generated per employee. It highlights the extent to which the number of employees influences revenues positively or negatively and whether this happens directly or indirectly. Generally, the figure shows that a negative relationship exists between revenues per employee (nominal and real) and the associated number of employees. There was a negative growth (in real terms) in revenues per employee in 1981 and 1982. It must be noted that in those years the number of employees had increased. The year 1982 recorded the highest level of the rate (about 13%) at which employees were increasing during the years under review. In 1986 there was a highest percentage growth in both nominal and real revenues per employee, with the nominal value increasing

<sup>40</sup> This takes into account fluctuations in monetary values due to inflation and business risk.

more than two and a half times that of the real value. An increase in both nominal and real revenues per employee can be attributed to three reasons, among others, an increase in tariffs, additional sales and a significant decrease in the number of employees in 1986. In that year tariffs were increased in order to reinstate a sound financial structure of Eskom. An increase of 10% in January followed by another 10% increase in July resulted in an increase in the average electricity price (in nominal terms) from 4.12 c/kWh in 1985 to 4.98 c/kWh in 1986 (Eskom Annual Report, 1986: 13). This resulted in an increase in total revenue. Moreover, in 1986 the number of employees was remarkably reduced due to the provision of “generous early pensions and benefits to older employees and putting a bar on recruitment...” (Eskom Annual Report, 1986: 7). Further staff reductions (about 3,600 employees) were proposed during the year due to the “emerging excess generating capacity” (*ibid*). In general, then, the number of employees increased from 1980 to 1985 and decreased from 1986 onwards, except for 2000 where it increased insignificantly. Revenue per employee increased by 15.4% and 4.1% per annum (in average) from 1980 to 2001 in nominal and real terms respectively. For the past ten years (1992 – 2001) it increased at an annual rate of 4.5% in real terms.

### 5.2.2.3 Revenues generated per labour cost

Figure 5.8: Revenues generated per Rand incurred in labour cost



Source: Eskom Annual Reports (1989 – 2001).

\*Revenues generated per cost of labour have been calculated based on available data.

Figure 5.8 (above) shows the amount of revenues generated per Rand expended on labour. On average, about R4.70 was generated per each Rand incurred on labour costs (wages and salaries) from 1989 to 2002 per annum. The figure shows in 1991 each Rand expended in labour generated about R5.52 (which is the highest) whereas the year 1999 recorded a noticeable decline in revenues per labour costs (R3.68). A decrease in revenues per labour costs in 1999 can be ascribed to an increase (in real terms using PPI) of about 13.5% in wages and salaries and a decline in real revenues of about 0.2%.

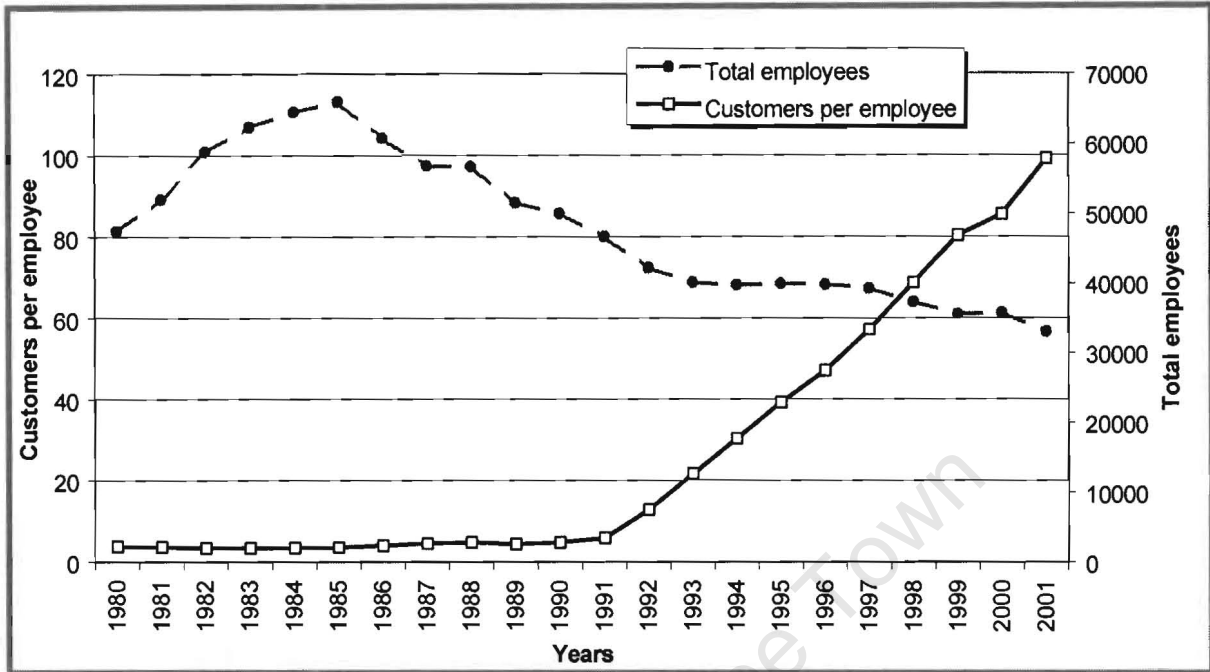
#### **5.2.2.4 Customers per employee**

When determining the number of customers per employee, the number of employees divides the total number of customers in each respective year. This is a very important productivity indicator, among others, which shows whether the number of customers served grows in respect to the number of employees or not. It should be noted that increases in electricity production must go hand in hand with increases in the number of customers (if not consumption) in order to utilise any extra electricity produced, since extra power cannot be stored. If the number of employees were to be departmentalised, it would be possible to assess the extent to which employees together with other associated resources in the marketing department in fact increase the number of Eskom customers.

In normal circumstances the number of customers per employee in a power utility (such as Eskom) operating in a monopolistic electricity industry should increase from one year to another, assuming that the number of employees is constant or increases insignificantly. This is justifiably true, especially in almost all ESIs in Africa where there still exist large numbers of households that are not connected to national grids. Thus, electrification programs still continue, and as the number of customers increases so does the number of customers per employee.

However, in a competitive ESI things work quite differently. Firms in a competitive industry will be expected to strive competitively to increase the number of customers through the provision of high quality services at reasonably lower prices. Effective marketing strategies are needed to attract new customers and maintain existing ones. If it happens that a firm in a competitive ESI increases its number of customers per employee (with others factors remaining constant), it would not be surprising to find that its operational performance is improving. As the number of customers increases (again, with other factors remaining constant) so do revenues and shareholder welfare. The opposite holds true as well.

**Figure 5.9: Customers per employee (1980 – 2001)**



**Source:** Compiled from Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

Figure 5.9 (above) shows customers per employee from 1980 to 2001. Generally, the trend shows that there was an increase in the number of customers except for the years 1980, 1981, 1982, 1983 and 1989. As noted above that the number of employees increased from 1980 to 1985, whereas the number of customers was only slightly increasing between 1980 and 1991 (before the electrification program)<sup>41</sup>, which ultimately gave rise to a decline in the number of customers per employee. In 1989 a decrease in the number of customers per employee can be attributed to a decline in the number of customers, particularly domestic but also industrial, due to the fact that Eskom sold some of its networks to Tygerberg municipalities (Eskom Annual Report, 1989: 13). On the other hand, there was also a dramatic increase in the number of customers per employee from 1992 onwards. In 1992 customers per employee increased by about 115% which is a result of an increase in total customers of about 95% (an increased number of domestic customers – about 178% - contributed significantly to this). A massive growth (95%) in the total number of customers was due to the connection of new customers, the electrification programs and the transfer of some of customers from local authorities to Eskom (Eskom Annual Report, 1992: 17). Generally, between 1980 and 2001, customers per employee increased by more than 25 times. From 1980 to 1990 customers per employee averaged below 5 while from 1991 to 2001 it averaged at 50. In 2001 the number of customers per employee was 99.

<sup>41</sup> Shown in Figures 5.5 and 5.4 respectively.

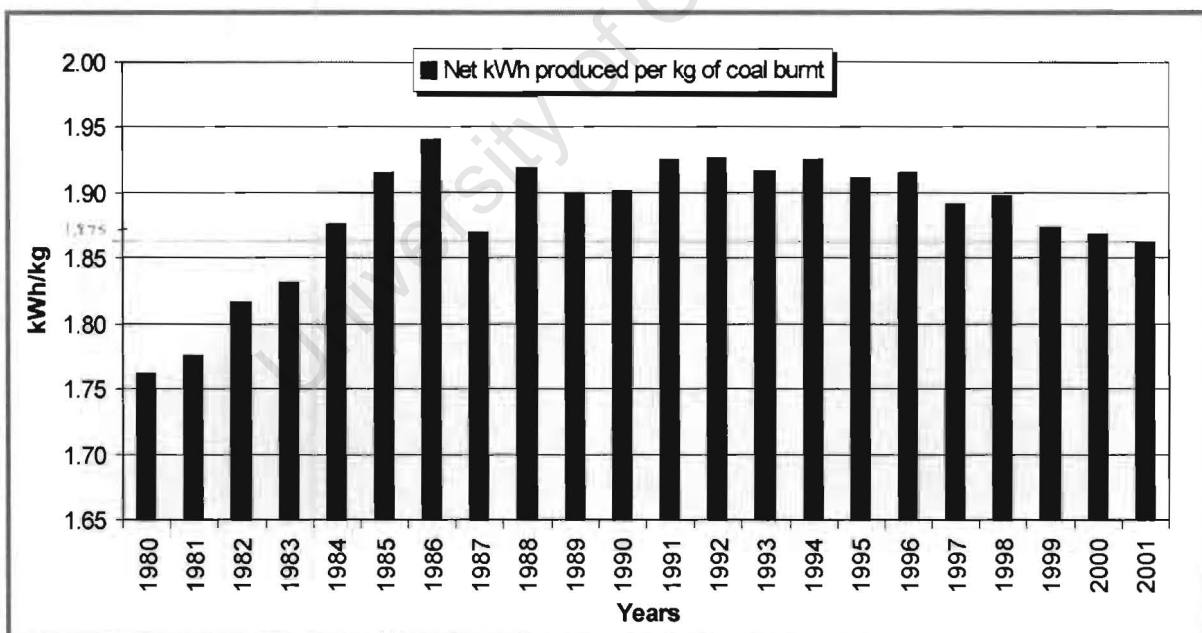
### 5.2.3 Raw materials (coal) productivity

As with all other resources used by Eskom, more efficient utilisation of coal would have major profitability implications. Between 1980 and 2001 coal burnt in power stations doubled from 46.8 million tonnes (Eskom Annual Report, 1980: 6) to 94.1 million tonnes (Eskom Annual Report, 2001: 3) which is more than 100% increase. Two indicators of raw materials productivity have been considered in this study: kilowatt-hours produced per a kilogram of coal consumed in power stations and revenues generated per cost of coal. These are discussed below.

#### 5.2.3.1 Kilowatt-hours produced per kilogram of coal utilised

Kilowatt-hours produced per kilogram of coal burnt show the extent to which Eskom utilises coal effectively – or not. Depending on a company’s thermal/technical efficiency and the quality<sup>42</sup> of coal used, the quantity of coal needed to produce a kWh should consistently decrease if the company conversion process is operationally efficient. Thus, the more efficient the company’s conversion process, the less will be the raw materials consumed to produce a given level of electricity.

Figure 5.10: Net kilowatt-hours produced per kilogram of coal burnt



Source: Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

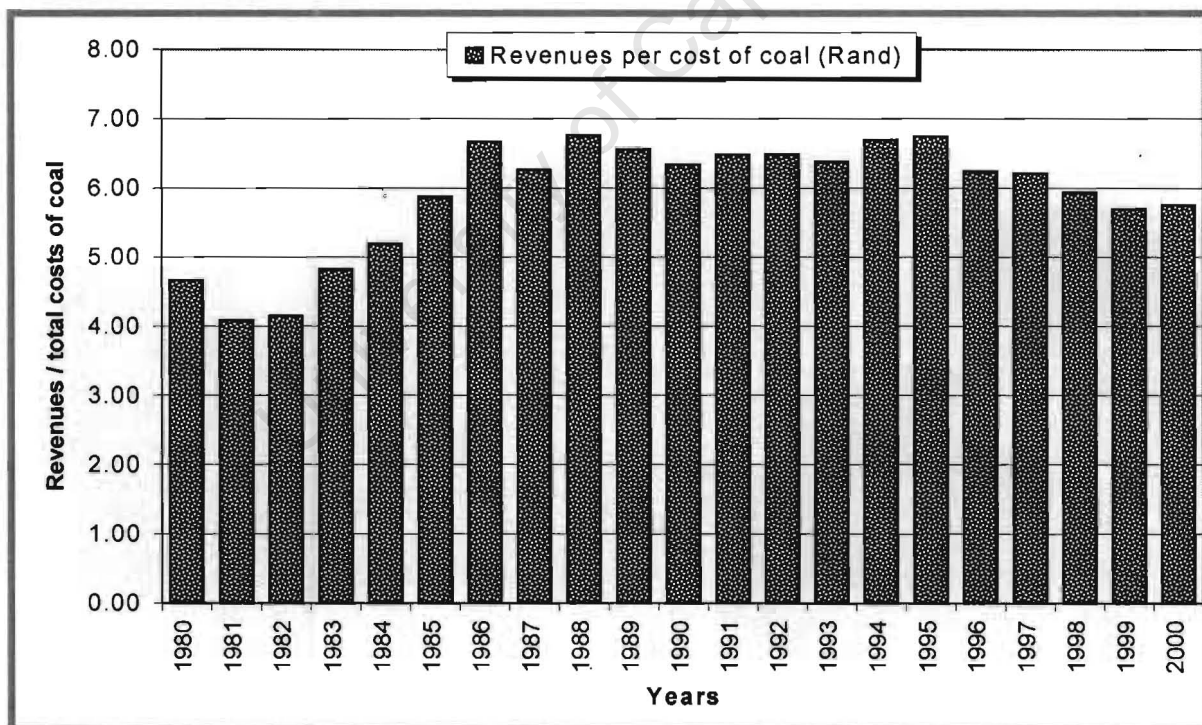
\*Net kWh generated per kg of coal burnt has been determined based on available data.

<sup>42</sup>The fact that Eskom coal-fired plants have been designed to burn low-grade coal leads to challenges in terms of both environmental sustainability (particularly air quality) and efficiencies (Eskom Annual Report, 2001: 62).

Figure 5.10 (above) shows kWh produced per kilogram of coal used from 1980 to 2001. Between 1980 and 1986 kWh/kg increased by about 10.2%, but this figure remained fairly constant from 1988 to 1994. The year 1986 recorded the highest level of kWh/kg (about 1.94 kWh/kg) which dropped dramatically in 1987. From 1996 to 2001 it was decreasing continuously. Generally, research findings ascribe a decline in kWh generated per a kilogram of coal to the old age of Eskom's power plants – most plants were commissioned in the mid 1980s. This led to an increase in thermal efficiency during that time. Figure 5.20 shows Eskom's overall thermal efficiency from 1980 – 2001. The overall thermal efficiency increased consistently from 29.6% in 1980 to 32.9% in 1986, which dropped to 32.7 in 1987 and thereafter it remained slightly constant before it declined slightly in the late 1990s. As the amount of coal needed to produce a kWh decreases, it is expected that the cost per kWh should also fall. Although Eskom's coal costs have generally been increasing in nominal terms due to increases in prices and inflation, they have consistently declined in real terms<sup>43</sup>.

### 5.2.3.2 Revenue generated per cost of coal

Figure 5.11: Revenue generated per cost of coal



Source: Eskom Annual Reports (1980 – 2000) & Statistical Yearbooks (1985 – 1996).

\*Revenues generated per cost of coal have been determined based on available data.

<sup>43</sup> Figure 4.10 in Chapter Four illustrates nominal and real cost of coal.

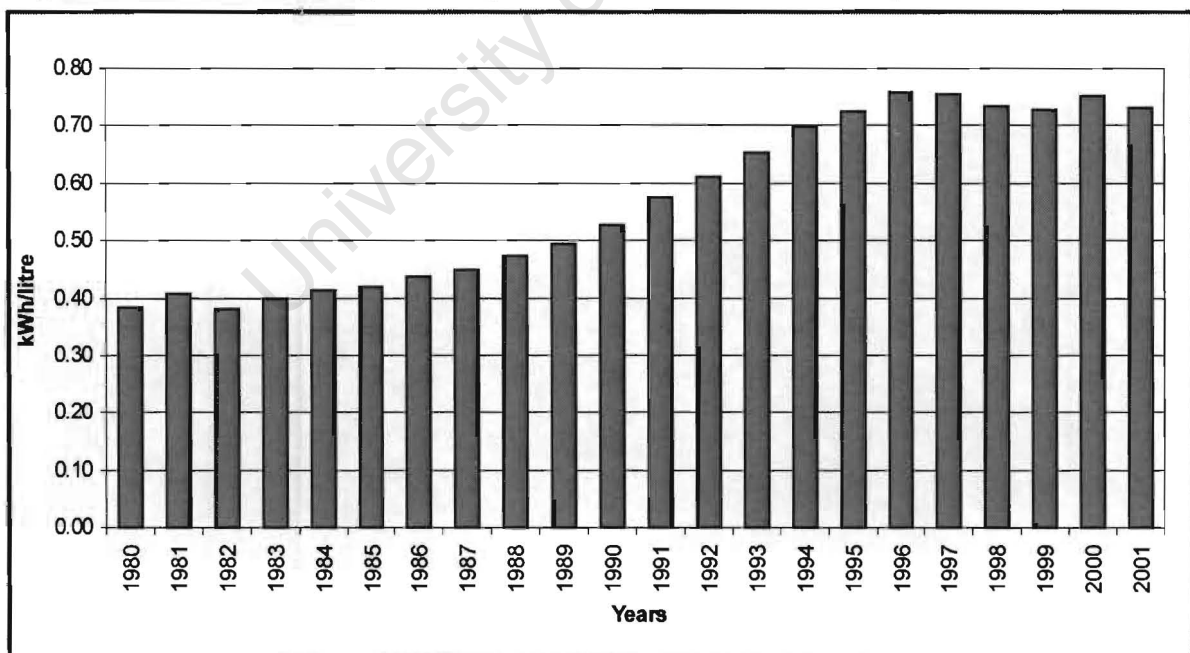
Figure 5.11 (above) shows revenues<sup>45</sup> generated per every Rand incurred in coal consumed for electricity production. Whilst from 1981 to 1986 there was a generally improvement in revenues generated per Rand incurred in coal, it slightly changed between 1988 to 1995 before it continuously declined from 1996 to 2000. In average, Eskom generated about R5.90 per every Rand expended in coal from 1980 to 2000.

### 5.2.4 Water resources

Eskom’s power plants consume a substantial amount of water. About 73% of its coal-fired plants use wet-cooled technology (Eskom Annual Report, 2001: 63) and therefore consume a lot of water. Eskom consumed about 239,233 million litres of water to generate 189,590 GWh of electricity in 2001, which is slightly higher compared to the amount of water and electricity produced in 2000 - it used 228,759 million litres of water to produce 189,307 GWh (Eskom Annual Report, 2001: 63).

In adherence to the National Water Act requirement, Eskom registered all its power plants as water users in 2001 (*ibid*). Eskom has also undertaken some measures that are aimed at conserving water and managing its water demand in an attempt to reduce its consumption.

**Figure 5.12: Kilowatt-hours produced per a litre of water consumed in power stations**



**Source:** Compiled from Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

<sup>45</sup> Revenues from electricity sales.

Figure 5.12 above shows the kilowatt-hours generated per litre of water. Generally, the trend is that kWh produced per litre of water increased consistently from 1982 to 1997, thereafter, it declined slightly. Overall, though, kilowatt-hours produced per litre of water increased by 100% between 1980 and 1997.

### 5.3 Productivity and profitability

A strong relationship exists between the productivity and the profitability of a company. Heap (1992: 7) and Cooper (2002:12) show that profitability is a result of productivity and price recovery<sup>45</sup>. Changes in either of these two variables (productivity and price recovery) or both can produce significant changes in a company's profitability.

Heap argues that "productivity measures the efforts of the management team to improve profitability or organisational effectiveness" (1992: 8). An effective management makes the best use of an organisation's resources to increase the profits of the company. As discussed in section 5.2 (above) it is obvious that an increase in the productivity of the resources could lead to an increase in the company's profitability (or at least reduce the losses of a loss-making company) and hence shareholders' wealth will be improved, if not maximised, *ceteris paribus*. Since the profitability of a company can however be influenced by external factors, then it is possible to have both an increase in productivity and a decrease in profit. Factors such as currency fluctuations and price changes of raw materials [and other resources] can, for instance, affect a company's profitability (Heap, 1992: 7), thus, together with productivity, external factors must be taken into consideration when evaluating the profitability of an organisation.

The need to integrate productivity and profitability indicators is inevitable as they both cater for the same objective. Productivity indicators show the extent to which a company's resources are utilised (i.e. the company's efficiency) to meet that company's objectives (effectiveness). As discussed in section 5.2 (above), the management of the company should manage its resources efficiently in such a way that an optimal level of resources is used to produce a given level of output. The efficient utilisation of resources would not necessarily enhance a company's effectiveness in meeting its goals, particularly the maximisation of shareholders wealth as reflected by increases in net profits of their investments. Vast amounts of monies are often tied up in assets, with the primary objective to produce

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<sup>45</sup> Price recovery is a ratio obtained by dividing the price of an output by the price of input. The higher the ratio the higher will be the profit and vice versa.

output that would eventually increase return to investors (shareholders). Idle resources can increase maintenance costs as well as storage costs that would negatively impact on profit. However, an increase in the resources' productivity is not a guarantee for maximising profit due to the fact that external factors (that are beyond the company's control) can strongly affect the profitability of a company as discussed above.

Furthermore, the use of "quantity-based productivity measures" without taking into consideration their monetary implications can mislead the company's management as far as the maximisation of profit is concerned. Heap (1992) suggests that productivity should be measured in both terms, physical and monetary. There may for instance be an increase in productivity when physical relationships of outputs and inputs are considered, and yet a decline in productivity may be noticed when monetary values are considered.

Cooper (2002: 13) has highlighted the relationship between profitability, productivity and price recovery by using the following formulas:

***Revenue: Value of Output = Quantity of Output x Price of Output***

***Costs: Value of Input = Quantity of Input x Price of Input***

***Profit: Profitability = Productivity x Price Recovery***

Cooper (2002: 13) also shows that profitability can be determined by dividing the value of output by the value of input, whilst productivity is a ratio of quantity of output to quantity of input, whereas price recovery is simply a ratio of output price to input price. These are the most important drivers of efficiency and effectiveness of the company that management has to monitor in the furtherance of the company's prosperity on the one hand and the maximisation of shareholders' wealth on the other.

The main objective of a company is to maximise shareholders' wealth. Shareholders are ultimately interested in the extent to which their investment maximises their profits. Thus, resources need to be efficiently and effectively managed in such a way that the company's profitability increases. All factors are employed with the primary purpose of maximising the company's profit in such a way that shareholders' wealth can be improved. Before discussing different financial indicators, it is important

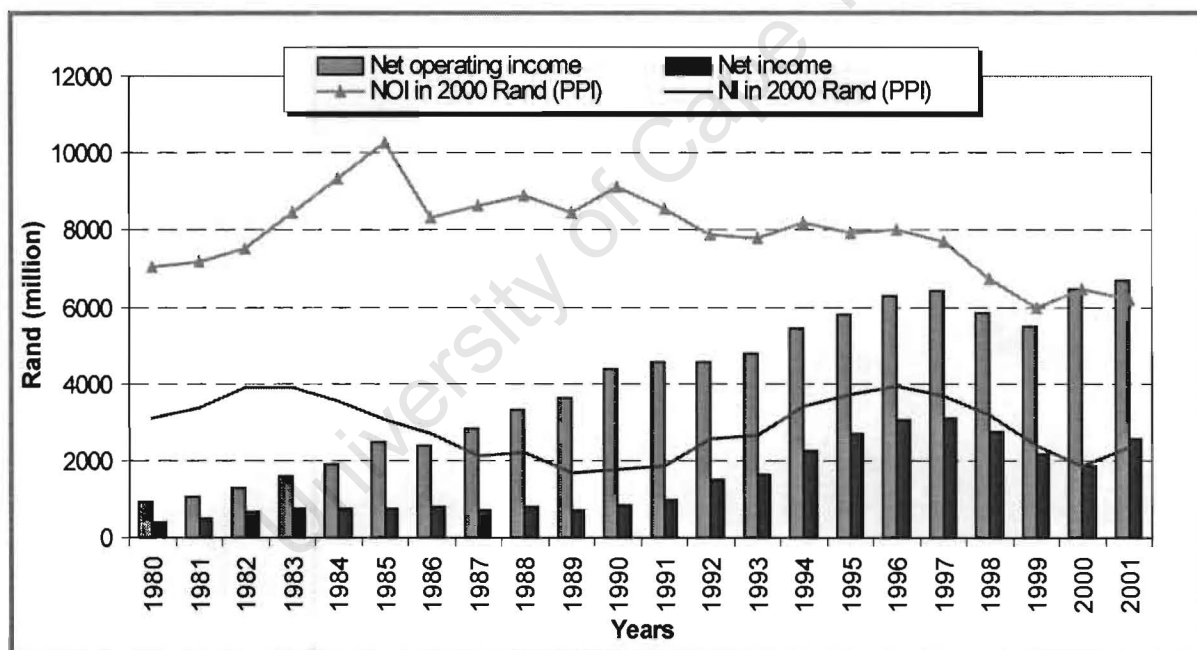
at the outset to highlight general financial performance of Eskom as reflected by revenue, operating and net income.

