Investment and Uncertainty: Historical experience with power sector investment in South Africa and its implications for current challenges

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1 Introduction

After a twenty-year period of owning surplus generation capacity, South Africa now faces important policy decisions about the development of its power sector. Eskom is planning to spend around R15 billion per year over the next five years alone on power generation capacity expansion, while smaller amounts will be spent by independent power producers (IPPs).[1] This investment may have a large impact on electricity prices, on Eskom's finances, and on the South African economy.

A review of recent history reveals that the previous investment expansion program (starting in the 1970s) was seriously flawed. The economy incurred huge opportunity costs in the form of unproductive surplus power station capacity. As it embarks on the next expansion plan, South Africa runs the risk of repeating the expensive mistakes in technology choice and investment configuration of the past. Thus, reflecting on the past is in order before South Africa proceeds further with its current plans.

1.1 Objectives

There are numerous issues of importance related to the growth in South Africa's electricity demand. However, the focus of this paper is limited to reviewing the history of Eskom's investment and technology choices in order to cast light on the reasons for its past investment problems and identify options for improving future investment decision making. The paper draws heavily from a larger work that compared experience with public electricity utility investment practices in the United Kingdom with those in South Africa[2].

1.2 Research questions, methodology and design

Anecdotal evidence suggests that senior utility managers and engineers play a key role in shaping the nature of power sector expansion, especially in the public sector. This study seeks to test this general hypothesis. It posits that there are specific problems with managerial incentives and information asymmetries that affect their technology and investment appraisals. These problems are tied to the inherent uncertainty about project outcomes and power demand. Using the case of Eskom, this study investigates the managerial investment incentives created by the institutional framework of the utility in the context of future uncertainty and how this shaped the system expansion.

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[1] The Electricity Supply Commission (ESCOM) established in 1920 was renamed Escom in 1985 and Eskom in 1987, following the Eskom Act (South Africa, 1987). All events referenced in this paper prior to 1987 specify "ESCOM", and all events after 1987 cite "Eskom".

[2] See Steyn (2002).

1.3 Paper structure

The paper consists of four parts. The introduction is followed by Section 2 which outlines a series of concepts from the literature that are relevant to managerial incentives and power plant investment decisions. Section 3 makes up the main part of the paper and features a review of Eskom's institutional and investment history. In the fourth and final section, the historical experience of power sector investment in South Africa is discussed in light of the theoretical concepts introduced (in Section 2), which leads to several key conclusions.

2 Perspectives on investment, finance and uncertainty

Investment in the power sector introduces a major challenge. The incentive structure for managers in turn shapes the response to this challenge. In this section key characteristics of the investment challenge are reviewed, followed by a discussion of institutional and governance factors that affect managerial responses in the context of monopoly public utilities.

2.1 Investment uncertainty and irreversibility

The investment challenge lies in choosing a project for which the returns (benefits) generated are greater than the project's costs over time, including the initial opportunity cost of allocating resources to the project. Two interrelated issues are at the core of this challenge: uncertainty and irreversibility.

Investing in a project with capital assets has uncertain outcomes for two primary reasons. Firstly, a project can lose value because an asset might cost more to create than originally anticipated. Secondly, once its assets have been created, a project can also lose value because the project's further costs (primarily operating and maintenance) may be higher or its benefits less than anticipated (for example, lower revenue if demand and sales are lower than expected).[3] In the latter case, a project could lose economic value if it is not utilised in the context and role for which it was created. If circumstances change some assets could potentially be freely redeployed to another role where they at least have the same economic value as before. However assets that are specific to a company or an industry are not easily redeployable. The expense of creating such assets may be a sunk cost and the investment can thus be considered to be irreversible.

Irreversible projects are thus more risky because assets cannot be readily redeployed if adverse circumstances arise. The value of an irreversible investment is dependent on the

[3] Outcomes could also be favourable, but this should not pose a problem. Investors are generally concerned about the "downside risk".

future (*ex post*) value of its construction and operating costs and output (either in its planned role or in its limited alternative applications). This inter-temporal dimension of the investment problem confronts decision-makers with the problem that future outcomes (costs or benefits) are not certain, begging the question of how the absence of certainty should be incorporated into project appraisal and investment decision making.

2.1.1 The absence of certainty

Conventional engineering system planning models make use of projected cash flow models, which discount costs to present values, at a single discount rate. The discount rate itself is usually calculated as the weighted average cost of capital, where the cost of equity is determined by using the capital asset pricing model.

Work in the field of financial economics over the last twenty years has shown that this approach to power sector planning is inadequate for determining appropriate strategies for real world circumstances, specifically in addressing uncertainty and ignorance about future outcomes. A review of the critiques is beyond the scope of this paper, but some main points are worth highlighting here.[4]

2.1.1.1 Uncertainty and ignorance rather than "risk"

Firstly, conventional finance project appraisal models generally deal with uncertainty as risk. It is assumed that the probability of all future contingencies can be mathematically described. However even early authors such as Knight (1921), and Luce and Raiffa (1957) realised that in reality such situations rarely exist, and that the term "uncertainty" could be used to describe a situation where probabilities cannot be objectively assigned or where all future contingencies may not be known[5].