## 5.4 Financial performance

### 5.4.1 Net operating income and net income

Whilst net operating income is the excess of operating revenue over operating expenditure, net income (profit after interest and tax) is the profit generated by deducting all expenditures, operating<sup>46</sup> and non-operating, from total revenue of an organisation. Generally, net operating income as well as net income has been increasing although some of the years experienced negative growth in net profits.

Figure 5.13: Net operating income (NOI) and net income (NI) from 1980 to 2001



Source: Compiled from Eskom Annual Reports (1980 – 2001).

Figure 5.13 (above) shows some years experienced negative growth in both operating profit as well as net profit. In 1998 there was a decline in operating profit of about 9.3% and 12.5% in nominal and real terms respectively whereas decreases of about 6% (nominal) and 11% (real) were noticed in 1999. Negative net profit growths were noticed in 1984, 1987, 1989, 1998, 1999 and 2000. Among the

<sup>46</sup> Operating expenditures are expenditures that fall within the core business of an organisation.

reasons that led to a negative growth in 2000 net profit is that Eskom became liable to pay corporate tax from 1st January 2000. A total of R1,454 million was charged to the income statement for deferred tax (Eskom Annual report, 2000: 18). Together with other factors that might have impacted negatively on the growth in net profit in 1999, voluntary separations contributed considerably in an increase in operating expenditure at the expense of net profit (Eskom Annual Report, 1999: 16). A drop in economic activities at the global level had its repercussions reflected on Eskom's performance in 1998. In that year foreign currency fluctuations that led to a decline in commodity prices affected Eskom's large industrial customers that consequently decreased electricity sales (Eskom Annual Report, 1998: 9). As a result, net profit decreased by about 10.8% compared to that recorded in the previous year (*ibid*).

Discussed below are some of the financial indicators that show the extent to which a company's resources contribute to its profitability. The objectives of each indicator have been highlighted in Table 5.2 (below).

**Table 5.2: Financial indicators**

<b>Groups of ratios</b>	<b>Financial indicators</b>	<b>Objective</b>
1. Profitability ratios	i. Return on equity (ROE)	Maximise net profit per Rand invested in equity
	ii. Return on assets	Maximise operating profit per Rand invested in assets
2. Debt management ratios	i. Debt/equity ratio	Minimise debt Increase equity
	ii. Interest cover ratio	Increase interest cover ratio
3. Liquidity ratios	i. Current ratio	Increase current assets Reduce current liabilities
4. Asset management ratios	i. Total assets turnover	Maximise sales revenue per Rand invested in total assets
	ii. Net assets turnover	Maximise sales per Rand invested in net assets
	iii. Fixed assets turnover	Maximise sales per Rand tied-up in fixed assets
	iv. Current assets turnover	Maximise sales per Rand invested in current assets

## 5.4.2 Profitability ratios

### 5.4.2.1 Return on Assets (ROA)

Return on assets determines the extent to which management utilises the total assets of a company in generating profits. It is a measure of efficiency, which establishes how much money can be earned by investing in the total assets of a company. Return on assets can be calculated by dividing operating profit (profit before interest and tax-PBIT) by total assets. It should be borne in mind, however, that not all the total assets are used when determining ROA, but rather only those that were responsibly engaged in the production and selling activities that gave rise to the operating profit. If a company's core business is to produce and sell electricity, and if it happens that a company invests in, for example, marketable securities, only the profit generated and its total assets used from its core business will be considered when determining its return on assets. Thus, if a company has subsidiary companies (as is the case for Eskom), return on assets invested in each subsidiary can be determined separately. McLeary (1995: 238) clarifies this as follows:

...operating income should be compared with the operating assets to determine the return on assets obtained from manufacturing operation, while the investment income should be compared with the investment assets in order to determine the return on the investment assets.

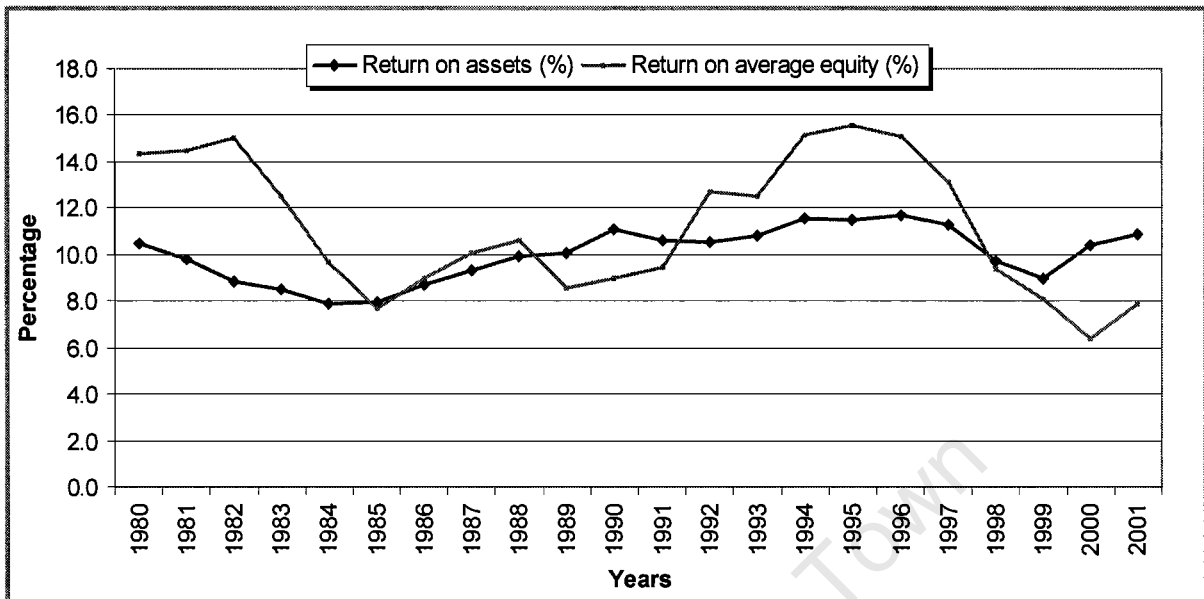
Thus, if it happens that a company engages in more than one line of business, it is of paramount importance to separate assets according to their operations when determining the extent to which the assets were utilised in the generation of the operating profit (return). Furthermore, operating profit is used rather than net profit (profit after interest and tax-PAIT) to determine return on assets, because both equity and debts normally finance operating assets. Hence, regardless of how total assets are financed, the main objective is to determine their capability to generate profits.

Eskom determines its return on total assets by expressing its net operating income as a percentage of total assets, where the value of its total assets excludes financial market assets and interest receivable, as they are separate undertakings altogether<sup>47</sup>. As shown in Figure 5.14 (below) ROA ranged between 8 – 12% and on averaged it was about 10% per annum from 1980 – 2001.

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<sup>47</sup> Refer Eskom Annual Report (2001: 5).

**Figure 5.14: Eskom's ROA and ROE from 1980 to 2001**



**Source:** Compiled from Eskom Annual Reports (1980-2001).

*Values for ROA and ROE were not available from 1980 – 1986 and 1980 – 1995 respectively. Values for such years have been determined based on available data.*

#### **5.4.2.2 Return on Equity (ROE)**

The ROE is a well-known yardstick of financial performance, which can be determined by dividing net profit by equity (Higgins 2000: 34, McLeary 1995: 239, and Correia 1993: 191). Moreover, Reilly (1994: 337) put forward that the ROE could be ascertained by dividing net income/profit by average total equity.

Furthermore, the ROE establishes the efficiency with which shareholders' equity is employed (Higgins 2000: 34). McLeary (1995: 239) pointed out that return on equity is determined by using net profit because, together with the operations of the undertaking, ROE deals with the financing policies and the tax management of a company.

Instead of ROE, Eskom determines return on average equity. It is a ratio obtained by dividing net profit by average equity. To ascertain the current year's average equity, the current year's reserves are added to the previous year's reserves and then the total obtained is divided by two. As shown in Figure 5.14 (above) ROE averaged at 11.2% from 1980 to 2001. A decline in ROA from 15.6% in 1995 to 6.4% in

2000 can partly be ascribed to a decline in real net income over the same period as shown in Figure 5.13 (above)

From the investors' perspective, taking into consideration all risks involved in every undertaking, return on equity should be equal to the interest rate offered by financial institutions if the investors wish to benefit equally from their investments. If the return on equity generated by an investment is lower than the interest provided by financial institutions (or the market interest rate), other things being constant, a rational investor would invest his money in a bank where his return would be higher.

In the case of state-owned enterprises such as Eskom, the government holds all the equity shares of the company. Effectively, such organisations were established not for profit making but for service provision. Return on equity is important to attract more capital into the company on the one hand, and to increase shareholders' wealth (through increasing the prices at which shares are sold) on the other.

The introduction of competition in the ESI in South Africa will have major implications for the way that power companies would be financed. Instead of depending on borrowed funds, companies would largely depend on shareholders whose motive is to make profits from their investment. To that end, it is likely that operationally efficient power companies would receive more capital, thereby strengthening their ability to earn more wealth, which in turn would be distributed to shareholders. This, to a great extent, will provide an incentive for management to improve their performance in order to attract more capital into their businesses.

### **5.4.3 Debt management ratios**

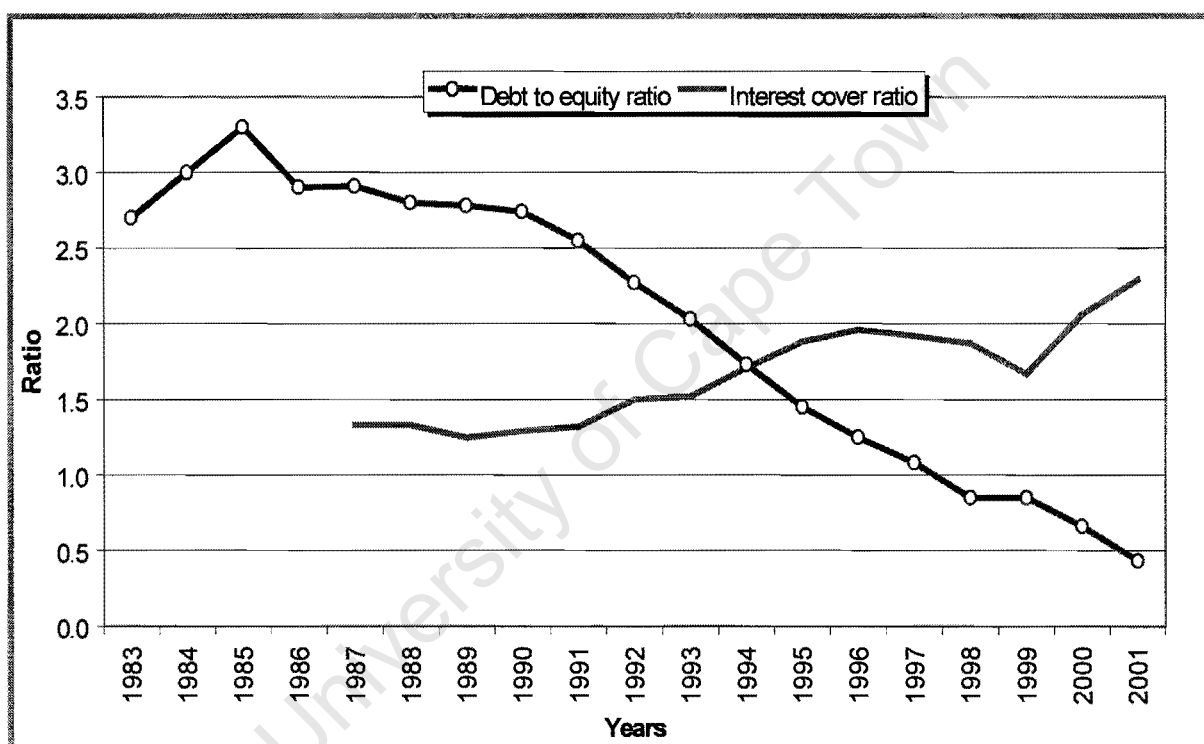
A company can finance its activities either by resources from its owner(s) or by borrowing (McLeary, 1995: 240) from external sources, local or international. In normal circumstances it is likely that each company will have a capital structure that is composed of both owners' funds (equity) and debts. These two establish the capital structure of the company.

#### **5.4.3.1 Debt to equity ratio (debt or gearing ratio)**

Debt to equity ratios are used to "...measure a firm's degree of indebtedness in that they determine the proportion of the firm's assets that are financed by debt relative to the proportion financed by equity" (Rao, 1995: 629). A debt ratio is determined by comparing the interest-bearing debt to owners' equity (McLeary, 1995: 240), the ratio obtained can be expressed as a percentage. In other words, debt to equity ratio can be ascertained by dividing long term liabilities by shareholders equity or total liabilities

by shareholders equity (Anthony *et al.*, 1999: 404; Brealey *et al.*, 1999: 458) depending on accounting policies adopted. The higher the ratio / percentage the higher is the debt dependence in financing the company's resources that are used in turn to generate income. The opposite holds true as well. There are advantages and disadvantages of too much dependency on debts to finance the daily activities of an organisation. Depending on the cost of debts (interest charges) and company's reputation respectively, too much dependency on debts may increase the total cost of production and may reduce creditors' confidence regarding to the payment of their credits.

**Figure 5.15: Debt to equity ratio and interest cover ratio**



Source: Compiled from Eskom Annual Reports (1983 – 2001).

Figure 5.15 (above) shows debt to equity ratios and interest cover ratios. Debt to equity ratios have generally declined. The debt to equity ratio was about 3.3 (times) in 1985 compared to 0.43 in 2001.

#### **5.4.3.2 Interest cover ratio (Times interest earned)**

The interest cover ratio is a ratio that shows the company's ability to honour its interest charges as they become due (Pandey, 1999: 122). It is ascertained by dividing earnings before interest and taxes (operating profit) by interest expenses (Brealey *et al.*, 1999: 459; Pandey, 1999:122; Rao, 1995: 630; Weston and Copeland, 1992: 205). The ratio obtained shows the number of times funds generated from

operating activities can service the interest charges. The higher the ratio, the stronger the company's ability to honour its interest charges, and vice versa.

Figure 5.15 (above) shows that Eskom's ability to service its interest charges has generally been improving. Of all the years under review, the year 2001 marked the highest level of Eskom's interest cover ratio. The figure also shows a negative relationship between the debt to equity ratio and the interest cover ratio. As the debt to equity ratio declines, the interest cover ratio increases. This is because, as the debt decreases, so too do the interest charges, and as a result the company's ability to service the reduced interest charges improves.

#### **5.4.4 Asset management (activity or efficiency) ratios**

Brealey and Myers (1996: 771) note that asset management ratios can be used to determine the extent to which the organisation utilises its [generation] capacity. In other words, these are ratios that show how effectively and efficiently an organisation utilises its assets in generating sales that ultimately increase owners' wealth. The efficiency with which assets are used can be ascertained by comparing the value of assets to the sales generated by those assets (McLeary 1995: 239). Net asset turnover, fixed asset turnover and current asset turnover are some of the ratios used to assess asset efficiency in generating sales by the company. The ratios determined show the extent to which one Rand invested in assets was employed in generating sales.

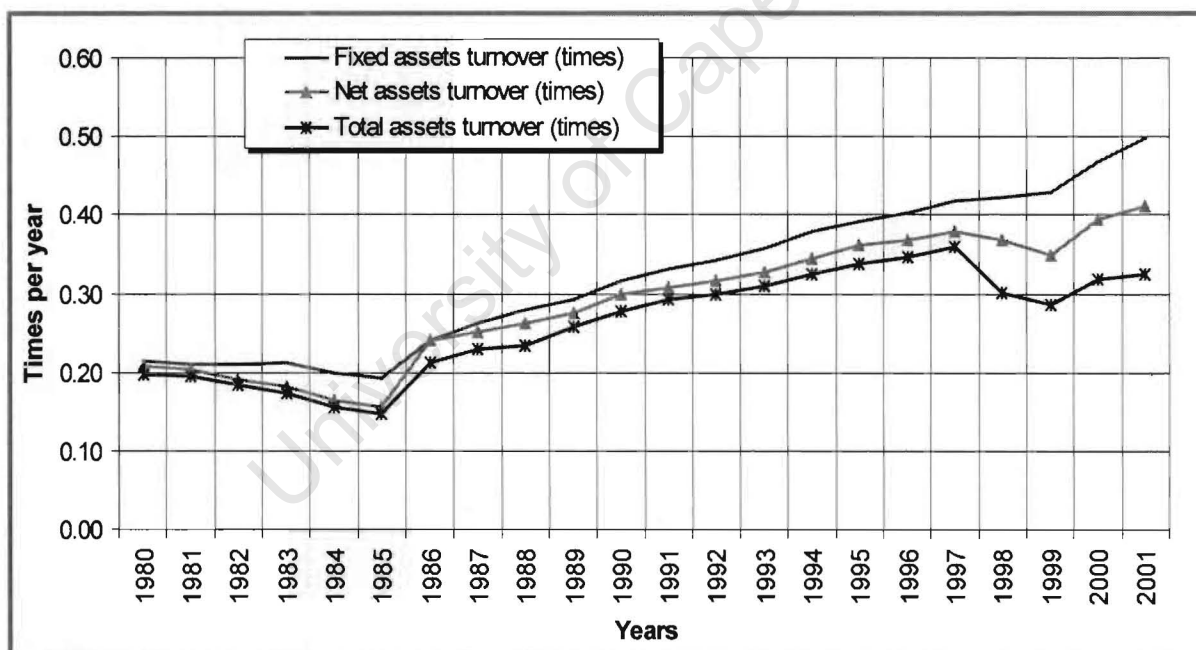
In the South African ESI large sums of money have been committed to assets (particularly power plants) with the prime objective of using such assets to produce electricity. An increase in sales would eventually increase the net wealth of the owners (apparently the government holds all shares). Pandey (1999: 129) highlights the fact that the firm's ability to produce large sales is crucial for its operating performance since unutilised or under-utilised assets tend to increase operating and maintenance costs. As discussed in Chapter Two that in a monopolistic ESI it is possible to pass excessive costs (e.g. additional costs resulting due to excess capacity etc) on to consumers by including them in the price of electricity. However, in a competitive market there is no room for excessive costs to be reflected in the market price because all companies in the industry are price takers. Thus it requires an optimal utilisation of resources to effectively compete in a competitive market.

#### 5.4.4.1 Net asset turnover

Net asset turnover can be determined by dividing sales generated in each year per net assets in that particular year as highlighted by Ross *et al.* (2001: 59). Net assets are composed of fixed assets and net current assets. Net current assets can be determined by subtracting current liabilities from current assets. In some years, Eskom categorised assets into three groups namely: fixed assets, non-current assets and current assets. From 1998, however, Eskom grouped its assets into two, non-current assets and current assets. Non-current assets include properties, plants and equipment, elements that were formally treated separately under the heading 'fixed assets'. Thus, to establish net assets, current liabilities were subtracted from total assets (comprised of fixed assets, non-current assets and current assets).

#### 5.4.4.2 Fixed asset turnover

Figure 5.16: Total assets, net assets and fixed assets turnover rates (times)\*



Source: Eskom Annual Reports (1980 – 2001).

\*Ascertained based on available data.

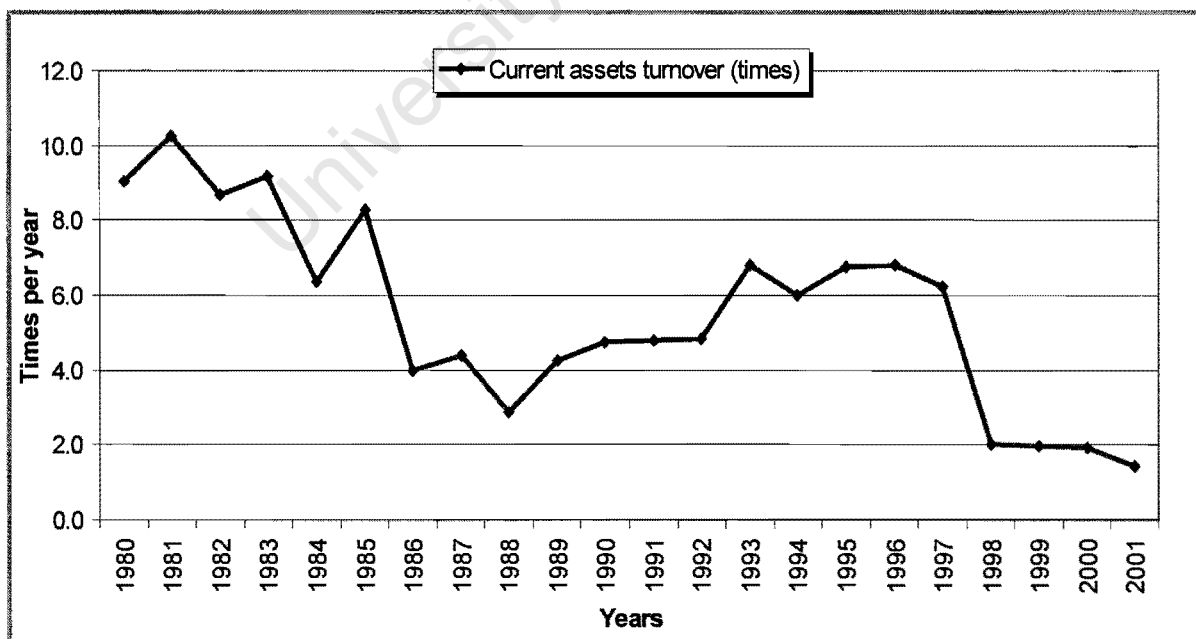
Fixed asset turnover can be ascertained by dividing sales by the net fixed assets of the company (*ibid*). The higher the sales volume, the higher will be the number of times that fixed assets were utilised to generate sales and vice versa.

Figure 5.16 (above) shows Eskom's total asset, net asset and fixed asset turnover rates (times) from 1980 to 2001. Research findings show that all the three were generally increasing, although they were decreasing between 1980 and 1985. They all recorded the lowest levels in 1985 whereas, fixed asset turnover was about 0.19 (times) and net asset turnover was 0.16 times whilst only 0.15 (times) for total asset turnover. Both, net asset turnover and fixed asset turnover recorded their highest levels of about 0.5 (times) and 0.41 (times) respectively in 2001. Generally, though, fixed asset turnover increased consistently from 1986 to 2001. Furthermore, in 1986 total asset turnover increased significantly with about 43% being recorded, and a decrease of about 16.2% was noticed in 1998. An increase in sales of about 26.3% (which is the highest in the years under review) and a decrease in total assets (about 11.7%) in 1986 contributed significantly to an increase in total asset turnover in that year. On the other hand, a decrease in total asset turnover in 1998 can be attributed to an increase in total assets (about 23%) compared to a 3.1% growth in sales.

#### 5.4.4.3 Current asset turnover

Pandey (1999: 129) shows that current asset turnover can be established by dividing sales by current assets. The ratio obtained shows the extent to which management utilises current assets to generate products that eventually give rise to sales.

Figure 5.17: Current assets turnover (times) from 1980 to 2001



Source: Compiled from Eskom Annual Reports (1980 – 2001).

\*Current asset turnover has been calculated based on available data.

Figure 5.17 (below) shows Eskom's current asset turnover from 1980 to 2001. Generally, there has been a decrease in current asset turnover between 1980 and 2001. Current asset turnover was about 10.24 (times) in 1981 and only 1.45 (times) in 2001, a decrease of about 85.8%. The years 1986 and 1998 recorded remarkably large decreases in current asset turnover (about 51.8% and 67.4% respectively). Although sales attained the highest increase rate in 1986 (about 26.3%) in the years under review, yet, current asset turnover decreased dramatically because in that year current assets increased by about 161.9% (about 6 times as much as an increase in sales in that year). Also, in 1998 current assets increased substantially by 216.2%, one of the reasons that justifies a significant decrease in current asset turnover in that year.