Collingridge (1982) argues that under conditions of "ignorance" actors do not have full knowledge of all future contingencies, and it is not possible to assign a probability distribution of any kind (Collingridge, 1983 and Loasby, 1976). Stirling (1998) distinguishes between "risk", "uncertainty", "fuzzyness" and "ignorance". An important and mostly overlooked problem resulting from "ignorance" in the context of power system planning, is that "we do not know what it is that we do not know".

For the purpose of this paper, the term "uncertainty" will be used to refer in general terms to "the absence of certainty" and will thus include all four categories identified by Stirling.

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[4] See Awerbuch (2000) for one such review.

[5] Some do not accept this distinction (Hirshleifer and Riley, 1992; Morgan and Henrion, 1990) and following with most conventional approaches, tend to use these terms interchangeably (for example: Brealey and Myers, 1996; Pierce and Nash, 1981; Lumby, 1994; McKenna, 1986; and Arrow and Lind, 1970).

2.1.1.2 Incorrect use of discount rates

The use of a single discount rate for a wide range of cost streams is limited and leads to incorrect conclusions. Different cost streams vary in their exposure to systematic risk, and thus have to be discounted at appropriate rates. For instance, fixed operating and maintenance costs, or property taxes are essentially debt equivalents and should be discounted at different rates than riskier costs streams such as fossil fuels (Awerbuch, 2003).

The common practice in South Africa of large public monopoly utilities using low discount rates based on the cost of their loan finance may also produce misleading results. The risks faced by lenders to monopoly public utilities are generally incomparable to the utility's risks in constructing and deploying production assets. Regulatory and legal frameworks often ensure that these utilities recover the revenues required to service their debt, irrespective of the economic performance of their projects. The cost of capital to these utilities thus bears little relation to the opportunity cost of capital to the economy of employing resources in the utility's investment projects. The real economic cost of capital for these projects will only be determined by analysing the riskiness of the real economic cost and benefit flows associated with new projects (Steyn, 2001).

2.1.1.3 Overlooking the benefits of portfolio effects and diversity

Conventional engineering economic appraisals ignore the beneficial portfolio effects that arise from plant diversity in the context of real-world uncertainty. When evaluated on a stand-alone basis, some individual projects might appear to cost more than other conventional alternatives. But if projects significantly reduce the exposure of the total portfolio of plant to volatility in costs and benefits, they could in reality have greater value than alternatives with lower stand-alone costs (Awerbuch and Berger, 2003; Stirling, 1998).

2.1.1.4 Overlooking the value of flexibility and options

Conventional NPV approaches generally assume implicitly that the most important decisions are taken at the outset of projects. This underrates the value of management and the fact that managers have the ability to respond to future contingencies. This approach does not encourage the explicit comparative evaluation of the *flexibility* characteristics of alternative projects (Laughton et al, 2000).

Faced with the challenge of irreversibility and the possibility of delaying or phasing in investments, real option approaches stress the fact that firms hold an asset with value: the opportunity to invest. Holding an opportunity to invest is the equivalent of holding a financial call option (Dixit and Pindyck, 1995). From the work on financial options, techniques now exist to value such real options.[6] As with financial call options, the value of an option to invest is positively correlated with the level of uncertainty of the underlying project's returns (Brealey and Myers, 1996).

Exercising an option to invest (by making an irreversible investment) effectively destroys the option. The cost of the project should thus include the loss of the option's value.[7] The valuation of investments which effectively create or include further options should, similarly, include the value of such options as project benefits.

2.1.1.5 Implications for system planning

Taken together these insights should fundamentally change power system development. System planning and project appraisal techniques that are more attuned to the real uncertainties of system and project development may lead to greater diversity in the power system and to a larger role for plant that provide managers with more flexibility to deal with future, possibly unforeseen, contingencies (Steyn, 2001). They may also lead to more appropriate strategies for balancing the risks and costs of undersupply with those of over investing in supply capacity.

2.2 Institutions and governance

Having identified important aspects of the project appraisal and investment challenge as well as a normative framework for addressing the challenge, the discussion now returns to the questions posed in the Introduction about the incentive framework that shapes managerial approaches.

The discussion focuses on three related theories from the finance literature that are useful for forming a theory of managerial investment incentives in monopoly public power utilities.

2.2.1 Agency theory

Following on the earlier work of Berle and Means (1932) and Fama and Miller (1972) that emphasised the problems that arise from the separation of ownership and control in the modern corporation, Jensen and Meckling (1976) published the first complete agency cost statement. The theory is based on the recognition of the distinction between the separate roles of principals and agents, which exists in many institutional structures, in this case the

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[6] An exposition of the theory and application of real option techniques is beyond the scope of this chapter. For a review of the real option approach see Pindyck (1991), Pindyck (1993), Dixit and Pindyck (1994), Dixit and Pindyck (1995) Brealey and Myers (1996) and Laughton et al (2000).

[7] This account excludes the impact of interactive factors and strategic considerations such as the possibility that waiting could allow a competitor to proceed – the first mover advantage.

firm. Costs arise from the agency relationship[8] between the principals and agents in which agents have incentives to behave in a way that is contrary to the interests of principals. Agency costs consists of the expense to the principal of monitoring agent activities, the bonding costs to the agent (to demonstrate commitment to pursue the principal's objectives) and the residual loss (the cost of agent behaviour that is not in the interest of the principal despite monitoring and bonding costs).

2.2.2 Information asymmetries

The idea of information asymmetries is central to the economics of information. Stiglitz (2000) provides a recent review of the economics of information. He distinguishes between at least two main groups of information problems that arise in the economy: problems with revealing information about scarcity, and problems with revealing information about the existence of hidden characteristics (of products or resources) or hidden behaviours of economic actors (often referred to as information asymmetry). Following Hayek (1945), he argues that in the standard competitive equilibrium model issues related to revealing information about scarcity are resolved by the price mechanism, but:

> ... because of these other problems of information that arise in the economy, prices do not in fact solve the information problem of scarcity. The exchange process is intertwined with the process of selection over hidden characteristics and the process of providing incentives for hidden behaviour. (2000: 1447)

Thus, the existence of information problems related to hidden characteristics and hidden behaviours could impact on how effectively the pricing mechanism reveals information about scarcity.

2.2.3 Moral hazard

The ideas of the principal-agent separation and of information asymmetries provide the elements for developing the concept of "moral hazard". This term originates from an investigation of incentive problems in health care insurance (see for instance Arrow, 1963; Pauly, 1968 and Arrow 1968).[9] Moral hazard refers to an incentive problem that arises when there is a separation between a "principal" and "agent" through a contract or legal obligation, and where the agent has to take appropriate action on behalf of the principal in the context

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[8] Jensen and Meckling define an agency relationship as "a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent" (1976: 308).

[9] Arrow formally delineated the problem of moral hazard in his Helsinki Yrjö Jahnsson lectures (Arrow, 1974: chapters 2 and 3).

of uncertainty about outcomes. The incentive problem arises because: the agent could benefit by actions different than those required by the principal; it is possible to do so due to the fact that the principal cannot adequately observe the agent's behaviour (information asymmetry); and most of the costs associated with failure to achieve the desired outcomes will be borne by the principal.[10]

The four elements required for moral hazard to exist are thus: (1) the existence of a principal-agent "contract"; (2) benefits for the agent from not complying; (3) information asymmetry with respect to the agent's behaviour; and (4) the shifting of costs of adverse outcomes to the principals.

Although moral hazard was developed in the context of contractual arrangements such as health care insurance, Arnott and Stiglitz (1988) argue that:

> Moral hazard is pervasive in the economy. It occurs whenever risk is present, individuals are risk averse, and "effort" is costly to monitor. And it arises not only in insurance markets, but also when insurance is provided by governments, through *social institutions*, or in principal-agent contracts. (1988: 384, emphasis added)

In addition to its use to understand incentive problems in financial insurance, moral hazard is now also widely used to examine incentive problems in many other areas, including the broader financial services industry, and environmental and safety regulation.[11] Moral hazard is an important theoretical concept for the questions under examination in this paper because it focuses on behaviour incentives in the face of risk and uncertainty.

The theory helps to provide a more precise formulation of the general hypothesis outlined in section 1.2 above: Managers of public electric utilities are subject to moral hazard with respect to their system expansion planning and investment decision making. This means that the technology and investment choices that are likely to be in the best interest of society, are not the same choices that are most likely to be in the best interest of managers, and that managers are able, and tend to, choose investment projects that benefit them most.

The hypothesis will be evaluated after presenting the empirical data related to South Africa's generation investments.

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[10] Arnott and Stiglitz (1988) define moral hazard more narrowly in an insurance context: insurance against adverse events will generally affect the individual's incentives to take precautions thereby affecting the probability of the insured events.

[11] See for instance Hanley *et al* (1997).

3 Investment, finance and uncertainty: the case of Eskom

Case material related to South Africa's electricity supply industry (ESI) is presented in two parts. The first part covers the period from the establishment of the Electricity Supply Commission (ESCOM) in the 1920s until the early 1980s with the appointment of the De Villiers Commission of Enquiry into ESCOM. The second part covers the institutional reforms, and the investment and financial history of the first ten years after the publication of the De Villiers Commission report.

3.1 The Electricity Supply Commission

ESCOM[12] was characterized by a unique institutional and governance framework, which in turn affected investment behaviour, and financial and pricing issues.