#### **5.4.5 Solvency and liquidity ratios**

McLeary (1995: 235) describes solvency as the ability to honour ones debts. The ability of a company to pay its debts can be established by comparing its assets and liabilities. If the assets of such a company are more than / exceed its liabilities, then it is said to be solvent. The balance sheet provides a summary of the financial position of a company. A value given for total assets should, in principle, be equal to a value of shareholders equity plus total liabilities. In times of liquidation, total assets are expected to generate revenue that will be used to settle all liabilities, and the amount that remains (if any) is to be divided amongst the shareholders. In normal circumstances, the value of assets given in the balance sheet might not be realised and consequently it may become impossible to honour all debts. For instance, McLeary (1995: 236) pointed out that the fact that a company may have more assets than liabilities does not necessarily provide assurance that it can pay all its liabilities if the need should arise.

However, liquidity ratios show the ability of a company to pay its maturing debts. Unlike solvency, McLeary (1995: 236) explicitly defines liquidity to refer to all assets that are in the usable form to settle debts as they fall due, that is, assets in the form of cash or assets that can easily be converted into cash.

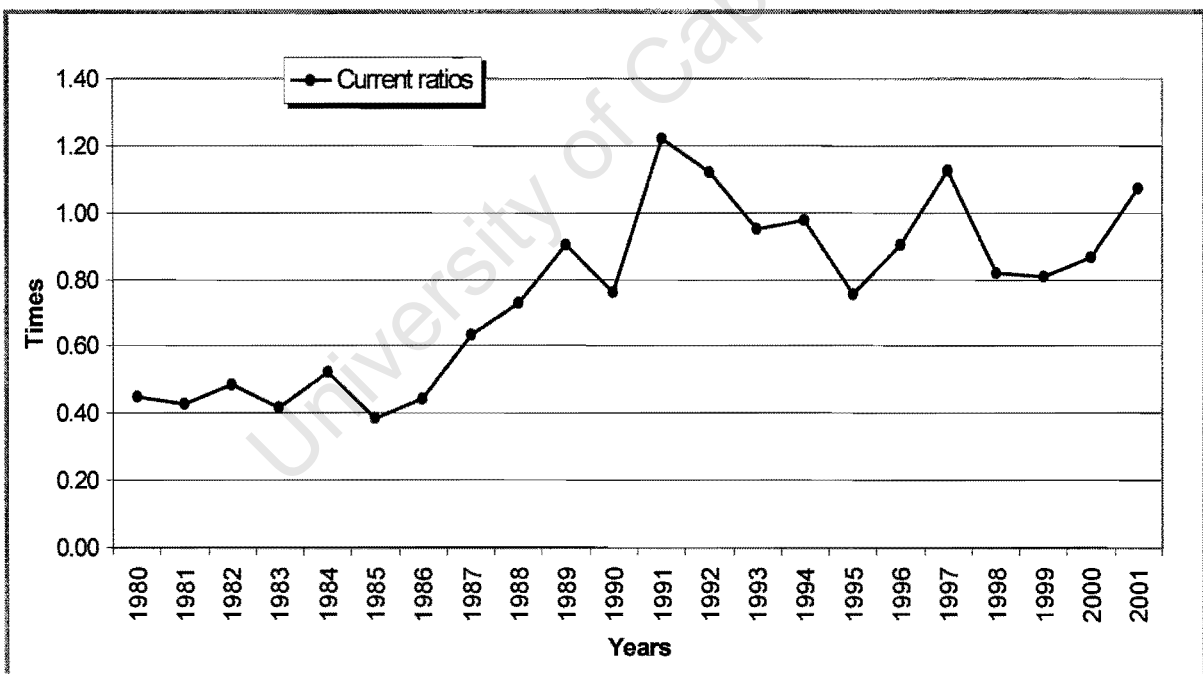
##### **5.4.5.1 Current asset ratio**

The most commonly used measure of liquidity of a company is a current asset ratio (simply called current ratio). The current asset ratio can be ascertained by dividing current assets by current liabilities (Ross *et al.*, 2001: 53; Anthony *et al.*, 1999: 403; Garrison and Noreen, 1997: 803; Brealey and Myers,

1996: 770 & Wood, 1993: 464)<sup>48</sup>. The higher the ratio, the stronger is the ability of a company to honour its maturing debts and vice versa. Any ratio below one indicates the inability of a company to pay those of its debts that may fall due within the year of operation. Failure of the company to honour its maturing obligations will result in the loss of credibility from suppliers of its resources that would negatively impact on its productivity and profitability.

Garrison and Noreen (1997: 803), further, note that a ratio that is widely used as a “rule of thumb” (described to be healthy) and to which reference should be made when ascertaining current asset ratio is 2:1. The higher the ratio the healthier will be the company in meeting its maturing obligations/debts and vice versa. Ross *et al.* (2001: 54) state that “an apparently low current ratio may not be a bad sign for a company with a large reserve of untapped borrowing power”. Due to government guarantees, it is possible that Eskom’s lenders (creditors) were not worried of Eskom’s poor records of current ratios and thus it could borrow funds from its creditors without difficulties.

**Figure 5.18: Current ratios from 1980 to 2001**



Source: Eskom Annual Reports (1980 – 2001).

*\*Current ratios have been determined based on available data.*

<sup>48</sup> Current assets involve all assets that can be converted into cash within one year and current liabilities include all claims that mature within one year.

Figure 5.18 (above) shows Eskom current ratios from 1980 to 2001<sup>49</sup>. Of all the years under consideration, only 1991, 1992, 1997 and 2001 had Eskom capable of meeting its obligations as they fall due from its internal sources. All the other years had current ratios below one, indicating that there were current liabilities in excess of current assets. In 1985 Eskom could only support about 40% of its current liabilities, whilst in 1991 it had more than 20% current assets in excess of current liabilities. There was a significant improvement in current ratios between 1990 and 1991 (about 60% increase), though they decreased drastically by 38% percent between 1991 and 1995. Generally, current assets increased quite considerably between 1980 and 1991 (about 172%) and by about 140% between 1980 and 2001. This signifies that Eskom's ability to meet its maturing obligations has substantially increased in the years under review.

## 5.5 Technical performance

### 5.5.1 Generation Load Factor

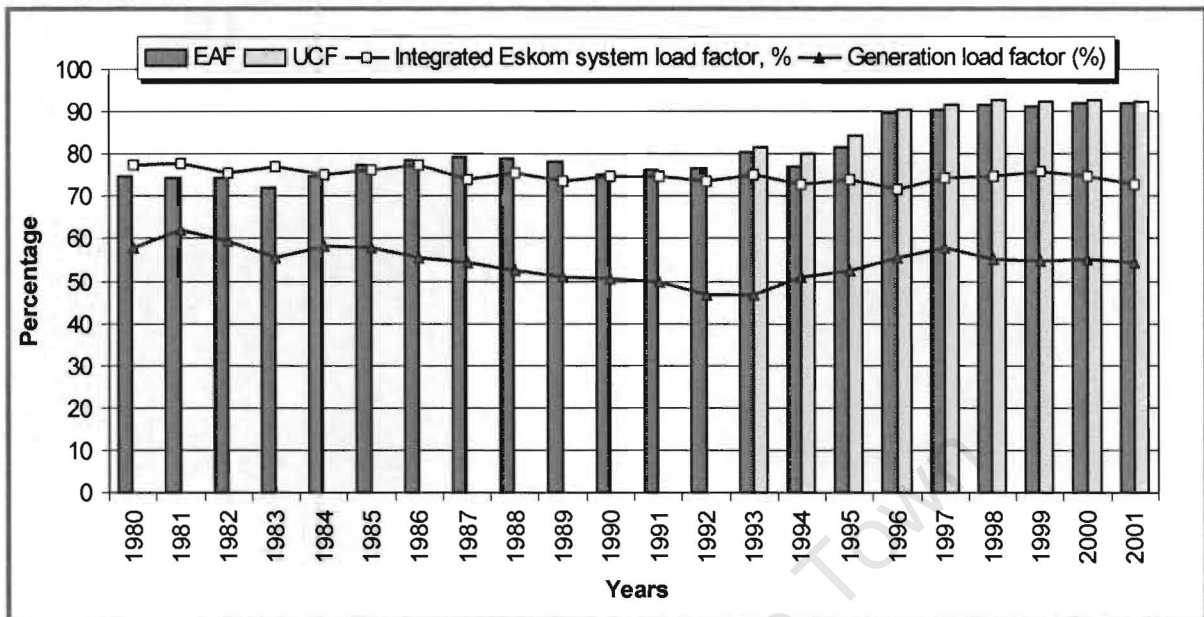
Spiegelberg *et al.* (2001: 6) define generation load factor as "...the ratio between the energy that a power plant has produced during the period considered and the energy that it could have produced at maximum capacity under continuous operation during the whole of that period". Generation load factor is among the indicators that are widely used to determine performance of power plants (Spiegelberg *et al.*, 2001: 6). As a performance indicator, the load factor is appropriate for the determination of operational performances of power plants that are exclusively meant for base load and not otherwise (*ibid*).

Eskom determines the generation load factor by dividing kilowatt-hours produced during the year by a product of average net maximum capacity and hours in a year under consideration expressed as a percentage<sup>50</sup>. As shown in Figure 5.19 (below), in 1981 the generation load factor was 62.2%, which was the highest in the years under review, and it was the lowest in 1993 (about 46.8%). The figure also shows a declining trend in generation load factor between 1985 and 1993, which thereafter increased to 57.7% in 1997, being the highest level for the past ten years.

<sup>49</sup> Current ratios have been determined based on available data.

<sup>50</sup> That is,  $\text{kWh produced} \times 100 / (\text{average net capacity} \times \text{hours in year})$  (Eskom Annual Report, 2001: 124 and Eskom Annual Report, 2000: 125). Other annual reports (e.g. Eskom Annual Reports 1991:43; 1990: 52; 1987: 47) show that the load factor can be determined by  $\text{kWh sent out} \times 100 / (\text{assigned sent-out rating} \times \text{hours in year})$ .

**Figure 5.19: Eskom Average Energy Availability Factor (EAF), Unit Capability Factor (UCF), Integrated System Load Factor and Generation Load Factor.**



Source: Compiled from Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

### 5.5.2 Unit Capability Factor (UCF) and Average Energy Availability Factor

“Unit Capability Factor is the percentage of maximum energy generation that a plant is capable of supplying to the electrical grid, limited only by factors within [the] control of plant management” (Spiegelberg *et. al.*, 2001: 86). The higher the UCF, the more effective is the company’s management with regard to the minimisation of unplanned energy losses, the optimisation of planned outages<sup>51</sup> and the maximisation of available electrical generation (Spiegelberg *et. al.*, 2001: 86; Eskom Statistical Yearbook, 1996: 84).

Spiegelberg *et. al.*, (2001: 86) distinguish the Energy Availability Factor from the Unit Capability Factor. The former is determined on the same basis as the latter, but instead of considering factors that can be controlled by the plant management, the Energy Availability Factor is reduced by losses that cannot be controlled by the plant management (Spiegelberg *et. al.*, 2001: 86). The reduction of planned and unplanned outages reduces planned and unplanned losses (respectively) that consequently improves safety and reliability of plant operation that as a result increases energy availability factor (Spiegelberg *et. al.*, 2001: 37). Together with taking into account energy losses resulting from factors

not under the control of management, Eskom also includes all internal non-engineering constraints when ascertaining its EAF (Eskom Annual Report, 2001: 58).

Figure 5.19 above shows the Average Energy Availability Factors, the Integrated System Load Factor and the Generation Load Factor from 1980 to 2001. The year 2000 recorded the highest level of the EAF, which was about 92.1% against a 90.0% target, whereas in 2001 it declined slightly to 92% (Eskom Annual Report, 2001: 58). For the past 15 years (between 1987 and 2001) Eskom had its lowest level of EAF in 1990 (about 75%). In that year there were high planned outage rate as well as forced outage rate (about 13.9%) due to unplanned shutdown of units to allow for repairs (Eskom Annual Report, 1990: 19).

### 5.5.3 Integrated System Load Factor

“The system load factor measures the average utilisation of the sent-out capacity of the system” (De Villiers, 1984: 12). Generally, Eskom’s system load factor remained constant over a number of years though there were inconsiderable changes in some years. The highest level was recorded in 1980 (about 77.5%) whilst the lowest level was about 71.5% in 1996 as shown by figure 5.22 (above).

### 5.5.4 Overall thermal efficiency

Overall thermal efficiency “measures the success with which the heat energy in the fuel is converted to electrical energy in the generator” (Eskom Annual Reports, 1990: 19; 1989: 21). Thermal efficiency can be improved by increasing steam pressures and temperatures. An increase in thermal efficiency helps the utility to reduce the amount of raw materials (coal) required to produce a kWh of electricity, which would subsequently reduce electricity price.

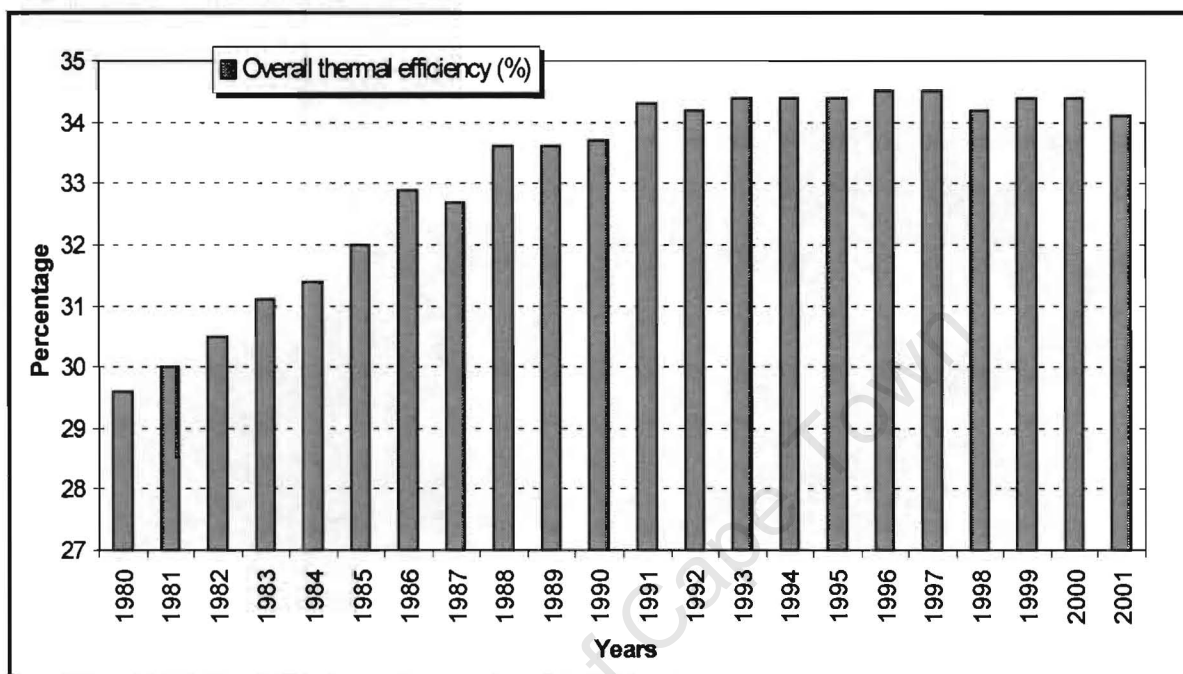
Figure 5.20 (below) shows Eskom’s thermal efficiency from 1980 to 2001. Generally, thermal efficiency increased consistently except for 1987 and 1992 where it declined slightly. Apparently Eskom’s overall thermal efficiency is 34.1%. Whilst the world’s average efficiency in electricity production is about 33%, modern large coal-fired plants have an efficiency rated as high as 42% (Khatib, 2001: 9). Eskom’s thermal efficiency improved modestly from 29.6% to 34.1% between 1980 and 2001. Between 1950 and 1982 Eskom managed to improve the thermal efficiency of its coal-fired

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<sup>52</sup> Planned outage is “an outage scheduled well in advance (at least two weeks) of the actual outage” whilst a forced outage is an “unplanned outage that requires the plant to be taken out of service immediately or before the next planned outage” (Mahona *et. al.*, 2001: 23).

power stations from 18.2% to 30.5% which as a result helped to reduce the average annual increase in coal price (De Villiers, 1984: 4)

**Figure 5.20: Overall thermal efficiency (1980 – 2001)**



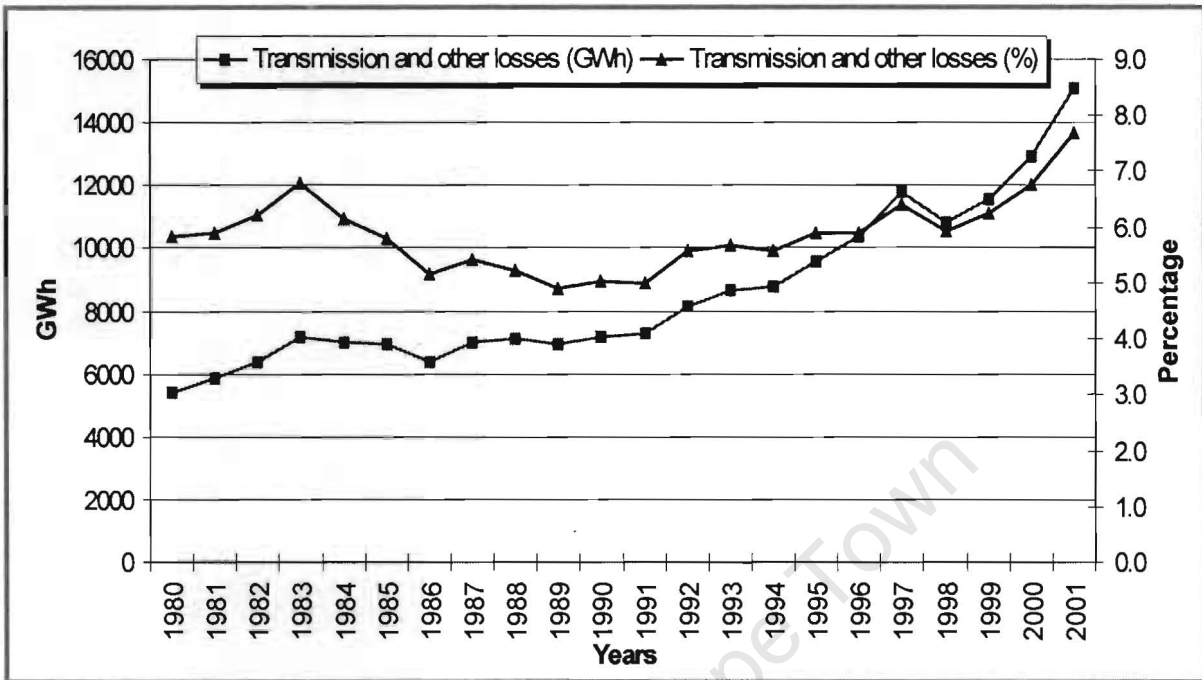
Source: Compiled from Eskom Annual Reports and Statistical Yearbooks (various years).

### 5.5.5 Transmission and distribution losses

A transmission and distribution loss results when electricity sold is less compared to electricity generated and sent out (Eskom Annual Report, 2001: 124), expressed in GWh and percentages in each respective year. It includes both technical and non technical losses (theft).

Figure 5.21 (below) shows that transmission and distribution losses have been increasing (in GWh) particularly from the early 1990s to 2001. As discussed in section 5.2.1.3 (above), this is a time when Eskom was directly involved in massive electrification of households which in turn led to an increase in its distribution losses. In the years under review, 1989 recorded the lowest transmission and distribution losses (about 5%) and it was the highest (about 7.7%) in 2001.

**Figure 5.21: Transmission and distribution losses\***



**Source:** Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

*\*Transmission and distribution losses have been calculated from the difference between electricity generated and sent out and electricity sold.*

## 5.6 Comparison of Eskom performance with other utilities

This section compares Eskom performance with other giant utilities in the world. As noted above it would be unfair to compare Eskom with any other electricity producer in South Africa, and thus necessary data was secured from other giant utilities in the world for comparative analysis. Although the chosen utilities operate in quite distinctive and different business environments, the main criteria for their choice was their generation and sales capacities. Fuel in use was also taken into consideration due to its effect on the electricity production costs of a particular power utility. Five companies were thus considered for comparative analysis, given the availability of data. These are the Southern Company, Hydro Québec, Tokyo Electric Power Company (TEPCO), ENEL and Korea Electric Power Corporation (KEPCO). Before embarking on a comparative analysis, it is worth at the outset to briefly highlight their profiles so as to provide a general picture of the companies in question and thereby be in a position to judge the differences in their performances.

## 5.6.1 Company Profiles

### 5.6.1.1 Southern Company

Southern Company is among the largest electricity producers in the United States. It ranks tenth in electricity sales and twelfth in generation capacity in the world (Eskom Annual Report, 2001: 135). In addition to providing electricity, Southern Company also has subsidiaries and affiliates that engage in other businesses such as energy services, security monitoring and wireless telecommunications (Southern Company, 1998). Its subsidiaries include, but are not limited to, Southern Communication Services (Southern LINC), Southern Company Energy Solutions, Southern Energy (Southern Energy Inc.) and Southern Nuclear Operating Company (Southern Company, 1998).

In 2001 Southern Company had an installed capacity of 34,579 MW and a maximum peak-hour demand (in the summer season) of about 28,934 MW, compared with 17,629 MW installed capacity and 25,981 MW peak-hour demand in 1990 (Southern Company, 1998: 60 – 61). Furthermore, Southern Company has about 3.8 million customers and businesses in the south-eastern part of the United States (*ibid*). Its traditional core business customers are grouped into four categories: residential, commercial, industrial and other. Large electricity users like Chevron in Mississippi and heavy residential and commercial users such as the Atlanta metro area are among its customers (*ibid*). Table 5.3 below provides more information about the company.

**Table 5.3: Southern Company's operating statistics and other information.**

Operating statistics	2001	2000	1999	1998	1997
Installed capacity (MW)	34,579	32,807	31,425	31,161	31,146
Peak-demand (MW)	29,700	31,359	30,578	28,934	27,334
Annual load factor (%)	62.0	60.2	59.2	60.0	59.4
Plant availability (%)					
Fossil-steam	88.1	86.8	83.3	85.2	88.2
Nuclear	90.8	90.5	89.9	87.8	88.8
Source of energy supply (%)					
Coal	67.5	72.3	73.1	72.8	74.7
Nuclear	15.2	15.1	15.7	15.4	16.5
Hydro	2.6	1.5	2.3	3.9	4.3
Oil and gas	8.4	4.0	2.8	3.3	1.7
Purchased power	6.3	7.1	6.1	4.6	2.8
Sales (GWh)	176,113	176,947	166,313	164,335	156,887
Number of customers	3,998,000	3,944,000	3,871,000	3,794,000	3,720,000
Number of employees	26,122	26,021	26,269	25,206	24,682

**Source:** Compiled from Southern Company Annual Report (2001: 58 – 59)

### 5.6.1.2 Hydro Québec

**Table 5.4: Hydro Québec's operating statistics and other information.**

<b>Operating statistics</b>	<b>2001</b>	<b>2000</b>	<b>1999</b>	<b>1998</b>	<b>1997</b>
Installed capacity (MW):					
Hydroelectric	28,906	29,246	29,235	29,203	29,203
Thermal	2,266	2,266	2,270	2,269	2,194
Wind	2	-	-	-	-
Total (MW)	31,174	31,512	31,505	31,472	31,397
Peak demand (MW)	32,616	33,767	35,577	35,275	32,305
Transmission lines (km)	32,273	32,283	32,227	32,144	32,036
Distribution lines (km)	107,139	106,448	105,898	105,705	104,640
Sales (GWh)	152,212	152,757	146,989	142,808	147,291
Number of customers	3,557,377	3,528,825	3,505,400	3,481,030	3,456,768
Number of employees					
Permanent	17,679	17,277	17,277	17,468	17,164
Temporary	3,545	3,399	3,126	3,379	3,252
Total employees	21,224	20,676	20,403	20,847	20,416

**Source:** Compiled from Hydro Québec Annual Report (2001: 58 – 59)

Hydro Québec is a state-owned and vertically integrated power utility in Canada. The Québec government owns all the shares of the company (Hydro Québec, 2001). With an installed capacity of 31,174MW, 32,273 kilometres of transmission lines and about 106,448 kilometres of distribution lines (of which about 9,000 kilometres are underground), Hydro Québec plays a leading role as a major producer and distributor of electricity in North America (Hydro Québec, 2001). Hydro Québec depends largely on water power to generate electricity – about 96% of its total electricity output depends on water power (*ibid*).

In addition to business ties with numerous electric utilities in the north-eastern United States, Ontario and New Brunswick, Hydro Quebec owns, builds or operates facilities in South America, Australia, the United State, as well as China (Hydro Québec, 2001).