3.1.1 Organisational framework, corporate governance and political control

Electricity supply in South Africa dates back to 1882 when the first electric streetlights were turned on in the diamond-mining town of Kimberley.[13] The extraction of South Africa's rich mineral resources would continue to be an important driving force behind the power sector's development for most of its existence.

After the establishment of the Union of South Africa in 1910 a diverse range of provincial acts and municipal bylaws governed the South African ESI in the absence of a national legislative framework. The industry consisted of mixed municipal and private undertakings that adopted different technical standards and operated their systems at different frequencies, making interconnection impossible. With the interruption of the First World War the possibility of government intervention was delayed until the early 1920s.

In 1920, the newly elected Prime Minister of South Africa, Gen. J C Smuts, tasked the Government Mining Engineer, Sir Robert Kotzé, and his Science and Technology Advisor, Dr Hendrik Johannes van der Bijl, with the drafting of new electricity legislation to establish a national power utility (Christie, 1984).

The electricity bill drafted by the committee departed from the precedent of mixed municipal and private sector development by proposing the creation of a national public utility, the Electricity Supply Commission (ESCOM), and a regulatory body, the Electricity Control Board (ECB).

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[12] See footnote 1 on page 1.

[13] This predated electric public lighting in London.

ESCOM was established on 6 March 1923. It was assigned wide-ranging powers and responsibilities, including the establishment of new or additional facilities for the "cheap and abundant" supply of electricity in any area; co-ordination and co-operation with existing electricity undertakings; and generally to ensure cheap and sufficient supply of electricity (South Africa, 1922a: section 3).

The ECB regulated electricity supply through its powers to licence the industry undertakings. Local authority undertakings, however, were not required to have an ECB license to supply. Their activities were largely unregulated but they required approval from the Provincial Administrator to establish or expand their electricity supply undertakings. The Provincial Administrator in turn had to ask ESCOM to indicate whether the local authority or itself should provide the necessary supply capacity.[14] This arrangement gave ESCOM an indirect role in the regulation of municipal electricity supply investment.

From its inception it was intended that ESCOM should, as soon as practicable, be financially independent from the state and function operationally as a semiautonomous statutory corporation. This concept created controversy when the Electricity Bill was laid before Parliament in 1920 because of concern about ESCOM's public accountability (Price, 1922).

In the end ESCOM was established as a "public business enterprise" and, more controversially, was not subjected to direct parliamentary accountability, but rather reported to its line minister (South Africa, 1922b).

3.1.1.1 Early strategic positioning

From the outset, the nature of ESCOM's institutional framework enabled it to have a large impact on the further development of the power sector. Within the first year of its existence it took a number of key decisions that established it as a central player in the sector.

ESCOM negotiated an agreement with the South African Railways which stipulated that the utility would take over, upon completion, the Colenso power station, which the Railways were constructing to electrify its railway line between the Transvaal and Natal (ESCOM, 1973). This would in turn assert ESCOM's role as supplier to the Railways.

When the Durban local government wanted to construct a further power station, the ECB arranged for a meeting between ESCOM, Durban and the Railways, where it was agreed that

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[14] The special position afforded to local authorities in this new regulatory dispensation reflected their central role in the development of the ESI and their political power to protect their interests (See the evidence from various municipal representatives before the Select Committee on the Electricity Bill, Union of South Africa 1922).

ESCOM would construct the Congella power station (ESCOM, 1973).[15] A similar agreement was reached for the construction of the Salt River power station in Cape Town in 1924. These arrangements also established ESCOM's role as a potential power supplier to municipalities from the outset.

The real opportunity to consolidate its position as a central player arose when the Victoria Falls and Transvaal Power Company (VFTPC) decided in May 1923 to apply to the ECB to amend its supply licence to allow it to construct a 60MW plant at Witbank.[16] ESCOM opposed the application, as it was authorised to do in terms of the Electricity Act of 1922 (Merz, 1932; Christie, 1984). An agreement was reached whereby the VFTPC would build and operate the station, while ESCOM would finance and own it (ESCOM, 1973). Later similar arrangements were made with the VFTPC for the construction of Klip and Vaal power stations.

These arrangements had great strategic value for ESCOM. The utility did not have sufficient personnel and skills to build and operate all its power stations and was thus faced with formidable obstacles in its quest to become a major force in power generation and supply. With these arrangements ESCOM gained the resources it needed most. The VFTPC also gained from these agreements as it could buy the power at cost price from ESCOM and sell it at a profit to the gold mines on the Reef (Christie, 1984).

Within the first two years of its existence ESCOM thus established itself as a central player in the ownership of new large-scale power stations.

3.1.1.2 The expropriation of the VFTPC

By the late 1940s the VFTPC was a large power undertaking with stations totalling 297.6 MW, with a further 117.6 MW of compressed air plant and large electricity and compressed air transmission and distribution networks (ESCOM, 1973). The VFTPC was also operating ESCOM owned stations totalling more than twice its own generation capacity. At this time, which coincided with the near-end of VFTPC's concessions, pressure was mounting for expropriation of assets, largely because of ESCOM's ability to supply power on a "non-profit" basis (Christie, 1984). An agreement was reached whereby on 1 July 1948 ESCOM purchased the VFTPC for a sum of £14 500 000, at the time the largest transaction in South Africa's history (ESCOM, 1973).