### 5.6.1.3 Tokyo Electric Power Company (TEPCO)

Established in May 1, 1951, in Japan. TEPCO is the largest private electricity utility in the world, with an installed capacity of about 57,000 MW, and supplies 265 TWh of electricity to households and businesses annually (TEPCO, 2002b: 4). TEPCO is the third largest supplier of electricity in the world when ranked by sales volume, and is the fourth largest utility in terms of generation capacity (Eskom

Annual Report, 2001: 135). It supplies electricity in Metropolitan Tokyo, one of the most densely populated cities in the world. Of the total population (about 40 million) living in the area, TEPCO serves a total of 26 million customers (TEPCO, 2002b: 4).

**Table 5.5: TEPCO's operating statistics and other information**

Erating statistics	2000	1999	1998	1997	1996
Authorised capacity (MW):					
Hydroelectric	8,508	8,103	7,695	7,664	7,643
Thermal	33,026	32,434	31,871	31,784	30,380
Nuclear	17,308	17,308	17,308	17,308	15,952
Wind	1	1	-	-	-
Total (MW)	58,843	57,846	56,874	56,756	53,975
Thermal efficiency	41.1	40.6	40.0	39.0	39.2
Transmission losses	4.9	5.0	5.2	5.3	5.1
Electricity generated	265,600	264,300	255,000	256,900	251,900
Sales (GWh)	280,651	274,200	267,000	265,400	257,400
Number of customers ("000")		26,360	26,070	25,740	25,330
Number of employees	41,403	41,882	42,170	42,672	43,166

Source: Compiled from TEPCO, 2002b.

#### 5.6.1.4 ENEL

Apparently, ENEL is a major joint stock electricity company in Italy. The historical background of ENEL dates back on 27<sup>th</sup> November 1962 when it was legally established although it started operations in 1963 (ENEL, 2003). Just like Eskom, ENEL became the giant power utility in Italy "... by gradually absorbing existing electric companies" (*ibid*). Currently, ENEL is the fifth largest electricity company in the world as rated by both generation capacity and electricity sales (Eskom Annual Report, 2001: 135). In 2001 its generation mix as grouped by primary energy sources was 29.0% oil, 27.1% natural gas, 21.6% hydro, 16.6% coal, 3.2% orimulsion and about 2.5% geothermal.

In February 1999 Italy's ESI underwent structural changes from a monopolistic to a liberalised one where new investors can enter the industry and compete. Denoted as the "Bersani Decree", the government cabinet approved a legislation to liberalise the industry, which involved the change of ENEL's corporate structure, network system and the partial sale of generating capacity (ENEL, 2003). ENEL's new organisational structure involves the industrial holding company, independent operating companies and about 3.8 billion shares (worth 30 trillion lire) of the company have been floated on the

stock exchange (*ibid*). The Transmission Network Manager is assigned (under concession) a duty to ensure the transmission of electricity and a unified management of the national network (*ibid*).

**Table 5.6: ENEL's operating statistics and other information**

Operating statistics	2001	2000	1999	1998	1997
Net electricity generation (GWh):					
Thermal	128,320	141,391	136,946	141,019	139,919
Hydroelectric	36,516	36,692	37,707	34,486	33,595
Geothermal	4,239	4,415	4,128	3,958	3,672
Other sources	31	29	32	21	15
Total (GWh)	169,106	182,527	178,800	179,500	177,201
Total electricity sales (GWh)	205,957	222,033	230,050	226,200	219,263
Number of customers ("000")			29,674	29,343	29,032
Number of employees	72,661	72,647	78,511	84,938	88,957

Source: Compiled from ENEL Annual Reports (1997 – 2001).

#### 5.6.1.5 Korea Electric Power Corporation (KEPCO)

KEPCO, originally called Korea Electric Company (KECO) before the change of its name in 1982, was established on July 1, 1961 by merging three regional electric companies (Chosun, Kyung Sung and Namsun) to form one national power utility (KEPCO, 2003). It was partially privatised in 1989 where 21% of its shares were sold to the public (*ibid*).

In April 2001 the Korean ESI underwent major changes where KEPCO lost its monopolistic power by separating its generation capacity into six subsidiaries and also the Korea Power Exchange was inaugurated (*ibid*) so as to enable competition in the industry.

**Table 5.7: KEPCO's operating statistics and other information**

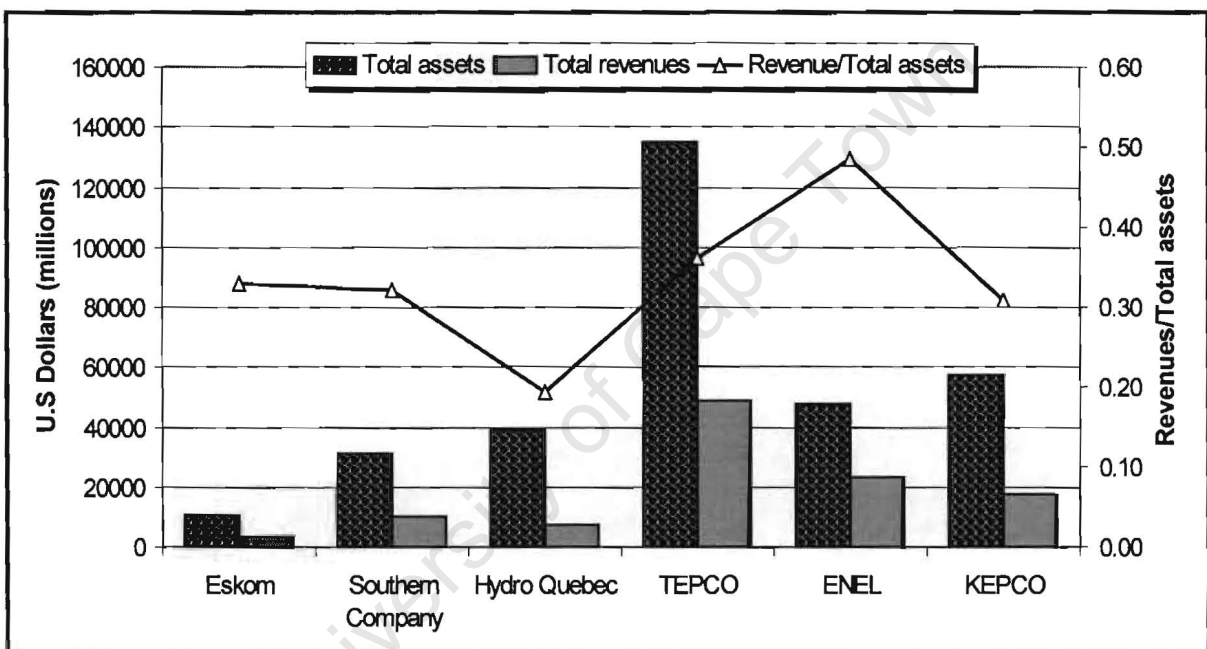
Operating statistics	2001	2000	1999	1998	1997
Installed capacity (MW):					
Thermal	33,267	31,586	30,114	28,259	27,611
Nuclear	13,716	13,716	13,716	12,016	10,316
Hydroelectric	3,876	3,149	3,148	3,131	3,115
Total (MW)	50,859	48,451	46,978	43,406	41,042
Electricity sales (GWh)	257,731	239,535	214,215	193,470	200,784
Number of customers ("000")	15,619	14,976	14,379	14,102	13,913
Number of employees	18,912	33,745	34,607	34,753	37,898

Source: KEPCO, 2003.

## 5.6.2 Productivity of total assets

Figure 6.25 (below) shows total assets, total revenues and the ratio of total revenues per total assets. The ratio (revenue / total assets) shows the extent to which a dollar invested in assets generated revenues in 2000. For instance, each dollar invested in ENEL's assets generated about 48 U.S cents as compared to 33 U.S cents for Eskom and only 19 U.S cents for Hydro Québec. This means that ENEL utilises its assets more effectively compared to other companies under consideration.

**Figure 5.22: Total assets, total revenues and the ratio of total revenue to total assets (2000)**



**Sources:** Compiled from Annual Reports; Eskom (2000), TEPCO (2001), Hydro Québec (2000), Southern Company (2000), KEPCO (2003) and ENEL (2000).

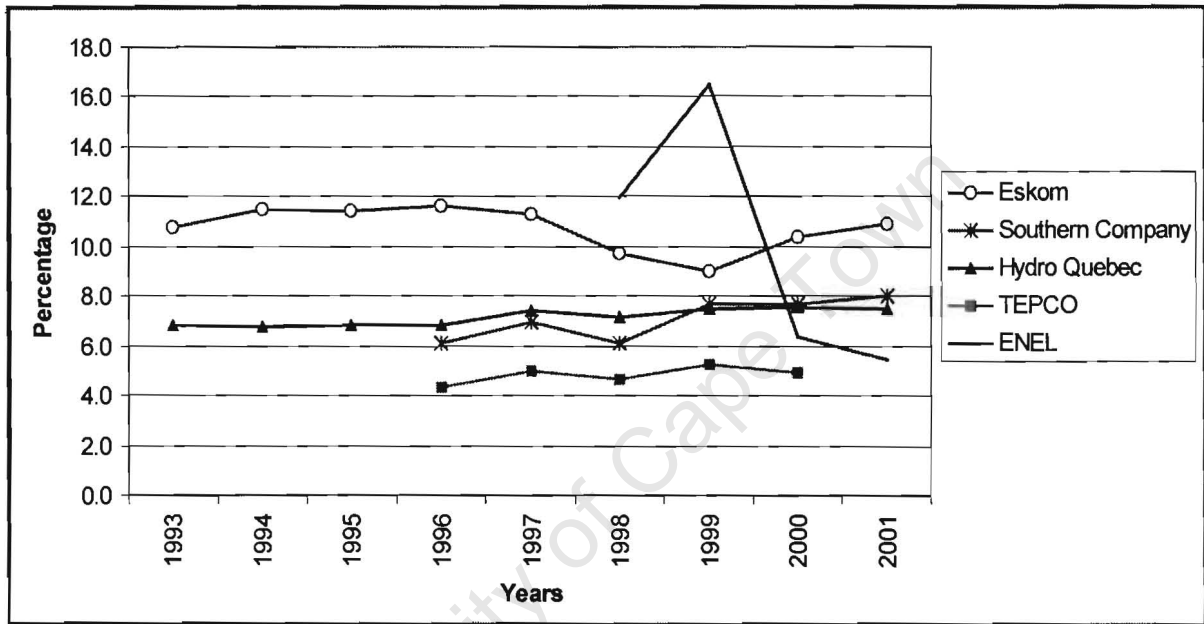
## 5.6.3 Profitability ratios

### 5.6.3.1 Return on asset

Figure 5.23 (below) shows the return on asset from 1993 to 2001. As appears from the figure, data for Southern Company, ENEL and TEPCO were not available for some of the years. Eskom's performance was exemplary compared to the other companies under review – except for 1998 and 1999 where ENEL had the highest ROA. Its return on asset averaged 10.7% per annum. This means that every Rand invested in Eskom's assets generated a profit of about 10.7%. Hydro Québec and Southern Company had an average return on asset of about 7% compared to 4.8% for TEPCO.

However, differences on return on asset can be attributed to the type of market in which a particular company operates and the regulatory tools in use. As noted in Chapter Two, in a monopolistic industry the individual company's assets are rewarded with an estimated return in advance, as opposed to a competitive environment where the return is not guaranteed and is likely to be volatile depending on the market performance.

**Figure 5.23: Return on assets**



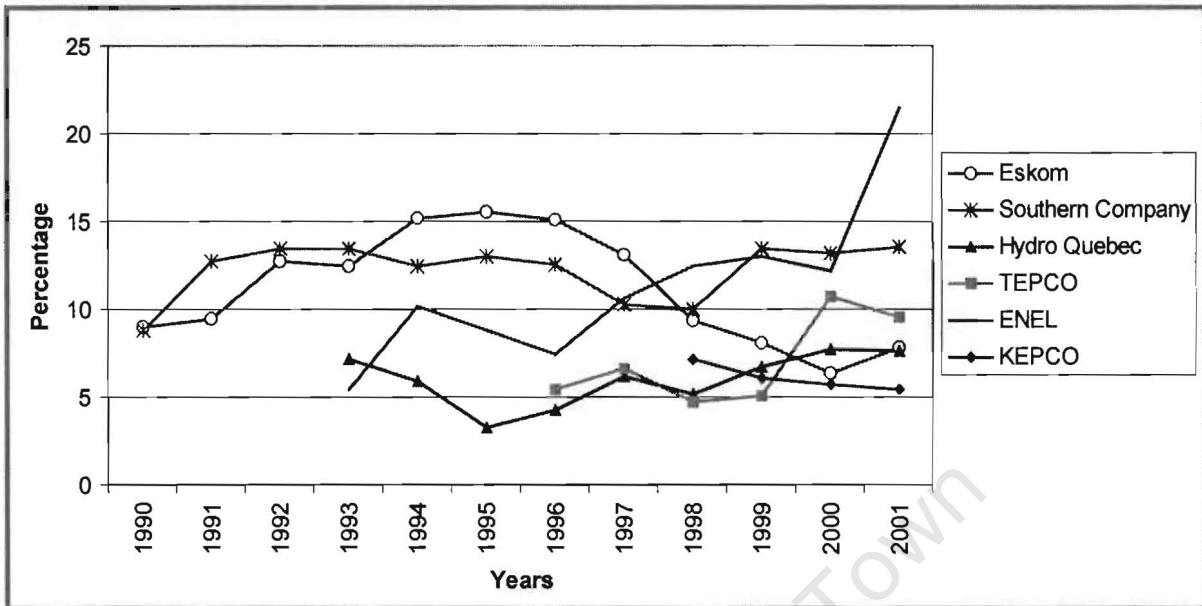
**Sources:** Compiled from Annual Reports; Eskom (1993-2001), TEPCO (1998-2002), Hydro Québec (1997-2001), Southern Company (1997-2001) & ENEL (1998-2001).

**Note:** Except Eskom, ROA for all the other companies under consideration have been determined based on available data.

### 5.6.3.2 Return on average equity

Figure 5.24 (below) depicts ROE. Eskom's ROE averaged at 11.5% per annum from 1993 to 2001 while Southern Company, Hydro Québec and ENEL had their annual ROE averaged at 12.4%, 6% and 11.3% respectively over the same period. This indicates that of all the companies reviewed, Southern Company was more efficient in utilising investors' funds thereby generating higher profit per share compared to other companies.

**Figure 5.24: Return on average equity**

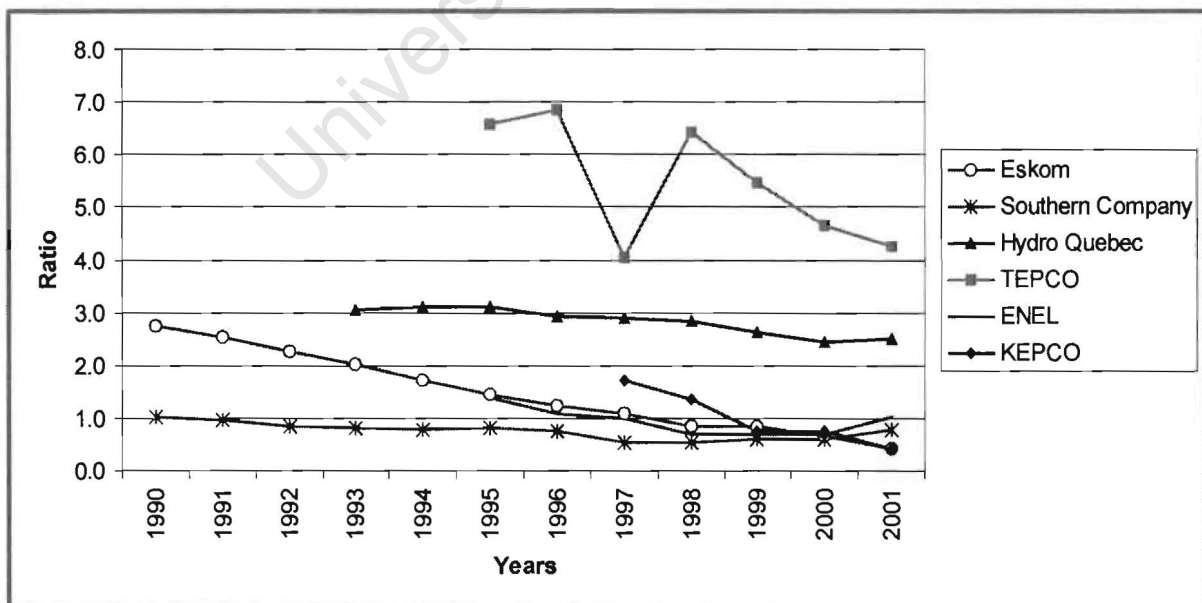


Sources: Compiled from Annual Reports; Eskom (1990-2001), TEPCO (1998-2003), Hydro Québec (1997-2001), Southern Company (1997-2001), ENEL (1997-2001) & KEPCO (2003).  
 Note: ROE for KEPCO and TEPCO has been ascertained based on available data.

## 5.6.4 Debt management

### 5.6.4.1 Debt to equity ratio

**Figure 5.25: Debt to equity ratio (1990 – 2001)**



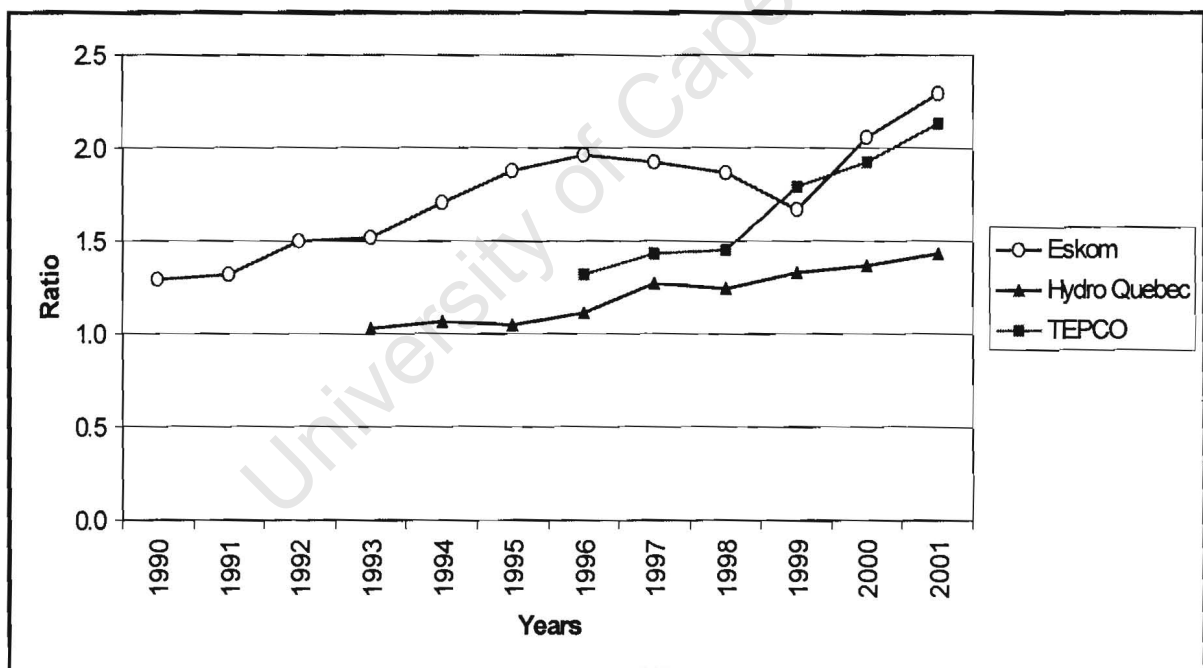
Sources: Eskom Annual Report (1994-2001), TEPCO (1998-2001), Hydro Québec (1997-2002), Southern Company (2003), KEPCO (2003) and ENEL (1997-2001).

**Note:** Except Eskom and ENEL, debt to equity ratios for other companies have been determined based on available data.

Figure 5.25 (above) shows that of all the six companies, Southern Company managed its debts most effectively. Its debt to equity ratio has been falling below one from 1991 to 2001. Eskom's debt to equity ratio has only been falling below one in 1999 onwards. In 1990 Eskom had the debt to equity ratio marked at 2.74:1 which has consistently declined to about 0.43:1 in 2001. On the other hand, the figure also shows that in 1996 TEPCO's resources were heavily financed by debt - 6.8 times as much as the amount of money obtained from shareholders/owners.

### 5.6.4.2 Interest cover ratio

**Figure 5.26: Interest cover ratio**



**Sources:** Annual Report; Eskom (1997-2001), TEPCO (1998-2002) & Hydro Québec (1997-2001).

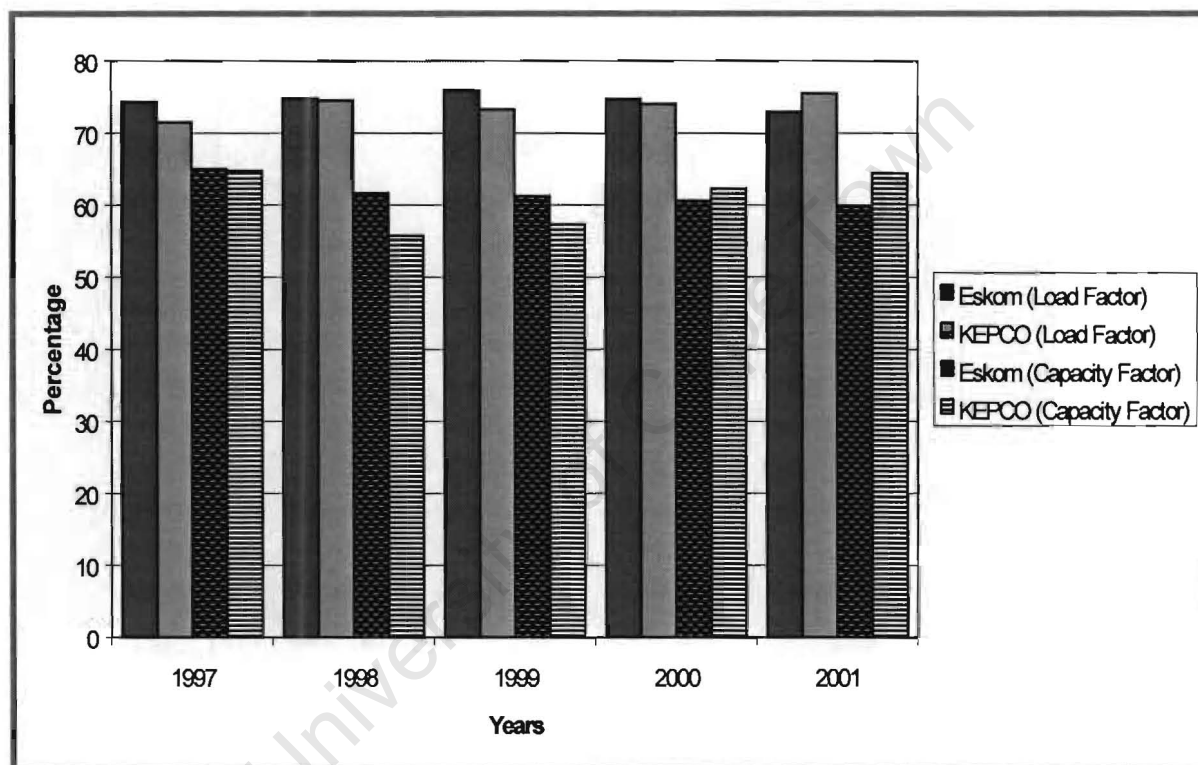
Figure 5.26 (above) shows that Eskom's ability to finance maturing obligation was generally higher than that of Hydro Québec and TEPCO. In 1990 Eskom had an interest cover ratio of about 1.29 (times), it reached 2.29 (times) in 2001 – about 78% improvement in its ability to service its maturing debts. This is due to a significant decline in the capital-related costs as pointed-out in Chapter Four.

## 5.6.5 Technical performance

### 5.6.5.1 Capacity and System Load Factor

Figure 5.27 (below) shows capacity and system load factors of Eskom and KEPCO from 1997 to 2001. Eskom's system load factor was 74.3% in 1997 and it decreased to 72.9% in 2001 whereas KEPCO's system load factor increased from 71.5% in 1997 to 75.5% in 2001.