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[15] It should noted that this was before South Africa had an integrated national power grid. Regional supply undertakings were isolated from one another.

[16] At the time the VFTPC, a private company listed in London, was the largest power and compressed air supplier in South Africa. Its clients were primarily mines and related industries in the Witwatersrand (Christie, 1984).

3.1.2 Investment

The nature and complexity of power sector technology and of the investment decision challenge changed significantly between the post war years and the late 1970s. This section reviews these changes and ESCOM's response.

3.1.2.1 The post war years

In the years following the Second World War ESCOM experienced a shortage of skilled human resources and could not source sufficient generation and distribution equipment. It consequently was unable to meet the full demand growth resulting from the increase in gold mining and industrial activity, ultimately forcing ESCOM to ration electricity (ESCOM, 1973). The gold mines in turn had to take special measures to limit their power demand to avoid unannounced load shedding, which would have caused damage and safety problems (ESCOM, 1973).

Former Chief Executive, Ian McRae (1997) explained that the historic role that the mining industry played in the establishment of the electricity supply industry fundamentally influenced the management culture of ESCOM and the way managers thought about their business up to the early 1980s. It was understood that the mining industry was the prime driver behind the establishment of the ESI and it was therefore inconceivable that its development should ever be stunted by shortages or poor quality of supply. The importance of, especially, the gold mining industry was underscored by the many high level meetings that where held with stakeholders in the 1950s and 1960s to discuss their needs (*ibid*).

During the 1960s ESCOM continued with the initial steps to interconnect its undertakings and increase unit sizes. The process of constructing the national grid interconnecting ESCOM's regional undertakings was completed in the early 1970s.

ESCOM's plans for the construction of the national grid had an important impact on its power station technology choice and investment decisions. Unit sizes of power stations could be dramatically increased to exploit economies of scale. Stations could be located adjacent to coal mines where, instead of railing coal over long distances, coal could be transported directly from the mine by a continuous conveyor operation. Mines could be partially, or totally, dedicated to supplying the station.

The pattern of power stations ordered from the middle 1960s onwards reflects these new possibilities. In 1964 plans were finalised for the construction of Hendrina, in the Eastern Transvaal (renamed Mpumalanga after 1994), with ten 200MW sets. In 1965 plans for the construction of Arnot power station specifying six 350MW sets , the fourth station in the Eastern Transvaal Highveld, were finalised. In this year ESCOM also announced the construction of its first "dry cooled" station, Grootvlei, close to Balfour in the South Eastern

Transvaal. Grootvlei would consist of six 200MW units and use cooling water from the Vaal dam.[17] The first two 80MW sets for the Hendrik Verwoerd hydroelectric scheme were ordered in 1968. Despite the unprecedented economic growth in the 1960s these four stations orders still ensured that capacity increased significantly above demand and contributed to the drastic increase in the reserve margin between 1967 and 1971.

In 1969, after three years of negotiations, the South African and Portuguese governments agreed that ESCOM would purchase base load electricity from the planned Cahora Bassa hydroelectric scheme on the Zambezi River. South Africa's purchase of 680MW from 1975, increasing to 1500MW by 1980, was required to ensure the economic viability of the scheme.[18]

To meet further growth anticipated in the 1970s ESCOM announced the construction of Kriel power station, between Ogies and Bethal in the Eastern Transvaal in 1969. With Kriel ESCOM again increased unit size dramatically by ordering six 500MW sets.

In 1967 ESCOM purchased the farm Duinefontein 30 km north of Cape Town where it planned to construct a nuclear power station by 1978. By the early seventies it became apparent that nuclear generation costs were not decreasing as was expected and the completion date for Koeberg was postponed until after 1981 (Baasch and Colley, 1970; ESCOM, 1973).

3.1.2.2 Increased demand and investment in the 1970s

After completing the interconnection of the country's main electricity systems in 1973, ESCOM initially estimated that growth in demand would require it to construct a further 3900MW of generation capacity over the following ten years, and that 2300MW of this would have to be base load capacity (ESCOM, 1973). This would entail an increase of 38 percent on the installed base. By the middle 1970s, ESCOM was experiencing unprecedented growth in maximum demand, and the utility soon determined that it would have to accelerate its construction programme even further to keep up with growing demand.

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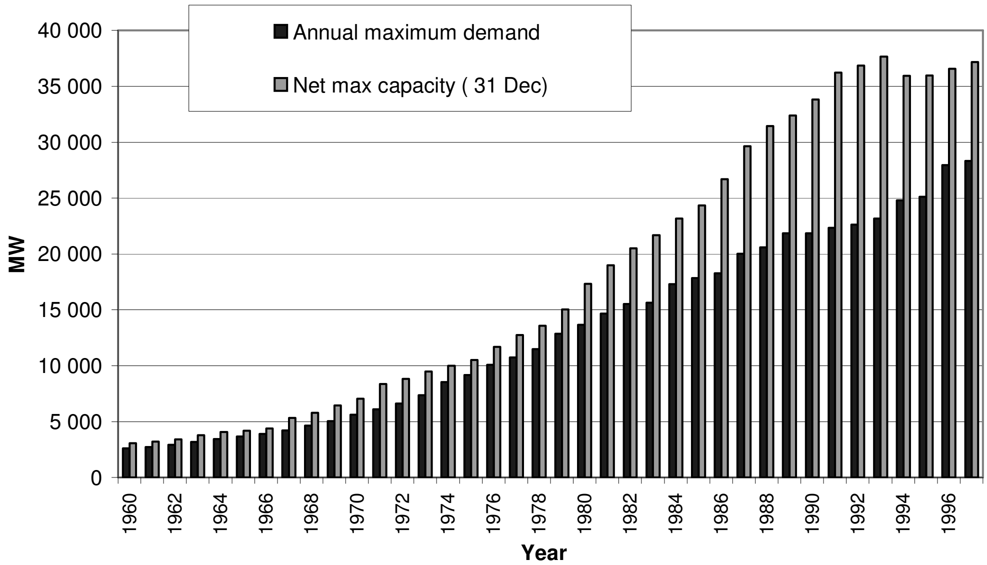
[17] While dry cooling technology still consumes water, it uses less than normal evaporation cooling. Dry cooling consumes approximately 0.8 litre/kWh while conventional wet cooling requires approximately 2.5 litres/kWh due to the higher evaporation rate, which amounts to approximately 80% of the water requirements of a conventional wet cooled station (ESCOM, 1985).

[18] ESCOM engineers were not in favour of taking power from Cahora Bassa because of their perceptions of its high availability risk (Harper, 1999).

Figure 1 shows ESCOM/Eskom's annual maximum demand and net maximum capacity.[19] Figure 2 below shows the absolute increases in maximum demand and net maximum capacity.



Source: Compiled from Eskom Statistical Yearbooks (various years)

Figure 1: Eskom maximum demand and net maximum capacity

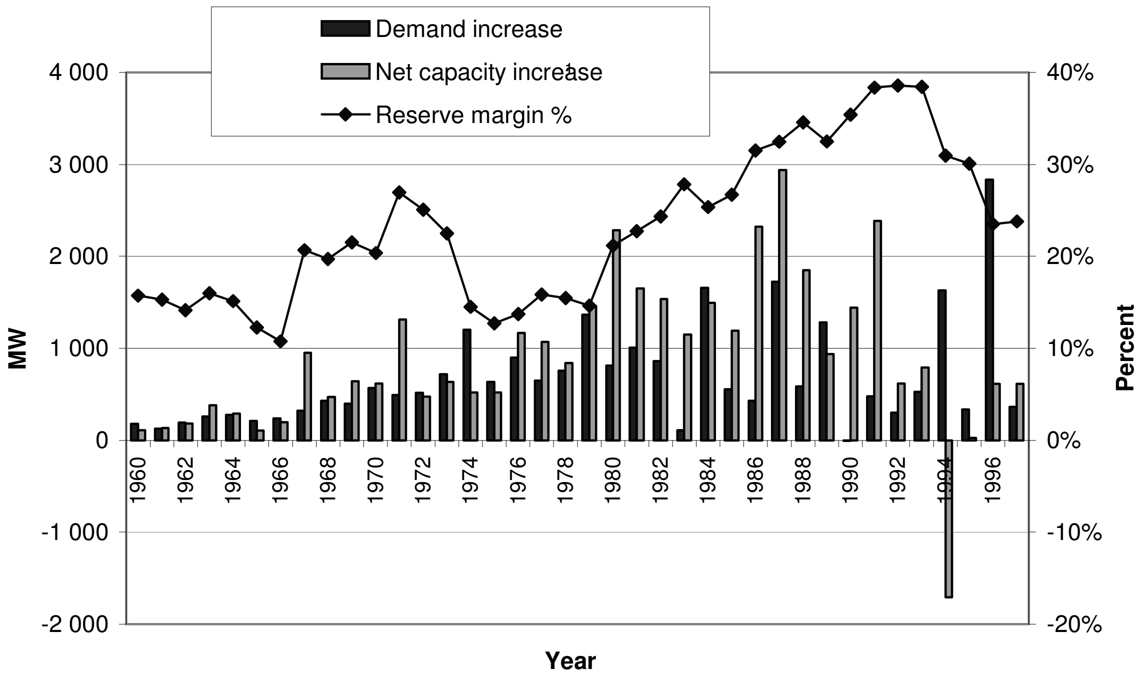
In 1974, a year after the oil crisis, maximum demand increased by a record 1,202 MW or 16.35 percent – the highest levels in the forty-year period from the 1960s to the present time. Initially oil, coal, and uranium prices soared, while electricity prices remained relatively stable.[20] Electricity consumption and system maximum demand increased rapidly as the economy increasingly turned to electricity as a cheap and convenient source of energy (Financial Mail 1977a). Most of this energy switching was attributed to oil based generators, mostly municipalities running diesel generators, switching to ESCOM power (Rubberts, 1997).