Figure 5.27: Capacity and System Load Factor

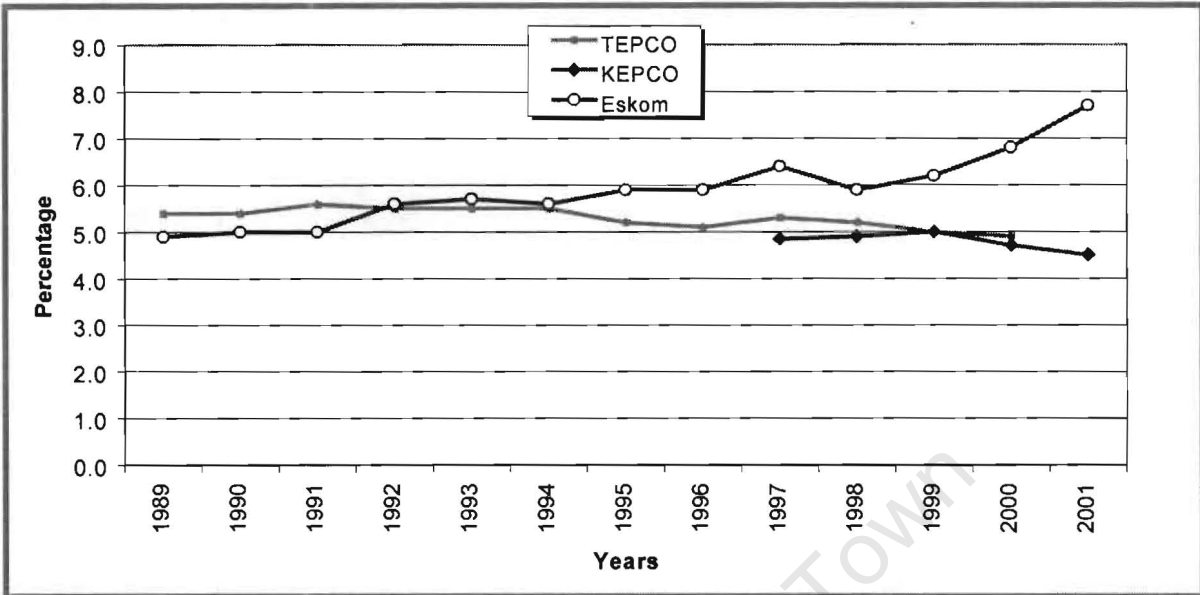


Sources: Eskom Annual Reports (1987 – 2001) & KEPCO (2003)

### 5.6.5.2 Transmission and other losses

Figure 5.28 (below) illustrates transmission and other losses. Between 1997 and 2001 KEPCO's transmission and distribution losses were below 5%. Whilst TEPCO's transmission losses decreased from 5.4% in 1989 to 4.9% in 2001, Eskom's transmission and other losses increased from 4.9% to 7.7% over the same period. Consequently, this reduced Eskom's revenues and at the same time TEPCO's revenues improved slightly. The decline in transmission and other losses would have significant contribution to the financial strength of Eskom.

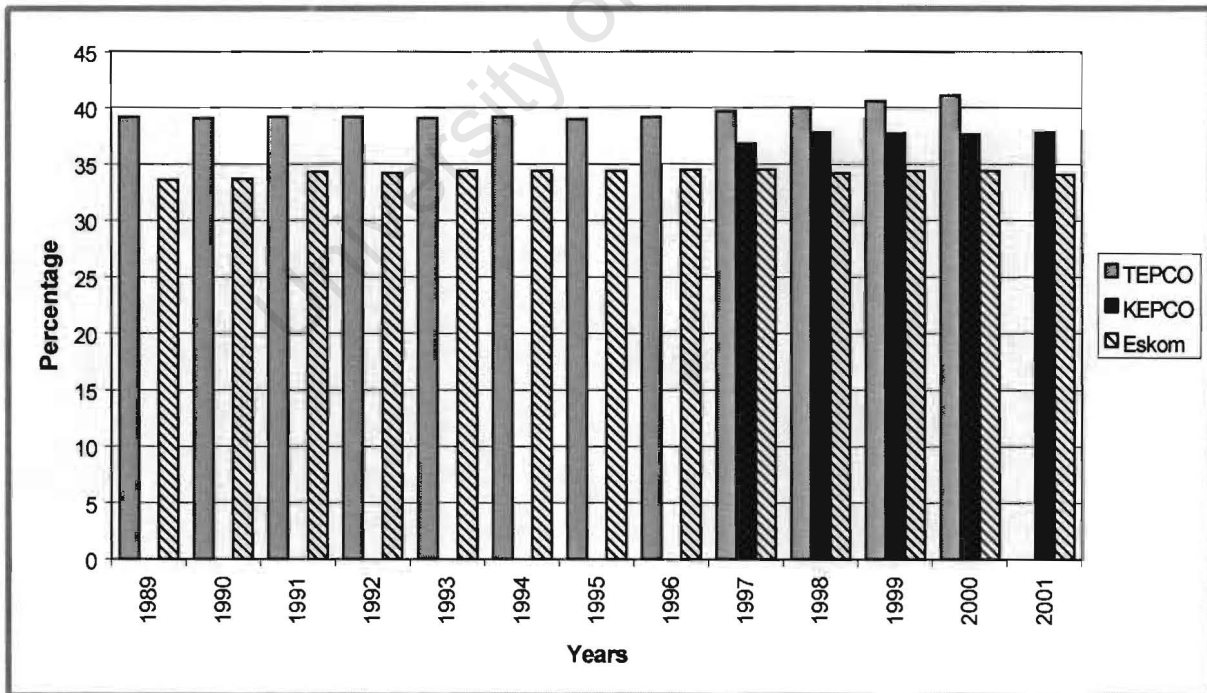
**Figure 5.28: Transmission and distribution losses**



Source: Eskom Annual Reports (1989-2001); TEPCO (2002b) & KEPCO (2003)

### 5.6.4.3 Thermal efficiency

**Figure 5.29: Thermal efficiency**



Sources: Eskom Annual Reports; TEPCO (2002b); KEPCO (2003).

Figure 5.29 (above) shows thermal efficiencies from 1989 to 2001. Between 1989 and 2000 TEPCO's thermal efficiency averaged at 39.6% per annum as compared to 34.3% of Eskom over the same period. In 2000 TEPCO had a thermal efficiency levelled at 41.1% whereas KEPCO's and Eskom's thermal efficiencies were 37.6 and 34.4 respectively.

## 5.7 Conclusion

This chapter investigated the productivity of resources, financial and technical performance of Eskom. Productivity indicators that were scrutinised include labour productivity, raw materials and water resources. Generally, labour productivity improved significantly in the mid 1980s until recently. Kilowatt-hours per employee, revenues generated per employee and customers per employee increased significantly whilst the revenues generated per labour cost increased before it declined from the mid 1990s and slightly increased in the year 2000.

Electricity produced per kilogram of coal increased consistently from 1980 to 1985 before it remained constant and thereafter declined towards the end of the 20<sup>th</sup> century. Research findings implicate a decline in electricity produced per a kilogram to a decline in thermal efficiency and old age of power plants. The same applied to water resources. Water consumed by power plants to generate electricity increased consistently from 1982 and it slightly declined from the mid 1990s.

Financial indicators improved quite significantly particularly in the 1990s. Asset management ratios have shown impressive performance whilst debt management ratios improved consistently from 1985 to 2001. The findings attribute the improvement in debt management ratios to a significant decline in capital requirements in recent years. Liquidity ratios improved significantly while profitability ratios (particularly return on assets) remained fairly constant due to the fact that it is regulated.

Collectively, improvement in operational performance, among others, contributed significantly to Eskom's low electricity prices.

## **Chapter Six**

### **Eskom Investment Efficiency**

#### **6.1 Introduction**

Investment decisions in the ESI involve high risks due to the fact that the industry is highly capital intensive and future circumstances for which these decisions are made are uncertain. Since investment decisions are based on forecasted growth in demand, accuracy in demand projections must be observed. Poor investment decisions commit the industry into high capital-related costs that are reflected in the electricity price charged to customers, hence great care must be taken when decisions on the type of technology and timing of investment (such that increased capacity coincides with demand requirement) are taken.

The choice of technology, timing and construction lead times of power plants need to be observed very carefully when decisions to install new plants are undertaken due to the fact that wrong decisions will have major price implications in the ESI. The installation of large capital-intensive plants will lead to high capital-related costs and longer lead times.

Furthermore, a wrongly timed plant investment will have different impacts depending on different market scenarios. In either a pure monopoly or a regulated ESI the costs of poor investment decisions that give rise to surplus capacity can easily be passed over to customers as these are reflected in the price. However, in the competitive industry the costs of surplus capacity are borne by investors, as they are also price takers. Moreover, in the competitive industry the existence of excess capacity will lead to the reduction in the price since there will be more capacity to generate electricity than demand requires. Consequently, competitors will have to compete for the available customers by either reducing their prices or improving the quality of their services. In this regard, social wellbeing, in terms of increased disposable income on the one hand and access to high quality electricity services on the other hand, will be maximised.

The fact that Eskom was primarily responsible for the supply of cheap and abundant electricity in the Republic of South Africa to support the fast growing economic activities (particularly, the mining industry) influenced the frequency and the magnitude of investments in power plants. The “White Paper on Energy Policy for Republic of South Africa” insightfully highlights the inherent consequences of monopolistic structure of the South African ESI as far as decisions on capacity expansions are concerned. The document notes the fact that:

For many decades Eskom has carried the responsibility of supplier of last resort, effectively enjoying a *de facto* monopoly on the construction of new generation capacity. Power station construction was based on projections of historic demand growth and by 1980 it became apparent that Eskom had committed itself to expensive over-capacity, a situation that has prevailed for the last fifteen years [by 1998]. Since customers ultimately have to bear the costs of poor investment decisions it is government’s intention to ensure greater public participation in future decisions on public expenditures of this magnitude. (DME, 1998: 41).

This chapter scrutinises Eskom allocative efficiency and provides an overall insight into Eskom’s investment behaviour and its repercussions on both costs and electricity prices in South Africa. To investigate the implications of Eskom’s investment decisions, this chapter analyses Eskom’s investment trends in relation to the electricity price over a number of years. Section 6.2 introduces key factors that fuelled the pace of investment in generation capacity, then section 6.3 provides a detailed description of investment trend, lastly section 6.4 looks at the way Eskom financed these investments.

## **6.2 Key drivers of investment in generation capacity in the late 1970s and early 1980s**

Economic development, particularly the rapid growth in the mining industry, had a greater influence in shaping the pace of South Africa’s ESI especially during the late seventies and early eighties. Eskom did not want to be seen as interrupting economic development by either poor quality of supply or inadequate capacity. More power supply was needed to match the sudden increases in electricity consumption. Between 1950 and the early 1980s the increase in demand for electricity averaged at about 7.5 percent per annum (Eskom Annual Reports, 1984: 24).

Eskom engineers had positioned themselves, enthusiastically and strategically, to supply power such that it would not impinge on economic development and thus placed emphasis on building more power plants to meet the pace of rapid growth in electricity consumption. Over-investment in power plants was thought to be of strategic importance. Meeting growth in demand was favoured at the expense of

efficiency allocation of capital resources, which, as a result, led to surplus capacity and associated capital-related costs. Consumers had to bear the cost of excessive capital expansion programmes. Interest expenditures, Capital Development Fund and loan redemption charges contributed significantly to the total costs of electricity production.

The 1973 oil crisis increased the demand for electricity in South Africa. The demand for electricity escalated between 1974 – 1982 following the connection of large consumers such as Sasol, Richards Bay Iron and Titanium Plant, Tubatsi Ferrochrome, Consolidated Metallurgical Industries, Transalloys and Ferrometals and Highveld Steel and Vanadium to the network (De Villiers, 1984: 155). The export of iron, ferro-alloys, platinum, aluminium steel as well as other energy-intensive products boomed during this period (De Villiers, 1984: 138). This was due to the fact that in most Western countries the price of energy, particularly electricity, increased exorbitantly compared to that of Eskom and thus South Africa had a competitive advantage.

Eskom's market share of electricity sales in South Africa rose to 93.6% during the period 1974 – 1982 mainly due to an increase in bulk sales as a result of some municipalities<sup>53</sup> that became increasingly dependent on Eskom's power following the 1973 energy crisis (De Villiers, 1984: 154). Bulk sales increased by 18.9, 21.7% and 16.3% in 1973, 1974 and 1975 respectively (De Villiers, 1984: 37).

### **6.3 Investment in generating capacity**

This section highlights the ineffectiveness of the econometric method of forecasting electricity consumption trends (future demand) and the resultant capacity expansion programmes that were based on estimates ascertained by this method. Eskom ordered and built more power plants than was necessary which consequently led to the existing surplus capacity.

#### **6.3.1 Projection of electricity demand after the 1973 oil crisis**

Generally the forecast of electricity consumption growth rates forms the basis for capital expansion programmes. Accuracy in forecasting the growth rate of electricity consumption is fundamentally important when a decision to construct a power plant is reached due to the associated capital related costs that considerably increase the electricity price.

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<sup>53</sup> Many municipalities generated their electricity using oil driven plants and therefore the 1973 oil crisis affected their production and thereby opted to buy electricity from Eskom.

The fact that the design, acquisition, construction and commissioning of a power plant can take eight to 12 (or more) years, the forecast of electricity demand should therefore be valid (De Villiers, 1984: 122). Overestimation or underestimation of demand has cost implications in the ESI. Whilst overestimation would lead to excess capacity and therefore inefficient allocation of capital resources, underestimation will not only restrict economic development but also lead to rapid increases in the price as a result of limited supply.

Eskom used a conventional method, which was based on econometrics, to estimate the consumption pattern of electricity in South Africa. Before the 1973 oil crisis, this method was widely used by utilities in the world particularly in Europe and the United States of America. The method employed “the historical trends of the *growth rate of the economy and the growing share of electricity* in the pattern of energy consumption” when forecasting the future increase in electricity consumption (De Villiers, 1984: 122). The 1973 oil crisis affected, substantially, the economic growth pattern on the one hand, and the rate at which electricity consumption was increasing in the total energy consumed in the world, particularly in South Africa. After the oil crisis, most utilities could not employ this method, as it was unreliable due to structural changes that eventually distorted its theoretical underpinnings.

The De Villiers Commission was very critical of Eskom’s employment of its “outmoded” forecasting method. Based on this method, Eskom estimated an electricity consumption growth rate of about 7% per annum that would only decline towards the end of the 20<sup>th</sup> century (Eskom Annual Report, 1981: 11) as opposed to the less than 5% estimate by the De Villiers Commission. Eskom highlighted the following reasons to be responsible for future increases in electricity demand in South Africa:

- “South Africa will become increasingly industrialized. Its mineral wealth will continue to provide the economy with great impetus, while the industrial sector will continue to expand and become more electricity-intensive.
- The swing from oil-based energy sources to electricity will continue. It is estimated that at present [1980] electricity constitutes just over 20 percent of South Africa’s total net energy usage. This figure will probably increase to 40 percent before the end of the century.
- South Africa’s Black population is rapidly becoming more economically active. Coupled with the electrification of Black towns and areas and the enhanced and more electricity-intensive lifestyle this is bringing about, further Eskom growth will result.”

(Eskom Annual Report, 1980: 12)

The 1981 projections showed installed capacities of about 35,000 MW and 70,000 MW would be required by 1990 and 2000 respectively to meet the growth in demand (Eskom Annual Report 1981: 11). A massive construction of more power plants was thought to be an ideal option to cater for the future increases in demand. Eskom planned to build 20 base-load stations and about five peaking stations to cater for demand increases in the next 25 years (*ibid*). Eskom management projected an installed capacity of about 57,000 MW by the second half of the 1990s – a capacity which was by then (in 1980) being run by the England and Wales Central Electricity Generating Board (Eskom Annual Report, 1980). The management, proudly highlighted that:

We would by then have a situation in which a country on one of the least developed continents would have reached a level of electricity usage comparable to that of one of the world's most industrialized countries...(Eskom Annual Report 1980: 12).

It is doubtful if other means of meeting increases in demand were taken into consideration when projections for new generation capacity were undertaken<sup>53</sup>. These range from energy efficiency programs that considerably help to reduce electricity usage and therefore reducing the necessity of capacity expansion. This has major implications. It reduces funds from being tied-up in expensive additional power plants and relieves electricity consumers from excessive use of their incomes on electricity bills.

### **6.3.2 Capacity expansion programmes**

In the first half of the 20<sup>th</sup> century, Eskom grew rapidly by building and taking over power stations from municipalities and private producers. As early as 1927 Eskom took over Central Power Station, with a nominal capacity of 30 MW, from Kimberley Municipality and in 1948 Eskom took over two power stations, Brakpan and King William's Town, from the Victoria Falls Power Company and East London Municipality respectively (Eskom Statistical Yearbook, 1996: 14). Brakpan had a nominal capacity of 48 MW and King William's Town had only 3.5 MW nominal capacity (*ibid*). By 1930 Eskom had an installed capacity of 227 MW, which increased to 742 MW ten years later and it was more than 1,600 MW in 1953 (De Villiers, 1984: 34). Between 1967 – 1982 Eskom's nominal capacity increased at a higher average rate per annum than its electricity sales (De Villiers, 1984: 4). By 1950 Eskom supplied just over 70% of the total electricity in South Africa and since 1979 it has contributed more than 90% of the total of South Africa's electricity requirements (Eskom Statistical Yearbooks, 1996: 20 and 1988: 18).

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<sup>53</sup> According to De Villiers (1984: 237), Eskom policy on "abundant electricity" encouraged wastage of resources due to the fact that customers were not persuaded to save electricity consumption.

Eskom took advantage of abundant coal reserves to build large unit sized coal-fired power plants near the coal mines, thereby reaping economies of scale and lower coal costs. Whilst Eskom had coal-fired installed capacity of 4,158 MW by early 1967, a total capacity of 4,800 MW (twenty four sets of 200 MW each) were commissioned between 1967 – 1977 and six 350 MW sets were operational from 1971 – 1975 (De Villiers, 1984: 178). Furthermore, another six sets of 500 MW each were commissioned between 1976 and 1979, whereas in the period 1979 – 1982 a combined capacity of 5,400 MW (nine 600 MW units) was commissioned (*ibid*). Most power plants<sup>55</sup> currently in use were built during the 1970s and the early 1980s as shown by Table 6.1 (below).

**Table 6.1: Commercial dates of first and last units of selected power stations**

Name of power station	Commercial service date of first and last unit	Number and capacity of generator sets	Nominal capacity (MW)	Net maximum capacity (MW)
Komati*	1961 – 1966	5 x 100, 4 x 125	1,000	891
Camden*	1966 – 1969	8 x 200	1,600	1,520
Grootvlei*	1969 – 1977	6 x 200	1,200	1,130
Hendrina	1970 – 1977	10 x 200	2,000	1,895
Arnot	1971 – 1975	6 x 350	2,100	1,980
Kriel	1976 – 1979	6 x 500	3,000	2,850
Matla	1979 – 1983	6 x 600	3,600	3,450
Duvha	1980 – 1984	6 x 600	3,600	3,450
Koeberg	1984 – 1985	2 x 965	1,930	1,800
Tutuka	1984 – 1990	6 x 609	3,654	3,510
Lethabo	1985 – 1990	6 x 618	3,708	3,558
Matimba	1987 – 1991	6 x 665	3,990	3,690
Kendal	1988 – 1993	6 x 686	4,116	3,840
Majuba	1996 – 2001	3 x 657; 3 x 713	4,110	3,843

\* In long-term reserve storage (*mothballed*)

**Source:** Eskom Annual Reports (2002: 132; 2001: 128; 1982: 56) and Statistical Yearbook (1996: 14).

Hendrina power station consisted of ten 200 MW units, which were built near Camden and Komati in the Eastern Transvaal (Steyn, 2001: 72). Whilst the decision to build Arnot power station that composed of six 350 MW sets was reached in 1965, Eskom announced the construction of a dry-cooled Grootvlei power station that had six 200 MW sets in the same year (*ibid*). Three years later two units of 80 MW capacity were ordered for a hydro power station, Hendrik Verwoerd (*ibid*).

<sup>55</sup> Tables 3.1 and 3.2 in Chapter Three show Eskom's power plants in commission at 31 December 2002.

Massive capital expansion programmes continued to keep pace with demand increases. It was in 1967 when the decision to build a nuclear power plant at Duinefontein (30 km north of Cape Town) was reached though in later stages the project could not justify its economic viability (Steyn, 2001: 73). Implementation of the decision to build the nuclear power plant took about nine years since the intention was announced<sup>55</sup>. Two years later the South African and Portuguese governments entered into an agreement where Eskom was allowed to buy additional base load power from Cahora Bassa (*ibid*). Due to political unrest in Mozambique at the time, reliability of electricity from Cahora Bassa was jeopardised.

In 1969 Eskom announced the building of a six 500 MW sets coal-fired plant at Kriel, in the Eastern Transvaal and it further constructed a six 600 MW sets Matla power station five years later (Steyn, 2001: 73 –75). Construction of the Drakensberg pumped storage scheme<sup>56</sup> (with four 250 MW sets) began in January 1975 and towards the end of 1975 Duvha, with large units similar to those of Matla, was under construction as well (Eskom Annual Report, 1981: 22 – 23). Duvha power station was built near a coal mine called Rand Mines' Duvha open-cast colliery and it largely depends on the Komati River for its water consumption (*ibid*)

Up to 31 December 1971 Eskom had generation, transmission and distribution segments that operated differently in every regional undertaking – each undertaking was assigned specific power plants (De Villiers, 1984: 23). By successfully interconnecting different undertakings into a national grid, Eskom became a central electricity planner for South Africa as it had to meet the country's electricity requirements (Steyn, 2001: 72).

Despite massive capital expansions in the mid 1970s, the 1979 oil crisis necessitated Eskom to take considerable measures to overcome deficiencies as far as electricity supply is concerned. Eskom ordered the construction of two power stations, Lethabo and Tutuka, with features similar to Matla and Duvha respectively (Steyn, 2001: 76). Construction work for Lethabo and Tutuka started in 1981. Whilst the Anglo American Corporation's New Vaal colliery and the Anglo American Corporation's New Denmark colliery were contracted to supply coal to Lethabo and Tutuka respectively, the Vaal River would provide water to Lethabo and the Grootdraai Dam on the Vaal River would meet Tutuka's water requirements (Eskom Annual Reports, 1982: 24– 25; 1981: 23).

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<sup>55</sup> Construction started in August 1976 (Steyn, 2001: 75).

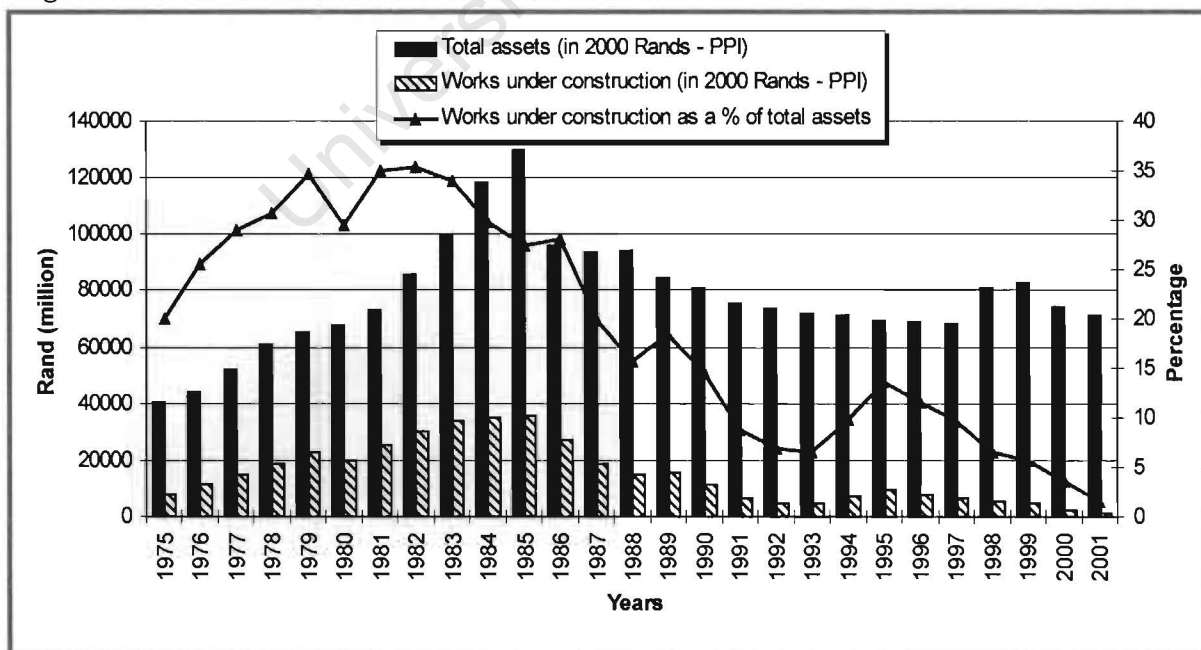
<sup>56</sup> This serves as a peaking and standby electricity generating plant for the Eskom integrated system.

Mainly due to the shortage of water at some sites, Eskom resolved to build large dry-cooled power stations. Construction work for Matimba, Kendal and Majuba coal-fired and dry-cooled power stations started in 1981 and 1982 respectively for Matimba and Kendal, and the year 1983 was planned for Majuba. Matimba, with 4 units of 600 MW (665 MW nominal capacity) each happened to be the largest direct dry-cooled sets in the world (Eskom Annual Reports, 1987: 21; 1982: 25). There was an intention to extend the installation of two additional sets at Matimba. Kendal had six sets with a 686 MW nominal capacity each and it was the world's largest indirect dry-cooled plant (Eskom Annual Report, 1987: 20).

At some stages the government intervened on Eskom's capacity expansion programmes and thus ordering or construction of some of the plants was delayed. The construction of Majuba was delayed until 1987 when civil works started and during the same year it was decided that the last three units of Majuba would be wet-cooled instead of dry-cooled as planned before (Eskom Annual Report, 1987: 20). Due to excess capacity the commissioning of the first set was actually delayed to 1996 and a further one-year interval for the second and the third. Furthermore, the commissioning of the sixth unit was only completed in 2001 after the decision to continue with the last three sets was taken in 1995 (Eskom Annual Report, 1995: 23).

### 6.3.2.1 Fixed assets (works) under construction

Figure 6.1: Total assets and works under construction

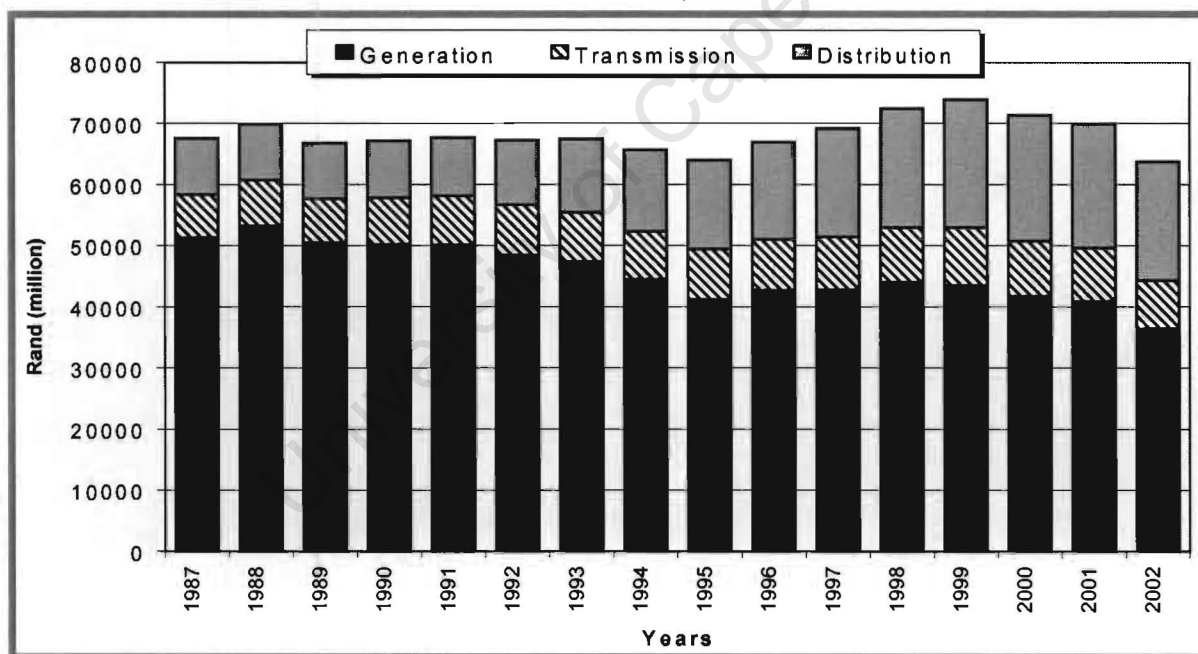


Source: Compiled from Eskom Annual Reports (various years).

As shown in Figure 6.1 (above) works under construction increased in real terms (using Producer Price Index) from R8,130 million in 1975 to about R35,484 million in 1985, which is the highest level, and since then it has declined dramatically to R1,130 million in 2001. Works under construction represented about 20% and 27.4% of total assets in 1975 and 1985 respectively and it was below 2% in 2001. The year 1982 recorded the highest proportion (about 35.4%) of works under construction in total assets. The figure shows there were large proportions of works under construction from 1975 to 1986, which indicates that more power plants were built during this period. It is also a time when electricity prices increased in real terms (shown in Figure 4.7 in Chapter Four). Between 1976 and 1985 works under construction increased in real terms by 16.9% per annum and total assets increased by 12.5% annually over the same period. Moreover, from 1986 to 2001 works under construction as well as total assets declined by an annual average rate of 15.7% and 3.3% in real terms, respectively.

### 6.3.2.2 Cost of plant in commission

Figure 6.2: Cost of plant in commission (in 2000 Rands using PPI)



Source: Eskom Annual Reports (various years)

The cost of plant in commission in each respective year includes generation, transmission and distribution. Figure 6.2 shows values of plant in commission from 1987 to 2002. On average, the cost of generation was about two third of the total cost. The cost of distribution assets increased significantly in the mid 1990s due to Eskom's involvement in the electrification of disadvantaged communities as highlighted in Chapter Five (section 5.2.1.3)

### 6.3.3 Technological change and choice

Eskom changed its technology from installing small turbines to large ones. This had two implications. Construction lead times increased from 8 to 14 years and plant availability declined.

Eskom engineers assumed little or no risk when they were making technological choices. Steyn (2001: 82) highlighted that in the early 1980s Eskom installed a number of new “partly proven technologies.” The up-scaling of unit sizes, the installation of dry cooling systems in Kendal, Matimba and Majuba (the first three units), and the design and installation of boilers that successfully burn low grade coal, among others, collectively signified a technological revolution in Eskom.

**Table 6.2: Thermal efficiency and availability of sets**

Power station	Size of sets	Steam conditions at turbine inlet	Thermal efficiency of sets (%)	Availability of sets (%)
Ingagane	100 MW	8,4 Mpa 510 °C	28.7	84.1
Camden	200 MW	10,3 Mpa 538 °C	30.7	75.0
Grootvlei	200 MW	10,3 Mpa 538 °C	31.6	77.5
Hendrina	200 MW	10,3 Mpa 538 °C	31.5	81.7
Arnot	350 MW	15,9/3,98 Mpa 510 °C	33.3	72.2
Kriel	500 MW	16,0/3,17 Mpa 510 °C	34.1	69.1
Matla*	600 MW	16,1/3,68 Mpa 535 °C	35.2	74.1
Duvha*	600 MW	16,1/3,55 Mpa 535 °C	34.3	69.0

**Source:** Eskom (adapted from De Villiers, 1984: 179).

\* Average for 1981, 1982 and 1983

Changes in technology revealed that as steam pressure, temperature and size of units increased so did their thermal efficiency at the expense of their availability and an increase in construction lead times. An increase in construction lead times meant that large sums of funds were tied-up in “works under construction” and thereby not contributing towards revenues. Between 1950 and 1974 Eskom managed to reduce the coal costs<sup>57</sup> by increasing thermal efficiencies of its coal-fired power plants that, among other factors, contributed to the availability of cheap, reliable and abundant supply of electricity (De Villiers, 1984: 211). Table 6.2 above shows the extent to which technological changes impacted on thermal efficiency and plant availability.

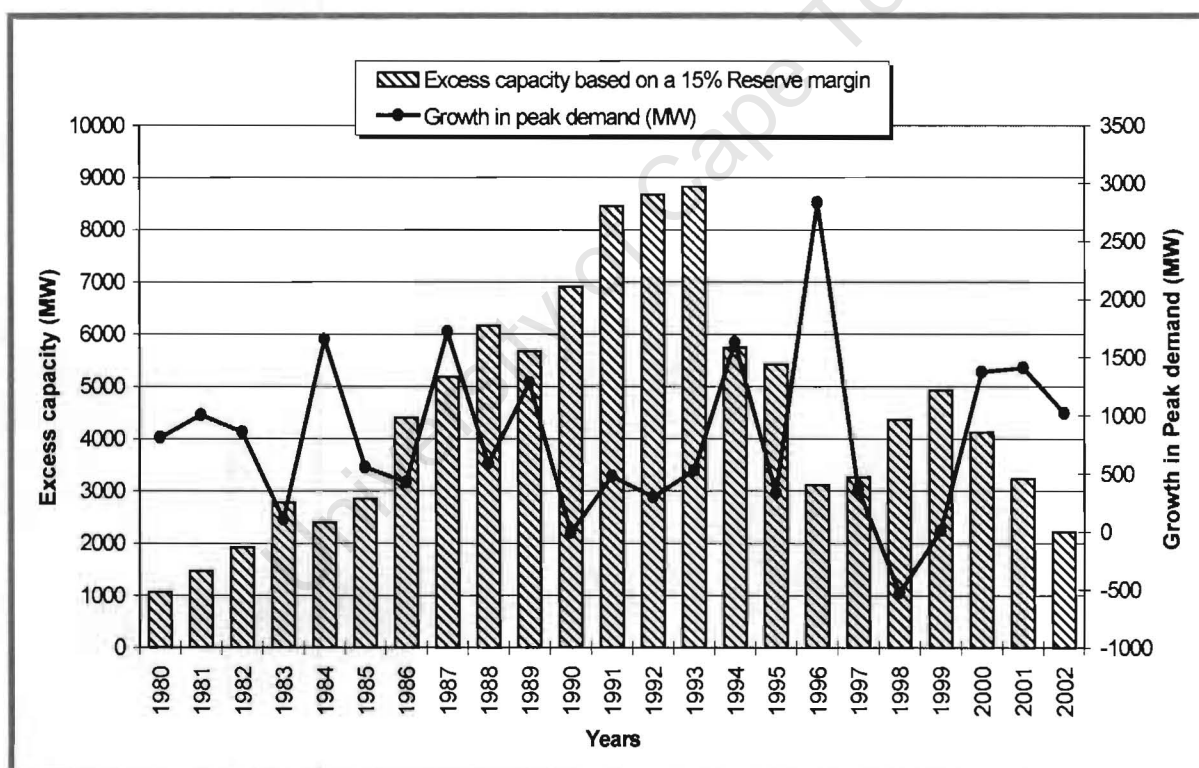
<sup>57</sup> An increase in thermal efficiency reduces the quantity of coal required to produce a kWh. In this regard, the total cost of coal required to produce a given amount of kWh tends to decline as thermal efficiency increases, and vice versa – other factors remain constant.

### 6.3.4 Excess capacity and timing of investment in generation capacity

#### 6.3.4.1 Allocative inefficiency

The presence of excess capacity<sup>58</sup> indicates poor allocation of scarce resources in the ESI in South Africa. Excess capacity at Eskom illustrates the implications of electricity growth rates that were used in the planning processes. Optimistically projected growth in electricity demand influenced Eskom's management to build more power plants over and above the actual demand. The growth rate of electricity consumption declined sharply. Consequently, power plants that were constructed could not be utilised efficiently as per projections, which led to wasteful excess capacity. Not only does excess capacity tie-up vast amounts of capital resources in unemployed assets but it also increases operational costs.

Figure 6.3: Excess capacities based on a 15% reserve margin and growth in peak demand



Source: Eskom Annual Reports and Statistical Yearbooks (various years)

<sup>58</sup> Capacity over and above the required level of reserve margin. Reserve margin is a level of available capacity that is maintained to meet sudden increases in peak demand and system breakdowns – in normal circumstances regulatory bodies require electricity producers to maintain a reserve margin of about 10 – 20% (Energy Vortex, 2003)

Eskom had an excess capacity of 2,500MW and 4,363MW in 1987 and 1989 respectively and about 7,000MW excess capacity was estimated by 1992 (Eskom Annual Reports, 1987: 24 and 1989: 24). Eskom's net maximum capacity is yet to be utilised until the year 2007 at the earliest. The costs of excess capacity were reflected in prices thereby passing over the burden of poor investment decisions to customers. This is a behaviour of a monopolist. Thus, together with the world's fuel problems at that time, electricity prices soared because of high capital costs that were composed of high interest and finance charges as well as contributions to the Capital Development and Reserve Funds.

Figure 6.3 illustrates excess capacities if a 15% reserve margin<sup>59</sup> is considered and the growth rate of peak demand from 1980 to 2001. The graph shows there had been an increase in excess capacities between 1980 and early the 1990s. This is due to the fact that most power generation units were commissioned during this period, which increased net maximum capacity consequently. Between 1980 – 1991 net maximum capacity increased by about 1,764MW (7.6%) per annum whereas the peak demand increased at an average rate of 791MW (4.8%) over the same period. From 1992 – 2001 the net maximum capacity increased marginally by 358MW (0.97%) annually and the peak demand increased by 826MW (3.2%) over the same period.

#### **6.3.4.2 Timing of investments**

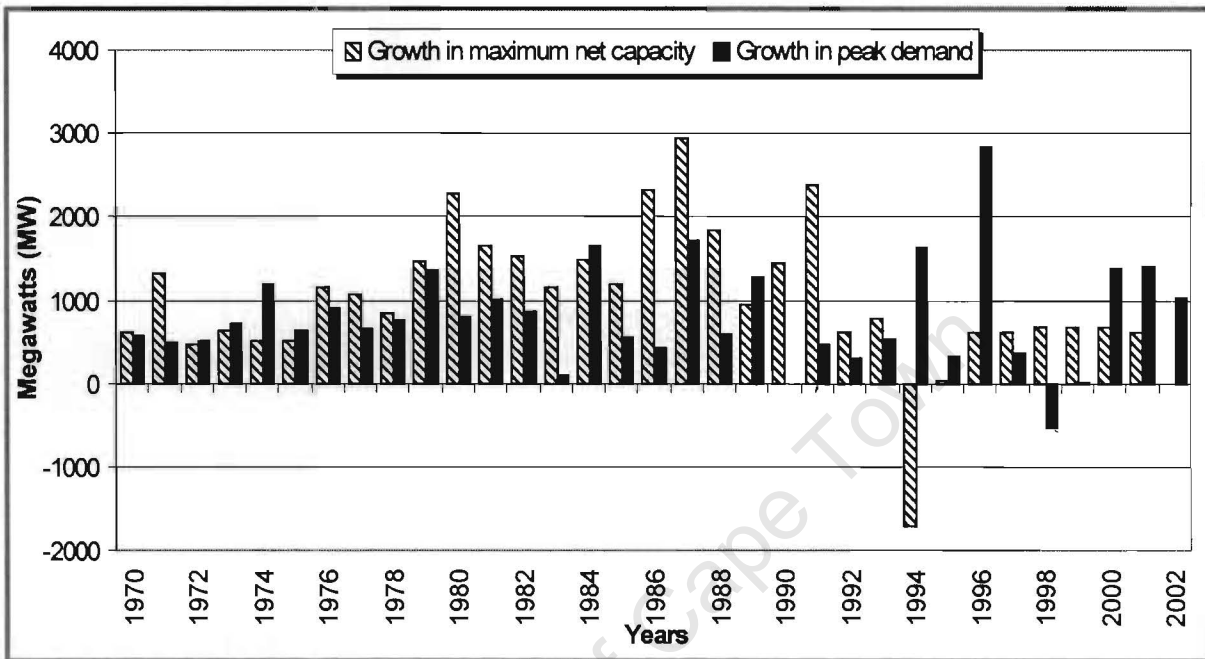
The existence of excess capacity in the South Africa's ESI shows that the timing<sup>60</sup> of investment in power plants did not coincide with demand requirement. Thus the construction of some plants was postponed or discontinued and some plants were mothballed. Figure 6.4 below shows growth in both net maximum capacity and peak demand. The figure shows a large difference (in MW) between growths in net maximum capacity and peak demand existed, particularly in the years 1971, 1980, 1983, 1986, 1988 and 1991 where net maximum capacity was very high compared to demand. However, increases in peak demand from the mid 1990s to 2001 were higher than that of net maximum capacity. Generally, increases in net maximum capacity were higher than increases in peak demand. This shows installation of power plants did not match with demand. Furthermore, the year 1987 recorded the highest level of growth in maximum net capacity because during the year a total maximum net capacity of 3,175 MW was added after five generating units were put into commercial service (Eskom Annual Report, 1987: 20). The year 1994 witnessed the official decommissioning of the Wilge and Salt River

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<sup>60</sup> Wrongly timed investment means increasing capacity by installing a new power plant earlier or later than per demand requirements. Whilst the installation of a plant earlier would lead to surplus capacity, a delay in investment will lead to shortage in electricity supply.

power stations and also it was decided that Ingagane, Highveld and Taaibos would be decommissioned in a near future (*ibid*), which consequently led to a negative growth in maximum net capacity.

**Figure 6.4: Growth in net maximum capacity and peak demand on integrated Eskom system**



**Source:** Compiled from Eskom Annual Reports and Statistical Yearbooks (various years).

### 6.3.4.3 Actions taken to limit excess capacity

Following the De Villiers Commission Eskom took a number of initiatives to deal with excess capacity. It postponed the construction of some power plants, increased the interval between the service dates of units, mothballed and decommissioned old and inefficient power plants. Whilst the construction of Kendal power station was delayed by one year, the construction of Majuba started six and a half years after the proposed date (Eskom Annual Report, 1989: 24). With improved financing means from external sources Eskom continued the construction of the 4,000 MW Majuba power station though in a delayed fashion and then mothball the plant when three of its six units were completed while the other three units remained on order (Steyn 2001: 109). The Klip, Vaal, Umgeni, Wilge, Salt River and West Bank power stations were decommissioned. Klip was decommissioned in 1986, Vaal in 1989 and Salt River and Wilge were decommissioned in 1994.

Eskom also mothballed old, less efficient power stations and reserved a number of sets of some generating plants for future use, thereby reducing running costs. This strategy not only helped Eskom

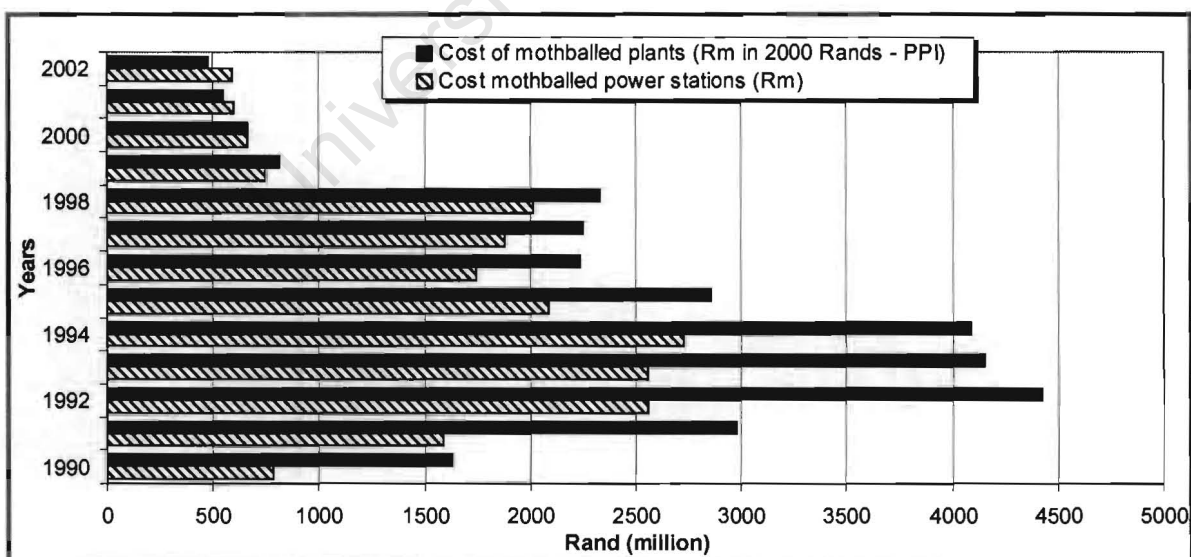
to reduce its excess capacity but also costs of coal. Table 6.3 (below) illustrates power stations that were in long-term reserve storage (mothballed) as at 31<sup>st</sup> December 1993.

**Table 6.3: Mothballed power stations as at 31<sup>st</sup> December 1993.**

Name of station	Number and rating of generator sets (MW)	Total net maximum capacity (MW)	Generators in reserve storage	
			Number	Total rating (MW)
Arnot	6 x 350	1955	3	990
Camden	8 x 200	1520	8	1520
Grootvlei	6 x 200	1130	6	1130
Highveld	8 x 60	412	8	412
Ingagane	5 x 100	465	5	465
Komati	5 x 100	473	5	473
	4 x 125	418	4	418
Salt River	4 x 30	114	4	114
	2 x 60	114		
Taaibos	8 x 60	440	8	440
Wilge	2 x 30	56	2	78
	3 x 60	143		
Total			53	6040

Source: Eskom Statistical Yearbook (1993: 14).

**Figure 6.5: Total asset values of mothballed power stations**



Source: Extracted from Eskom Annual Reports (1990 – 2002).

Figure 6.5 (above) shows asset values<sup>61</sup> of mothballed power stations from 1990 to 2002 in both nominal and real terms. The value of mothballed plants in 1992 is about nine times as much as that of 2002. Towards the end of the 20<sup>th</sup> century and the beginning of the 21<sup>st</sup> century the total asset value has been decreasing, though marginally. Moreover, the cost of mothballed plant expressed as a percentage of the cost of plant in commission was more than 5% in 1992, 1993 and 1994 and thereafter it declined sharply to less than one percent in 1999 – 2002.

Another strategy that Eskom implemented to reduce its excess capacity was to provide specific programmes that encouraged large customers to increase their consumption (Eskom Annual Report, 1989: 24). This sounds ridiculous. What was expected of Eskom was to encourage electricity conservation thereby fostering sustainable development as far as scarce resources are concerned.

### **6.3.5 The need for new capacity and its implications on the price**

Eskom's 2002 projections show that the existing surplus capacity would be eroded by 2007 and thus new capacity will be required to cater for future increases in electricity demand. As highlighted in Chapter Four, capital-related costs constitute the largest share of the electricity price. Bearing this in mind, it is most likely that the existing electricity price will increase in real terms to accommodate future expansions in capacity.

New investments in the ESI will allow the installation of environmentally benign technologies such as gas-fired (single and combined cycle) technologies. These have less construction lead times as well as capital intensity due to their sizes as compared to large coal-fired power plants currently used by Eskom. Lower lead time means the installed plant will start contributing to revenues earlier and thereby reducing some of the costs, particularly capital-related costs. Moreover, the installation of gas-fired plants and other environmentally friendly technologies will reduce the emission of greenhouse gases (GHGs) thereby enabling the government to meet one of its objectives of power sector reforms in South Africa.

New investment requirements in the industry will provide a chance for independent power producers (IPPs) to participate in the industry. As the market share of Eskom is gradually reduced, that of the IPPs will increase in the industry resulting in intense competition. The choice of technology in a

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<sup>61</sup> Historical costs of mothballed plants

competitive environment is of particular importance when investment decisions are undertaken as the risks of poor investment decisions will not be passed over to customers.

### **6.3.6 Financial requirements for capacity expansion programmes**

Despite the fact that Eskom received neither financial aid nor subsidies from the government, the electricity Act authorised Eskom to raise loans<sup>62</sup> and to transfer a substantial amount of its revenue to Capital Development Fund and Reserve Fund (De Villiers, 1984: 10) to cater for its expansion programmes. Originally, the Electricity Act allowed Eskom to transfer annually to the Reserve Fund and the Capital Development Fund a maximum of 3% of unredeemed loans and 15% of contributions to unredeemed loans which were increased to 6% and 30% respectively in 1977 (Steyn, 2001: 87). The annual contributions to Capital Development Fund as well as funds generated externally (from loans) were subject to the approval of the State President (De Villiers, 1984: 188).

Moreover, the State also provided Eskom with favourable conditions tailored to safeguard and improve its financial aspects / underpinnings. These include:

- Protection by the Reserve Bank at a low cost against currency fluctuations in its obligations.
  - The State subsidised some of the consumers who could not afford to pay for the electricity price.
  - Tax deduction privileges were rendered to foreign investors who invested in Eskom stock.
- (De Villiers, 1984: 188).

#### **6.3.6.1 External loans**

The local and international capital markets provided Eskom with access to external loans that were used to finance its capital expenditure and loan repayments. In 1980 external loans contributed about 26 percent of its financing requirements (Eskom Annual Report 1980: 13). Furthermore, arrangements were made between Eskom and suppliers to finance capital equipment through trade agreements.

Continuous growth in demand for electricity especially during the late 1960s and early 1970s necessitated Eskom to construct more power plants in an attempt to overcome shortages in electricity that could impinge on economic development. This intensified the magnitude and urgency of the need for capital resources. Furthermore, the mid 1970s (a time when Eskom required a substantial amount of external loans to finance its massive capital expansion programmes) was a time when South Africa's economy experienced a decline in foreign loans. Steyn (2001: 89) highlighted that in 1977 South

Africa experienced difficulties in raising international loans due to a number of national strikes following the Soweto killings and South Africa's invasion to Angola. Furthermore, De Villiers, (1984: 140) put it this way "...foreign capital influx changed from more than 10% of the total investment during the period 1946 – 1976 to a net outflow after the Soweto riots."

Steyn (2001: 87) pointed out that in 1960s and early 1970s Eskom's increased demand for funds to finance the construction of power plants led to a shortage in capital resources in the economy which eventually increased interest rates. This is due to the fact that Eskom had to finance its capital expenditures from the local market. Among other things, the higher the demand on the locally available capital resources the higher was the cost of capital that eventually led to increases in prices by that time.