For four consecutive years between 1971 and 1975, the rate of demand growth outstripped the rate at which ESCOM could add capacity. The engineers who joined ESCOM as young recruits during the 1950s gold mining supply crises, had by now moved through the ranks to become the key players in determining ESCOM's expansion plans. With this unprecedented increase in demand the primary concern was that ESCOM should not be "responsible for

[19] Net maximum capacity refers to the generation capacity power stations have available after allowing for their own demand.

[20] In real terms prices actually declined from 1972 – 1974, and remained practically constant in 1975.

holding back economic growth" (McRae, 1997) as was alleged during the crises in the 1950s. It was considered far more acceptable to end up having over capacity than not being able to meet demand. The situation looked precarious. ESCOM engineers considered a 17 percent capacity reserve margin as sufficient. Reserve margins had already reached exceptionally low levels in 1974 and dropped to only 11 percent in 1975[21] and improved only marginally to 13.5 percent in 1976 (Financial Mail 1977a). From the engineers' point of view, there was not much to debate about the appropriate course of action. They announced and ordered even more power stations.



[1] Calculated from the difference between net max capacity (31 Dec) and annual maximum demand.
Source: Compiled from Eskom Statistical Yearbooks (various years)

Figure 2: Increases in Eskom maximum demand and net maximum capacity

The construction of Matla, with six 600MW units, started in October 1974, five years after the previous large coal station, Kriel, was ordered. Work on South Africa's largest pump storage scheme, Drakensberg, with four 250MW units started in January 1975, and the construction of Duva, with a further six 600MW units started in November 1975. The decision to proceed with Duva was taken shortly after the Portuguese lost political power in

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[21] These figures reflect the reserve margin on the date when maximum demand occurred while the reserve margin values in Figure 1 are an approximation based on the year end net installed capacity reported in the ESCOM annual reports.

Mozambique and the future reliability of the planned supply from Cahora Bassa became increasingly uncertain (McRae, 1997).

The construction of the Koeberg nuclear plant was also finally started in August 1976, barely two months after the Soweto uprising. ESCOM's senior engineering managers agree that Koeberg was "never an economic option", but was imposed by the Government for military and political strategic reasons (Ham, 1997; Rubberts, 1997). The engineering team was required to produce reports showing an economic justification for the station on the basis of the cost of coal transport costs to the Cape, transmission costs and loss of load probability (Rubberts, 1997).

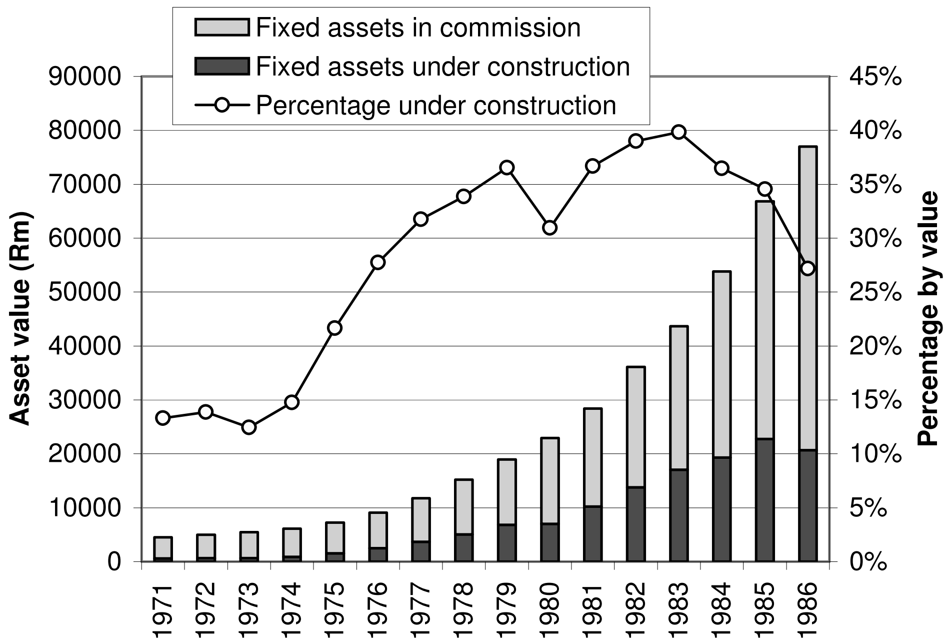
A further large coal fired station "C", to be named "Illanga", was to be ordered after Duva, but was delayed by the intervention of Chris Heunis, Minister of Economic affairs (Harper, 1999). With the second oil crisis in 1979 demand growth increased to twelve percent, leading to a further alarming reduction in the reserve margin. It was considered that there was no time to draw up new designs or go through long tendering processes for ordering new stations. Lethabo (3 708 MW) was ordered as a copy of Matla, and Tutuka (3 654MW) as a copy of Duva. The supply arrangements were negotiated with the same turbine and boiler contractors as were used with the original stations (Ham, 1997; McRae, 1997; Harper, 1999). The cost of this haste became apparent when lower prices were subsequently achieved for Matimba through a competitive tendering process (Rubberts, 1997).