### **6.3.6.2 Internally generated funds**

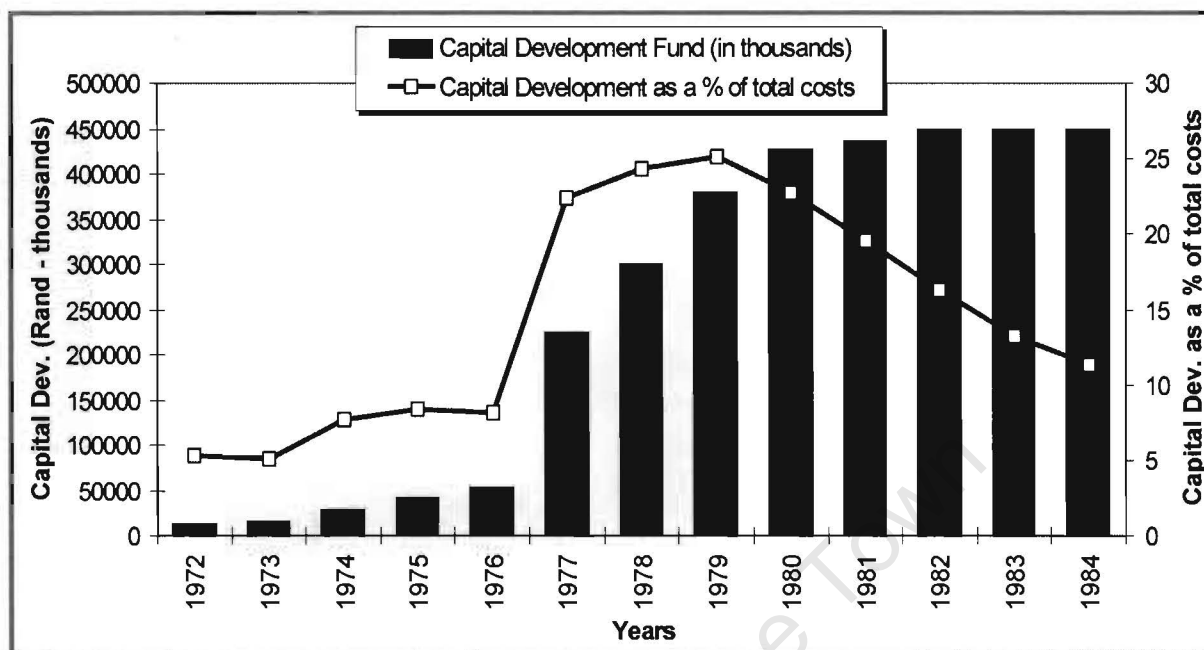
Apart from externally obtained finances, Eskom operated three internally generated funds namely the Redemption Fund, Capital Development Fund and Reserve Fund. Whilst the Redemption Fund was meant for the redemption of locally obtained loans (on a sinking-fund basis), the Capital Development Fund was aimed at financing "capital expansion and the replacement of assets taken out of service" (Eskom Annual Report, 1986: 3). Moreover, the Reserve Fund was used "for upgrading plants, exceptional repairs or emergencies" (*ibid*).

Before the establishment of the Capital Development Fund in 1972 Eskom depended substantially on debts to finance its capacity expansions programmes. As highlighted in Chapter Four, interest expenditures and loan redemption charges were reflected in the electricity prices and thus consumers shouldered the costs of debts used to finance the capital expansions as well as a contribution to the Reserve Fund for capital replacement. As noted in section 6.3.6.1 (above) that, foreign loans became increasingly difficult to obtain. Eskom had to finance its capital expansion programmes largely from funds generated from its tariff revenue, which resulted into a substantial increase in Capital Development Fund in 1977 as shown in Figure 6.6 (below).

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<sup>62</sup> Eskom's foreign loans were guaranteed by the government.

Figure 6.6: The Capital Development Fund (1972 – 1984)



Source: Extracted from Eskom Annual Reports (1985: 60; 1982: 62; 1981: 62 and 1980: 58)

The establishment of the Capital Development Fund was aimed at improving the capital structure, which by then was “debt-dominated”, thereby enabling Eskom to finance its investment from internally generated funds (Steyn, 2001: 87). Funds accumulated in this account were invested in Eskom stock, which was a locally registered stock (traded on the Johannesburg Stock Exchange) or other profitable investments (Eskom Annual Report, 1980: 8). Consequently, the Capital Development Fund increased the burden of high prices to the consumers. Whilst at first capital expansion programmes were financed by debts and their associated costs were met by customers in the future when new plants became operational, the establishment of the Capital Development Fund meant that consumers contributed in advance towards funds that would be required for new capacity (Steyn, 2001: 90). The Franzsen Commission, as quoted below, recommended this in 1972:

... the share of internal funds, as a source of financing the capital expenditures of government enterprises, should be increased, not only that dependence on borrowed funds and the accompanying pressure on interest rates can be reduced but also that the interest and redemption burden on current revenue can gradually diminish or at least, not rise so rapidly (De Villiers, 1984: 109).

A total of R13.6 million was contributed to the Capital Development Fund when it was launched in 1972 (*ibid*). In 1977 Eskom increased its contributions to Capital Development Fund by a considerable

amount due to uncertainty surrounding foreign loans that were required to finance its capital expansions programmes (De Villiers, 1984: 188). Figure 6.6 (above) illustrates Capital Development Fund from 1972 – 1984. The Capital Development Fund was about R53.6 million in 1976 and it increased fourfold to R224 million in 1977. During the same period the Capital Development Fund contributed about 8.16% and 22.47% of total costs respectively. After 1979 the proportion of the Capital Development fund to total cost declined substantially from 25.14% to 11.27% in 1984 although the Capital Development Fund increased marginally over the same period.

## **6.4 Conclusion**

This chapter investigated Eskom's allocative efficiency. The chapter established that Eskom was not allocatively efficient due to over-investment in power plants. From a microeconomic perspective, Eskom misallocated fiscal resources. As a result of being supply-driven, Eskom engineers ordered and built power plants than were necessary to match expected increases in demand. This is due to over-estimation in demand following the use of the distorted econometric-based method. Because of its monopolistic powers, Eskom engineers assumed little or no risk when planning for new investments. Poor investment decisions, especially towards the end of 1970 and in the early 1980s, caused excess capacity, and as a result electricity prices soared, shifting the burden of poor investment decisions to customers.

A decline in capital expansion programmes led to a dramatic decrease in real capital related costs that, to a great extent, led to a considerable decrease in the real price of electricity. Eskom's current low electricity price is due to the fact that most capital-related costs were paid during the late 1970s and early 1980s.

As the existing surplus capital is eroded, new investments in power plants will be required. The need for capacity expansions in the near future means that the existing electricity price will increase as a result of associated costs. It is important for Eskom and other generators to start accounting for future capacity expansion needs.

## Chapter Seven

### Conclusions

The study investigated why Eskom's electricity prices are apparently low and if this means it is operationally and allocatively efficient. The study first scrutinised the magnitude/level of South Africa's households and industrial electricity prices by comparing them with those of selected countries. Eskom's retail prices were then compared with other giant utilities' prices over a number of years. Research findings established that Eskom's prices were generally low compared to those of many other utilities in the world. The study then sought to find the reasons that account for Eskom's low prices.

Eskom's average price was broken down into the main contributing elements, which included interest expenditure, primary energy, wages and salaries, depreciation, income tax and net income. Interest expenditure, wages and salaries and primary energy make up the largest component of the price. These price components were subjected to close examination in the years under consideration in order to ascertain their trends and proportional contributions to the price. The findings established that there was a declining trend (in real terms) in almost all the components per a kilowatt-hour of electricity sold.

The real price of coal has declined consistently. This contributed to a significant decline in Eskom's real price of electricity. The fact that Eskom had access to abundant and low priced coal has enabled it to enjoy a comparative international advantage. The price of coal in South Africa is low compared to many countries in the world. The study also revealed that Eskom reduced coal costs by not only buying coal from collieries on long term contracts but also utilising low-grade coal; this, though, has environmental repercussions.

The findings established further that capital-related costs, particularly interest expenditures, played the most influential role in a declining trend in the level of Eskom's price. These amounts were large when new capital expansion programmes were undertaken. Interest expenditure has declined dramatically (in

real terms) since the mid 1980s following a substantial reduction in debt (in real terms) as a result of a decline in investment in power plants. Chances are high for the current low price of electricity to increase in real terms once new power plants are installed in South Africa.

Investment efficiency has a profound impact on an organisation's general performance. This is especially true with capital-intensive industries such as the ESI. Once poor decisions have been made with regard to the technology and timing of the investment, the likelihood of committing the industry to high long-term capital costs is quite high and operational efficiency can do very little to reduce the price. In other words, operational performance involves short-term decisions (mainly concerning the daily activities of an organisation), whereas investment decisions are long term. Thus, when a decision is taken to install a new power plant, little can be done to reduce the committed capital costs. It is only once these costs have been paid for, that the burden of highly priced electricity will be reduced. Investment efficiency in power plants requires accuracy with regard to demand estimation, which of course should also take into account the risks of unforeseen circumstances that might considerably change the magnitude of the estimated demand. This will help to reduce (if not to avoid) over-investment or under-investment, because both have significant repercussions on the electricity price.

In addition to the above-mentioned attributes, the study also uncovered a number of factors that impacted on Eskom's electricity prices. These were, *inter alia*, non-payment of income tax and dividends (in past years), and exclusion of environmental (external) costs of electricity generation in its pricing system. The last aspect has environmental repercussions that make Eskom's low price questionable from the social welfare point of view.

The study also investigated the extent to which Eskom's operational performance contributed to its low price. A broad spectrum of performance indicators that include productivity and financial and technical parameters were scrutinised and analysed from 1980 to 2001. Generally, the indicators showed a significant improvement as far as Eskom's operational performance is concerned.

Productivity of labour, raw materials and water resources generally improved through the period reviewed although some indicators stabilised or slightly worsened at some stages. A decline in the number of employees was among the reasons that contributed to labour productivity at Eskom although the ability of the workforce to identify and utilise available resources at optimal levels to generate electricity and provide high quality services were even more crucial.

The quantity of coal required to produce a kilowatt-hour declined consistently in the early 1980s before it stabilised and then increased slightly towards the end of the last decade of the 20<sup>th</sup> century. This was partly due to thermal efficiency, which improved quite significantly during the early 1980s and thereafter remained fairly constant for some time before it worsened in the late 1990s. The use of low-grade coal jeopardised Eskom's operational performance in terms of utilising more kilograms of coal when producing a kilowatt-hour of electricity.

To ascertain Eskom's financial performance, the study examined a number of indicators that included profitability, asset management, liquidity and debt management ratios. On average, liquidity ratios (particularly ROA) remained fairly constant. Basically, this is because of regulation inherent in the ESI. Furthermore, asset management ratios improved while liquidity ratios strengthened in the years under review. Most importantly, the capital structure improved significantly in recent years and that consequently led to a substantial decline in debts and associated interest expenditures. This was primarily due to a decline in capital expansion programmes in recent years following the De Villiers Commission's report. Tight budgets and commercial behaviour instituted at Eskom contributed to its financial performance.

The need for new capacity in South Africa poses a threat to the current Eskom's financial performance, particularly debt management ratios. Because of significant capital amounts required for new power plants, Eskom's capital structure can significantly be distorted thereby leading to high electricity prices due to possible increases in capital-related costs. Moreover, the incorporation of Eskom as a company provides it with more alternatives when in need of capital resources. Eskom can either choose to raise its capital through borrowing or by floating its shares on the local and international stock exchanges to finance new capacity expansion. It can also choose to combine the two. Decisions with regards to the appropriateness of the method chosen for raising capital have to consider the advantages and disadvantages of each as far as their repercussions on price are concerned.

Eskom's technical performance was reasonably good. Generation load factors, availability factors, quality of supply and thermal efficiency contributed significantly to Eskom's overall performance. The introduction of new technology (particularly more efficient and large power plants) in the industry had noticeable productivity implications. Efficiency improved at the expense of availability of power plants. An increase in thermal efficiency had obviously reduced the quantity of primary energy resources (particularly coal) used to generate a kilowatt-hour. This in turn resulted in reduced overall costs of coal consumed. The benefits of improving thermal efficiency should outweigh the costs. There

is a need to assess the suitability of a new technology before decisions to adopt such technologies are reached.

The structure of the industry within which the firm operates and the effectiveness of regulation plays a major role in shaping Eskom's operational and investment performances. Eskom assumed the "supplier of last resort" responsibility due to its monopolistic powers. Eskom over-estimated increases in demand that in turn led to over-capacity in power plants and unreasonably high prices from the mid 1970s to the mid 1980s. It used a conventional econometric-based method to estimate increases in demand consumption. The effectiveness of the method was distorted by economic fluctuations following the mid 1970s oil crisis. The burden of poor investment decisions was simply passed on to customers who, because of the monopolistic market structure, could not influence the organisation to operate and invest efficiently. The price increased exorbitantly which led to a political outcry. The government had to intervene to rescue the customers from unnecessarily high prices of electricity.

Moreover, in the mid 1970s South Africa experienced difficulties in accessing foreign capital. The government enacted a law that allowed Eskom to include the Capital Development Fund in its pricing system so as to provide the necessary funds for capital expansion programmes. This meant consumers paid for capital expansion costs in advance.

The mid-1980s witnessed institutional and organisational changes at Eskom with commercial behaviour being instituted. With this, significant improvement in overall performance was recorded. The Electricity Council monitored accountability and responsibility of the Management Board. Initiatives to improve overall (particularly financial) performance were taken. Instead of ordering new power stations, the new management had to find ways of reducing over-capacity. The construction of already ordered plants was postponed and no new power plants have been ordered since the mid 1980s.

The government intends to restructure Eskom. The white paper on energy policy directs the industry to be restructured and/or privatised to form a competitive market. Eskom's market power will be diluted, different participants with competitive spirits will compete for customers. The ultimate objective is to improve efficiency and effectiveness in the ESI. Government's reform model is one of managed liberalisation. There will be considerable challenges to ensure that competition is effective. If this is achieved, it is hoped that there will be ongoing pressure to improve efficiencies in the industry, particularly with regard to allocative or investment efficiencies. Eskom's investment record was

disastrous in the 1970s and 1980s. It has yet to be seen whether a competitive electricity market in South Africa will result in new generation investments being made more efficiently and timeously.

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## Appendices

### Appendix I:

Table A1: Eskom's cost of coal and GWh produced and sold.

Year	Coal burnt (kt)	Average cost of coal				Total nominal cost of coal – Rand (million)	Total real cost of coal in 2000 Rand – PPI (million)	GWh Produced (from Eskom coal-fired plants)	Total GWh produced by Eskom	GWh produced (coal-fired plants) as a % total GWh produced
		R/t - Nominal	% Change	R/t – 2000 values (PPI)	% Change					
1980	46,755	8.12	16.7	61.05	0.0	379.65	2,854.52	82,342	83,362	98.8
1981	53,904	9.71	19.6	64.30	5.3	523.41	3,466.28	95,675	97,824	97.8
1982	55,198	11.75	21.0	68.31	6.2	648.58	3,770.79	100,217	102,769	97.5
1983	55,010	12.44	5.9	65.47	-4.2	684.33	3601.71	100,738	103,295	97.5
1984	58,704	12.55	0.9	60.92	-7.0	736.74	3576.38	110,094	116,581	94.4
1985	59,489	13.25	5.6	54.98	-9.8	788.23	3270.66	113,941	121,987	93.4
1986	58,916	14.87	12.2	51.63	-6.1	876.08	3041.95	114,298	126,511	90.3
1987	65,787	17.11	15.1	52.16	1.0	1,125.62	3431.75	122,947	132,507	92.8
1988	64,490	18.67	9.1	50.32	-3.5	1,204.03	3,245.36	123,777	138,837	89.2
1989	67,529	20.94	12.2	48.93	-2.8	1,414.06	3,303.87	128,304	143,204	89.6
1990	70,861	23.91	14.2	49.92	2.0	1,694.29	3,537.13	134,744	146,047	92.3
1991	70,523	25.70	7.5	48.13	-3.6	1,812.44	3,394.08	135,743	148,671	91.3
1992	71,038	27.47	6.9	47.53	-1.2	1,951.41	3,376.15	136,830	148,207	92.3
1993	75,926	28.48	3.7	46.23	-2.7	2,162.37	3,510.06	145,514	154,260	94.3
1994	76,883	29.98	5.3	44.95	-2.8	2,304.95	3,455.70	148,003	160,293	92.3
1995	79,377	31.99	6.7	43.82	-2.5	2,539.27	3,478.45	151,730	164,834	92.1
1996	85,401	35.05	9.6	44.88	2.4	2,993.31	3,832.66	163,541	178,855	91.4
1997	90,169	36.52	4.2	43.68	-2.7	3,292.97	3,938.96	170,464	187,811	90.8
1998	87,225	40.69	11.4	49.99	7.6	3,549.19	4,098.37	165,473	183,093	90.4
1999	88,470	42.79	5.2	46.71	-6.6	3785.63	4132.79	165,665	181,818	91.1
2000	92,289	44.40	3.8	44.40	-4.9	4097.63	4097.63	172,362	181,307	95.1
2001	94,136							175,223	189,590	92.4

Source: Compiled from Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

## Appendix II

Table A2: Electricity cost, price and selected price components.

Years	Average cost of electricity (c/kWh)	Average selling price (c/kWh)	Nominal cost of coal burnt			Nominal wages and salaries			Nominal Interest expenditure		
			c/kWh	As a % of average cost	As a % of selling price	c/kWh	As a % of average cost	As a % of selling price	c/kWh	As a % of average cost	As a % of selling price
1980	2.14	2.02	0.46	21.6	22.8	—	—	—	0.69	32.3	34.3
1981	2.36	2.28	0.55	23.2	24.0	—	—	—	0.77	32.6	33.7
1982	2.86	2.80	0.65	22.6	23.1	—	—	—	0.91	31.9	32.6
1983	3.47	3.36	0.68	19.6	20.2	—	—	—	0.96	27.6	28.5
1984	3.74	3.58	0.67	17.9	18.7	—	—	—	1.20	32.1	33.5
1985	4.08	4.12	0.69	17.0	16.8	—	—	—	1.71	41.9	41.5
1986	4.81	4.98	0.77	15.9	15.4	—	—	—	2.16	45.0	43.5
1987	5.18	5.75	0.92	17.7	15.9	—	—	—	1.74	33.7	30.3
1988	5.66	6.29	0.97	17.1	15.5	—	—	—	1.92	33.9	30.5
1989	6.36	6.9	1.10	17.3	16.0	1.47	23.1	21.3	2.16	34.0	31.3
1990	7.26	7.88	1.26	17.4	16.0	1.65	22.7	20.9	2.42	33.3	30.8
1991	7.77	8.46	1.34	17.2	15.8	1.53	19.7	18.1	2.34	30.1	27.6
1992	8.08	9.16	1.43	17.7	15.6	1.74	21.5	19.0	2.16	26.8	23.6
1993	8.45	9.59	1.49	17.6	15.5	1.78	21.1	18.6	2.19	25.9	22.8
1994	8.80	10.32	1.56	17.7	15.1	1.92	21.8	18.6	2.13	24.2	20.7
1995	9.40	11.15	1.67	17.8	15.0	2.13	22.7	19.1	2.01	21.4	18.0
1996	9.46	11.30	1.83	19.3	16.2	2.37	25.1	21.0	1.93	20.4	17.1
1997	10.07	11.85	1.93	19.2	16.3	2.13	21.1	17.9	2.53	25.1	21.3
1998	10.87	12.29	2.14	19.7	17.4	2.25	20.7	18.3	2.52	23.2	20.5
1999	11.27	12.44	2.29	20.3	18.4	2.75	24.4	22.1	2.45	21.8	19.7
2000	11.44	13.23	2.38	20.8	18.0	2.64	23.1	19.9	2.36	20.6	17.8
2001	11.90	13.76	2.97	25.0	21.6	2.49	20.9	18.1	2.28	19.2	16.6

Source: Compiled from Eskom Annual Reports (1980 – 2001) & Statistical Yearbooks (1985 – 1996).

## Appendix III

Table A3: Steam coal prices<sup>1</sup> for electricity generation

COUNTRY	YEAR							
	1994	1995	1996	1997	1998	1999	2000	2001
OECD (All)	38.44	39.30	34.40	32.90	30.50	29.00	26.0	29.8
OECD Europe	56.30	62.20	42.90	39.30	37.50	33.80	32.4	n.a
Argentina ✓	n.a	n.a	81.68	81.68	81.68	81.68	89.41	92.19
Austria ✓	72.50	n.a	n.a	n.a	n.a	n.a	n.a	67.46
Belgium ✓	40.05	43.66	45.64	42.65	34.20	30.20	32.8	37.7
Brazil ✓	63.60	52.76	54.18	50.50	39.66	n.a	n.a	n.a
Chile ✓	n.a	n.a	n.a	67.51	59.32	52.17	50.46	45.02
Taiwan ✓	114.86	116.87	113.81	108.92	93.04	96.37	100.03	74.16
Colombia	n.a	n.a	9.02	9.79	18.98	15.50	14.00	12.69
Costa Rica	n.a	n.a	10.84	8.38	7.50	6.77	n.a	n.a
Cuba	n.a	n.a	66.18	80.45	80.45	80.45	n.a	n.a
Czech Republic <sup>1</sup>	8.30	9.60	9.90	8.90	9.50	9.60	8.0	8.0
Dominican Rep.	n.a	n.a	39.40	56.45	52.23	49.83	48.67	n.a
Finland	56.92	84.29	77.57	52.13	43.00	39.5	38.60	86.16
France	40.65	45.80	45.41	45.16	38.60	36.10	35.50	65.91
Germany	141.59	161.83	55.80	49.00	46.60	42.00	42.40	51.90
India	10.04	9.93	9.09	n.a	n.a	n.a	n.a	19.36
Ireland	40.93	47.18	50.93	45.76	36.30	30.90	30.30	35.4
Italy	56.81	57.79	59.93	55.90	50.40	n.a	n.a	45.12
Jamaica	n.a	68.17	76.56	76.56	74.29	69.32	63.07	58.85
Japan	72.34	74.42	71.20	62.79	n.a	n.a	n.a	31.77
Mexico <sup>1</sup>	28.10	21.90	23.70	26.90	25.90	28.80	31.80	n.a
Panama	n.a	n.a	n.a	n.a	n.a	52.58	n.a	n.a
Paraguay	n.a	n.a	207.92	196.10	157.66	138.64	n.a	n.a
Peru	n.a	n.a	n.a	36.23	32.95	28.57	27.78	27.63
Poland	30.20	31.98	30.65	29.84	32.60	29.10	28.20	43.16
Portugal	38.93	44.32	45.08	42.04	36.00	31.50	30.20	39.29
Russia	16.14	22.12	30.58	n.a	n.a	n.a	n.a	n.a
<b>South Africa*</b>	<b>8.44</b>	<b>8.82</b>	<b>8.15</b>	<b>7.51</b>	<b>6.91</b>	<b>6.96</b>	<b>5.87</b>	<b>15.22</b>
Thailand	8.44	8.82	8.15	n.a	n.a	n.a	n.a	n.a
Turkey <sup>1</sup>	13.14	17.90	17.58	15.65	15.90	15.40	14.40	33.28
United Kingdom	55.67	55.38	54.95	55.22	50.00	46.90	44.40	46.42
United States	31.00	30.10	29.50	29.10	28.60	27.80	24.50	28.20
Venezuela	31.00	33.09	35.72	34.30	32.10	29.20	n.a	n.a

Sources: IEA (2002; 2001; 2000: 1.66); EIA (2003a) & \*DME (2003)

<sup>1</sup>Brown coal price for Czech Republic, Mexico and Turkey.

n.a = Not Available.

\*South Africa's coal prices for the years 1997 to 2000 were converted into U.S Dollars as at 31<sup>st</sup> December of each year.

## Appendix IV

Table A4: Electricity prices for households in selected countries (U.S cents/kWh)

COUNTRY	YEAR							
	1994	1995	1996	1997	1998	1999	2000	2001
Argentina	n.a	n.a	n.a	n.a	13.90	14.10	8.90	8.60
Austria	16.60	19.20	19.40	16.90	16.80	n.a	11.80	12.14
Belgium	17.60	20.30	19.10	16.80	16.50	n.a	13.20	13.23
Brazil	12.30	10.00	13.10	12.90	12.8	n.a	n.a	n.a
Chile	n.a	n.a	n.a	n.a	10.40	9.00	9.10	n.a
Taiwan	9.30	9.60	9.30	8.90	7.70	7.90	8.10	8.38
Colombia	n.a	n.a	n.a	n.a	6.80	7.70	6.30	n.a
Costa Rica	n.a	n.a	n.a	n.a	5.40	5.00	8.30	n.a
Cuba	n.a	n.a	n.a	n.a	13.10	13.30	13.5	n.a
Czech Republic	3.20	3.70	3.80	3.70	5.00	5.10	5.40	6.11
Denmark	18.00	20.90	21.50	19.50	21.30	20.7	19.70	19.53
Finland	8.80	10.90	11.10	10.00	9.80	9.10	7.80	7.89
France	15.00	16.70	16.40	13.40	12.90	n.a	10.20	10.17
Germany	17.80	20.30	18.00	15.90	15.90	n.a	12.10	16.66
India	3.00	3.10	2.90	3.40	n.a	n.a	3.90	3.88
Ireland	12.30	13.20	13.50	13.10	12.30	11.70	10.10	9.57
Italy	16.40	16.90	17.80	15.90	15.90	14.70	13.50	13.42
Jamaica	n.a	n.a	n.a	n.a	13.10	12.80	15.10	14.60
Japan	25.00	26.90	23.00	20.70	18.70	21.20	21.40	21.44
Mexico	6.90	4.50	4.80	5.40	5.50	5.90	6.80	7.78
Panama	n.a	n.a	n.a	n.a	12.00	12.10	12.10	n.a
Paraguay	n.a	n.a	n.a	n.a	6.60	5.70	5.60	n.a
Peru	n.a	n.a	n.a	n.a	10.10	9.50	10.00	n.a
Poland	4.90	6.20	6.50	6.20	6.70	6.40	6.50	8.34
Portugal	16.30	18.10	17.60	15.60	15.40	14.10	12.00	11.77
Russia	0.50	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Slovakia	2.90	3.10	3.10	2.90	2.80	3.50	5.00	6.28
<b>South Africa</b>	<b>4.70</b>	<b>5.00</b>	<b>4.50</b>	<b>4.60</b>	<b>4.10</b>	<b>4.20</b>	<b>4.00</b>	<b>3.80</b>
Spain	17.60	19.50	19.00	16.30	15.40	14.30	11.70	14.33
Switzerland	13.10	16.50	15.90	13.60	13.50	13.10	11.10	11.12
Turkey	7.60	7.60	8.70	8.00	7.90	8.40	8.40	8.49
United Kingdom	12.20	12.70	12.50	12.50	12.10	11.70	10.7	10.10
United States	8.40	8.40	8.40	8.40	8.30	8.20	8.200	8.60
Venezuela	2.50	3.10	1.70	n.a	1.10	1.00	n.a	n.a

Sources: IEA (2002; 2001; 2000: 1.63) & EIA (2003b)

*n.a = Not Available*

## Appendix V

Table A5: Electricity prices for industry in selected countries (U.S cents/kWh)

COUNTRY	YEAR							
	1994	1995	1996	1997	1998	1999	2000	2001
OECD	7.30	7.90	7.40	6.80	5.10	6.30	4.70	n.a
OECD Europe	7.10	7.70	7.40	6.50	6.60	6.00	5.20	n.a
Argentina	n.a	n.a	n.a	n.a	7.90	7.90	7.50	n.a
Austria	7.20	8.10	8.10	8.10	7.80	n.a	3.80	9.21
Belgium	5.90	6.80	6.50	5.50	n.a	n.a	4.80	4.77
Brazil	7.60	5.70	5.40	5.10	5.70	n.a	n.a	n.a
Chile	n.a	n.a	n.a	n.a	5.90	5.00	5.20	5.60
Taiwan	7.60	7.60	7.30	6.90	5.80	5.80	6.10	5.86
Colombia	n.a	n.a	n.a	n.a	8.50	8.10	5.20	4.2
Costa Rica	n.a	n.a	n.a	n.a	8.00	7.60	6.80	7.60
Cuba	n.a	n.a	n.a	n.a	6.70	6.00	8.00	7.80
Czech Republic	5.60	6.10	5.90	5.20	5.20	4.80	4.30	4.68
Denmark	6.30	6.90	7.30	6.40	6.80	6.60	5.80	5.97
Finland	5.00	6.00	6.20	5.20	5.00	4.60	3.90	3.94
France	5.30	6.00	5.70	4.90	4.70	n.a	3.60	3.58
Germany	8.90	10.00	8.60	7.20	6.70	n.a	4.10	7.90
India	7.00	7.60	7.40	8.00	n.a	n.a	8.00	8.01
Ireland	6.10	6.60	6.60	6.30	5.90	5.70	4.90	4.62
Italy	9.10	9.30	10.10	9.40	9.50	8.60	8.90	9.30
Jamaica	n.a	n.a	n.a	n.a	10.20	10.20	11.90	11.00
Japan	17.20	18.50	15.70	14.60	n.a	n.a	n.a	14.26
Mexico	4.20	2.70	3.30	4.10	3.80	4.20	5.10	4.75
Panama	n.a	n.a	n.a	n.a	9.90	9.90	9.90	n.a
Paraguay	n.a	n.a	n.a	n.a	3.80	3.30	3.20	n.a
Peru	n.a	n.a	n.a	n.a	5.60	5.50	5.60	n.a
Poland	3.50	4.00	4.00	3.60	3.70	3.70	3.70	4.76
Portugal	11.60	12.20	11.20	9.70	9.40	8.10	6.70	11.77
Russia	2.20	3.10	4.40	n.a	n.a	n.a	1.10	n.a
Slovakia	4.50	4.90	4.90	4.90	4.90	4.10	4.20	4.35
<b>South Africa</b>	<b>2.50</b>	<b>2.90</b>	<b>2.30</b>	<b>2.30</b>	<b>2.00</b>	<b>1.70</b>	<b>1.70</b>	<b>1.72</b>
Spain	7.80	8.10	8.00	6.40	5.90	5.60	4.30	5.58
Switzerland	10.60	12.50	12.00	10.20	10.10	9.60	6.90	7.09
Turkey	7.70	7.60	8.50	7.70	7.50	7.90	8.00	8.05
United Kingdom	6.70	6.80	6.50	6.50	6.50	6.40	5.50	4.96
United States	4.80	4.70	4.60	4.50	4.50	4.40	4.60	5.00
Venezuela	6.80	6.10	3.30	n.a	2.90	2.60	n.a	n.a

Sources: IEA (2002; 2001; 2000: 1.62) & EIA (2003c)

n.a = Not Available

## Appendix VI

**Table A6: Consumer Price Index (CPI) and Production Price Index (PPI)  
(Annual averages)**

Base year: 2000 = 100

Years	Consumer Price Index		Production Price Index	
	Index	% Change	Index	% Change
1975	6.1		6.9	
1976	6.8	+11.5	8.0	+15.9
1977	7.6	+11.8	9.0	+12.5
1978	8.4	+10.5	9.9	+10.0
1979	9.5	+13.1	11.4	+15.2
1980	10.8	+13.7	13.3	+16.7
1981	12.5	+15.7	15.1	+13.5
1982	14.3	+14.4	17.2	+13.9
1983	16.1	+12.6	19.0	+10.5
1984	17.9	+11.2	20.6	+8.4
1985	20.8	+16.2	24.1	+17.0
1986	24.7	+18.8	28.8	+19.5
1987	28.7	+16.2	32.8	+13.9
1988	32.4	+12.9	37.1	+13.1
1989	37.1	+14.5	42.8	+15.4
1990	42.4	+14.3	47.9	+11.9
1991	49.0	+15.6	53.4	+11.5
1992	55.7	+13.7	57.8	+8.2
1993	61.2	+9.9	61.6	+6.6
1994	66.6	+8.8	66.7	+8.3
1995	72.4	+8.7	73.0	+9.4
1996	77.7	+7.3	78.1	+7.0
1997	84.4	+8.6	83.6	+7.0
1998	90.2	+6.9	86.6	+3.6
1999	94.9	+5.2	91.6	+5.8
2000	100	+5.4	100	+9.2
2001	105.7	+5.7	108.4	+8.4
2002	115.4	+9.2	123.8	+14.2

Source: Statistics South Africa (2003a; 2003b).

## Appendix VII

Table A7: Total assets, employees, raw materials and GWh produced and sold

Years	Total assets		Employees		Raw materials (Coal burnt)		Production		Sales	
	Rm	Change (%)	Total number	Change (%)	Tonnes (Million)	Change (%)	GWh	Change (%)	GWh	Change (%)
1980	8,973		47,490	8.7	46.755	8.1	83,362	10.2	87,539	8.6
1981	11,021	22.8	52,080	9.7	53.9037	15.3	97,824	17.3	93,844	7.2
1982	14,698	33.4	58,850	13.0	55.1984	2.4	102,769	5.1	96,136	2.4
1983	18,975	29.1	62,420	6.1	55.0102	-0.3	103,295	0.5	98,251	2.2
1984	24,414	28.7	64,560	3.4	58.7036	6.7	116,581	12.9	106,904	8.8
1985	31,252	28.0	66,000	2.2	59.4886	1.3	121,987	4.6	112,306	5.1
1986	27,607	-11.7	60,800	-7.9	58.9159	-1.0	126,511	3.7	117,353	4.5
1987	30,643	11.0	56,830	-6.5	65.787	11.7	132,507	4.7	122,524	4.4
1988	34,940	14.0	56,726	-0.2	64.4896	-2.0	138,837	4.8	129,493	5.7
1989	36,092	3.3	51,554	-9.1	67.5293	4.7	143,204	3.1	134,347	3.7
1990	38,801	7.5	50,000	-3.0	70.8612	4.9	146,047	2.0	136,168	1.4
1991	40,245	3.7	46,637	-6.7	70.5232	-0.5	148,671	1.8	138,687	1.8
1992	42,455	5.5	42,223	-9.5	71.0379	0.7	148,207	-0.3	138,126	-0.4
1993	44,397	4.6	40,128	-5.0	75.9264	6.9	154,260	4.1	143,800	4.1
1994	47,364	6.7	39,760	-0.9	76.883	1.3	160,293	3.9	149,443	3.9
1995	50,625	6.9	39,952	0.5	76.3769	-0.7	164,834	2.8	153,547	2.7
1996	53,770	6.2	39,857	-0.2	85.401	11.8	178,855	8.5	165,370	7.7
1997	56,912	5.8	39,241	-1.5	90.169	5.6	187,811	5.0	172,550	4.3
1998	69,975	23.0	37,311	-4.9	87.225	-3.3	183,093	-2.5	171,457	-0.6
1999	75,493	7.9	35,573	-4.7	88.47	1.4	181,818	-0.7	173,412	1.1
2000	74,028	-1.9	35,707	0.4	92.289	4.3	189,307	4.1	178,193	2.8
2001	76,909	3.9	33,032	-7.5	94.136	2.0	189,590	0.1	181,511	1.8

Source: Compiled from Eskom Annual Reports and Statistical Yearbooks (various years).

## Appendix VIII

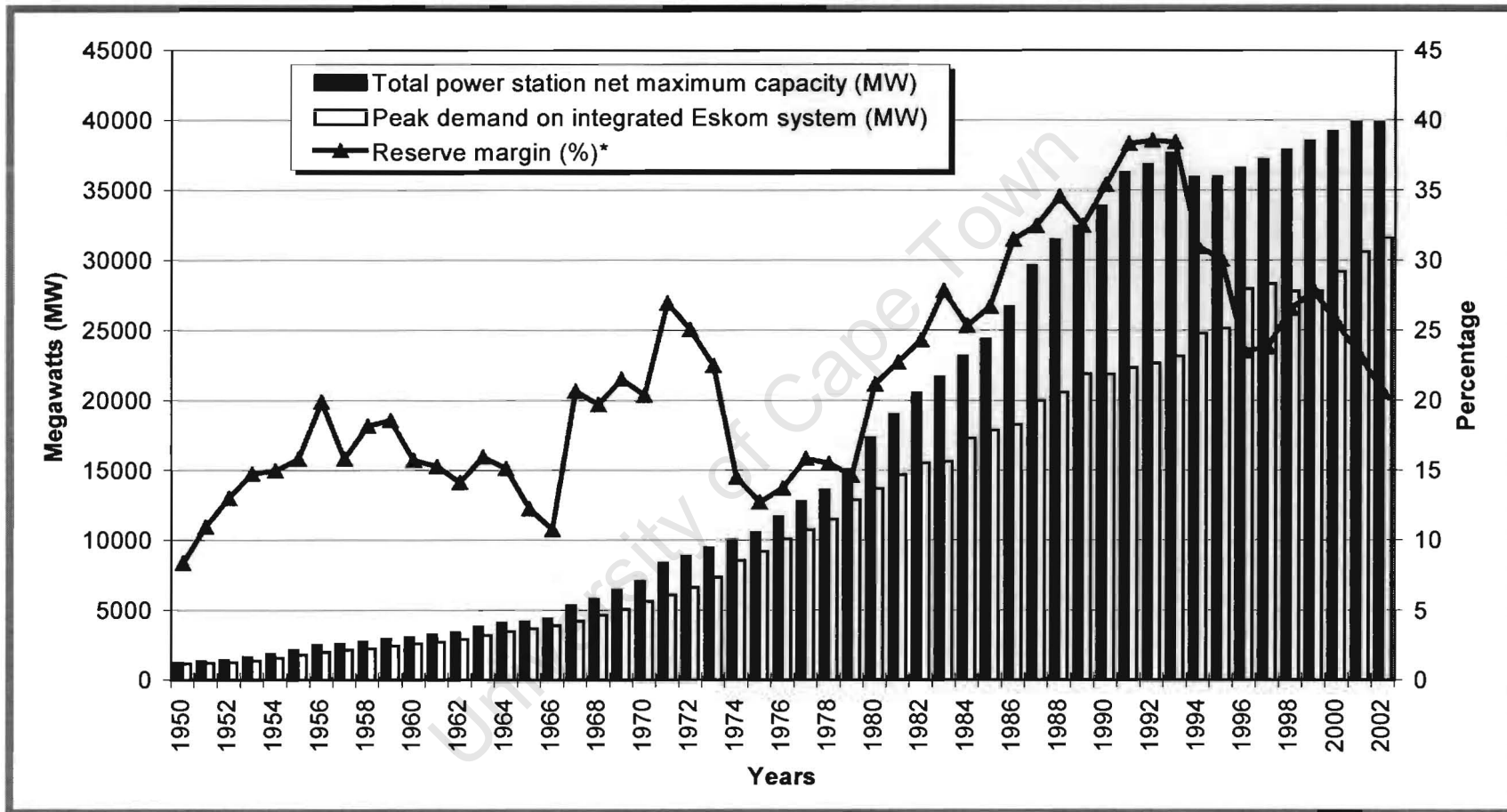
Table A8: Change in revenues and net incomes

Years	Revenues				Net Income			
	Rm (Nominal)	Change (%)	Rm (in 2000 Rands)	Change (%)	Rm (Nominal)	Change (%)	Rm (in 2000 Rands)	Change (%)
1980	1,772	15.9	13,323.3	-0.7	414		3,112.8	
1981	2,141	20.8	14,178.8	6.4	507	22.5	3,357.6	7.9
1982	2,695	25.9	15,668.6	10.5	671	32.3	3,901.2	16.2
1983	3,302	22.5	17,378.9	10.9	744	10.9	3,915.8	0.4
1984	3,832	16.1	18,601.9	7.0	732	-1.6	3,553.4	-9.3
1985	4,625	20.7	19,190.9	3.2	738	0.8	3,062.2	-13.8
1986	5,845	26.4	20,295.1	5.8	781	5.8	2,711.8	-11.4
1987	7,046	20.5	21,481.7	5.8	702	-10.1	2,140.2	-21.1
1988	8,159	15.8	21,991.9	2.4	816	16.2	2,199.5	2.8
1989	9,271	13.6	21,661.2	-1.5	728	-10.8	1,700.9	-22.7
1990	10,736	15.8	22,413.4	3.5	845	16.1	1,764.1	3.7
1991	11,726	9.2	21,958.8	-2.0	988	16.9	1,850.2	4.9
1992	12,649	7.9	21,884.1	-0.3	1,489	50.7	2,576.1	39.2
1993	13,793	9.0	22,391.2	2.3	1,646	10.5	2,672.1	3.7
1994	15,417	11.8	23,113.9	3.2	2,268	37.8	3,400.3	27.3
1995	17,114	11.0	23,443.8	1.4	2,716	19.8	3,720.5	9.4
1996	18,687	9.2	23,927.0	2.1	3,072	13.1	3,933.4	5.7
1997	20,448	9.4	24,459.3	2.2	3,083	0.4	3,687.8	-6.2
1998	21,074	3.1	24,334.9	-0.5	2,750	-10.8	3,175.5	-13.9
1999	22,245	5.6	24,284.9	-0.2	2,179	-20.8	2,378.8	-25.1
2000	24,459	10.0	24,459.0	0.7	1,868	-14.3	1,868.0	-21.5
2001	26,112	6.8	24,088.6	-1.5	2,561	37.1	2,362.5	26.5

Source: Compiled from Eskom Annual Reports (1980 – 2001) and Statistical Yearbooks (1985 – 1996).

## Appendix IX

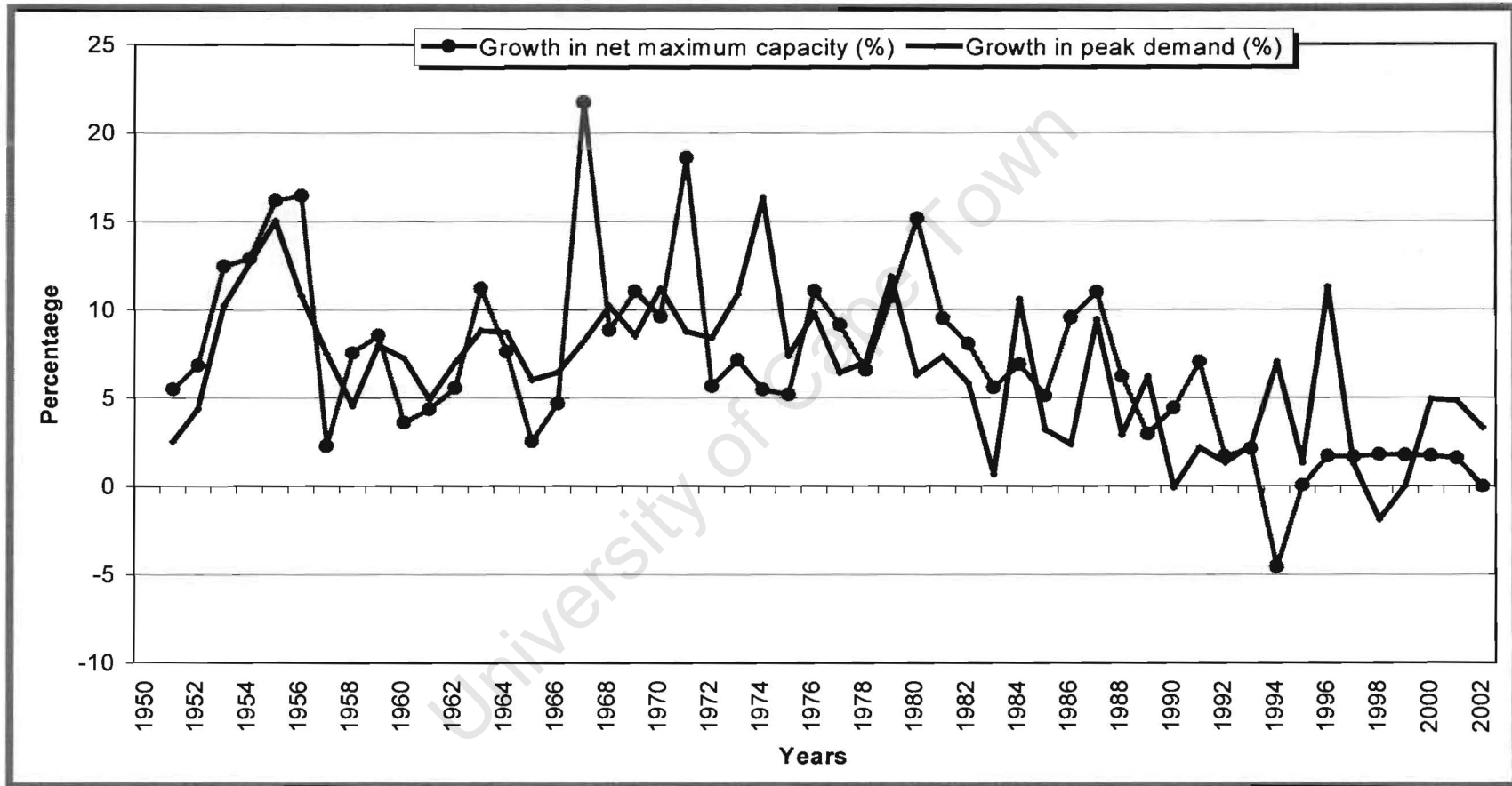
Figure A1: Eskom's net maximum capacity, peak demand and reserve margin



Source: Compiled from Eskom Annual Reports and Statistical yearbooks (various years).

## Appendix X

Figure A2: Growth in net maximum capacity and peak demand from 1950 to 2002

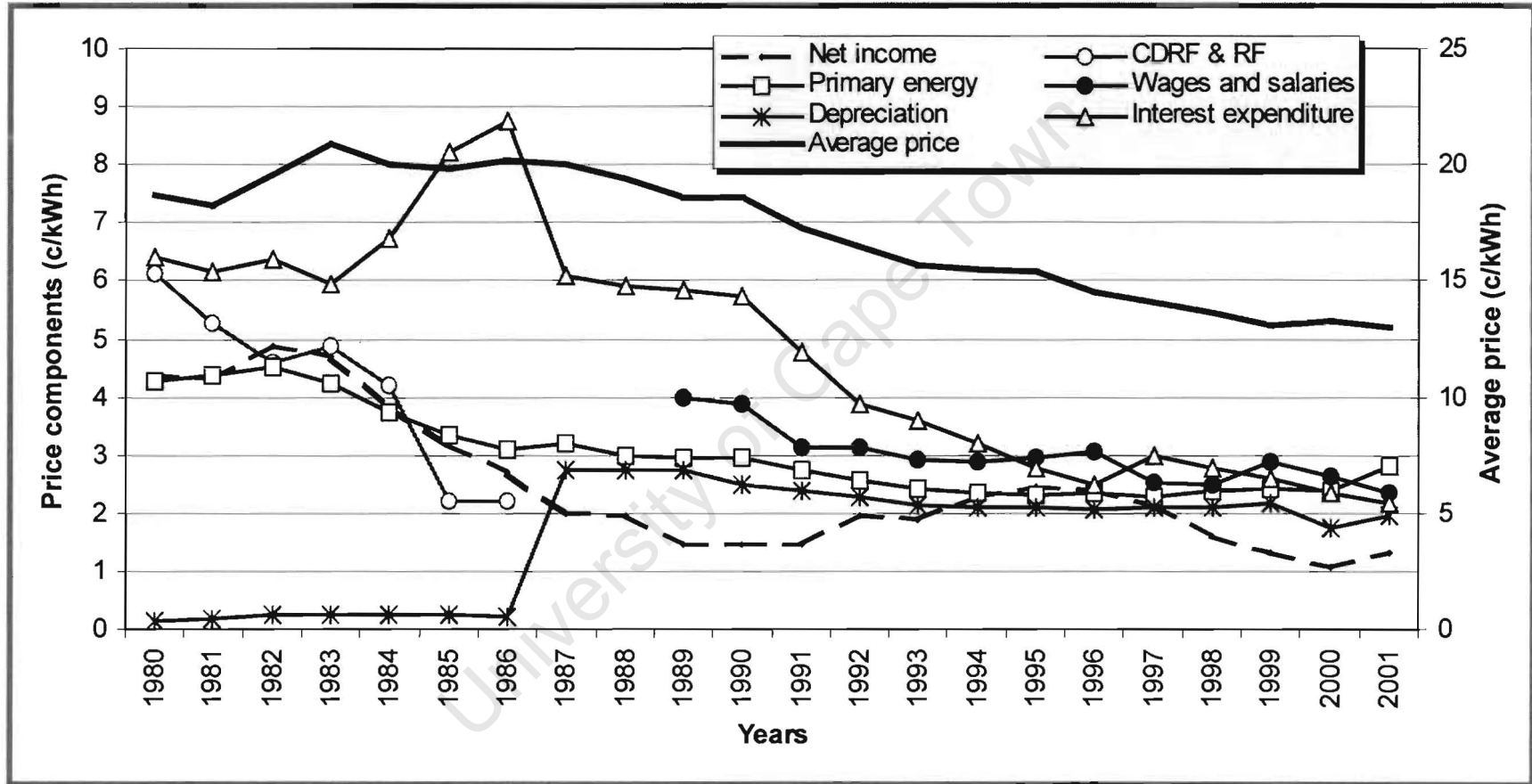


Source: Compiled from Eskom Annual Reports and Statistical Yearbooks (various years).

## Appendix XI

**Figure A3: Trends of Eskom's price components (in 2000 values – CPI)**

Source: Compiled from Eskom Annual Reports (1980 – 2001) and Statistical Yearbooks (1985 – 1996).



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