ESCOM, now for the first time, included the right to defer the construction of the last three of the six turbine-boiler sets in the contracts for the stations, perhaps because of concern about the sheer magnitude of the programme to which it was committed.

3.1.2.3 Problems with up-scaling and capital costs

While scaling up unit sizes would in theory deliver greater economies of scale and reduce costs and prices, these benefits became increasingly difficult to capture in practice. Larger power stations meant longer construction lead times. By the middle 1970s it was taking fourteen years between the decision to construct a large six-unit coal fired station and the commissioning of the last unit. Most of the capital expenditure occurred between year seven and eleven during this process (de Villiers et al, 1985).

During a phase when a utility is increasing its capacity, long lead times mean that large amounts of capital are tied up in works under construction and are therefore not earning the revenue streams necessary to service the utility's debt. Figure 3 shows how fixed assets under construction had grown as a proportion of ESCOM's total assets.



Figures are expressed in January 1998 Rands using PPI
Source: Compiled from ESCOM annual reports (various years).

Figure 3: ESCOM fixed assets under construction

The increase in the proportion of works under construction is reflective of the increase in the relative magnitude of the construction programme as well as the increase in lead times associated with stations consisting of larger units. By 1983, 40 percent of the firm's assets by value, a large proportion of which was funded by interest bearing debt, was not in commission and thus not productively employed.

3.1.2.4 Capacity crises and further investment in the early 1980s

Despite the large-scale construction programme ESCOM operating engineers encountered unexpected difficulties in the early 1980s. They were confronted with the deterioration and ultimately the loss of the 1373 MW of contracted firm capacity from Cahora Bassa as the transmission lines flashed over and were sabotaged by Renamo fighters in Mozambique (Rubberts, 1997). Although it was vaguely anticipated at least five years before[22], the eventuality was not properly planned for and when the lines where sabotaged from 1980 onwards, it “played havoc with the ESCOM system” (McRae, 1997).

In addition, commissioning problems were experienced with the new 600MW sets at Matla and Duva (ESCOM, 1981). Their problems were further compounded by the unexpected

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[22] See the discussion on the decision to build Duva, above.

deterioration of station availability from an average of 85 percent in 1975 down to 74.7 in 1980, and ultimately to 71.9 percent in 1983[23], as a result of poor initial performance from the new large-scale generating sets (ESCOM 1981; ESCOM 1982). The primary problems arose at the three largest stations Arnot, Kriel and Matla. The problems at Arnot were caused by high abrasiveness of its coal supply. Kriel, the first station utilising the new larger 500MW units, was "a nightmare" (McRae, 1997). Design problems caused the boilers to "slag up". It also suffered from "massive" tube leaks that continuously needed repair. Matla suffered from slagging problems as well, ultimately requiring its boilers to be redesigned (*ibid*). Despite the huge commitment to higher specification boilers and additional plant, at this stage hardly any scientific research had been conducted related to the combustion characteristics of South Africa's coal in power sector applications (Hofmänner, 2002). This meant that little was understood of the potential impact that South African coal would have on higher specification, European designed boilers.

Table 1 below shows how availability deteriorated in the stations, especially the newer ones, with larger unit sizes, and higher operating temperatures and pressures.

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Table 1: Availability (%) of selected ESCOM power stations

	Taaibos 8x60 MW	Ingagane 5x100 MW	Grootvlei 6x200 MW	Arnot 6x350 MW	Kriel 6x500 MW	Matla 6x600 MW	Duva 6x600 MW	All ESCOM Stations
1973	83.6	89.7	83.4	65.0				82.5
1974	86.2	93.0	81.7	73.3				83.7
1975	91.2	94.7	83.6	80.8				85.0
1976	84.1	87.2	76.4	80.2	68.0			82.3
1977	86.1	81.3	77.2	66.9	70.6			78.5
1978	85.3	74.9	76.6	66.0	71.4			77.4
1979	90.3	87.7	79.9	68.1	81.6	45.9		78.8
1980	87.9	75.8	62.2	66.5	72.0	59.5	78.2	74.7
1981	88.1	80.5	82.5	73.3	61.8	70.1	55.8	74.2
1982	88.6	76.4	71.4	82.1	57.7	71.2	79.0	74.3
1983	86.1	54.8	64.6	74.3	60.5	80.9	72.2	71.9
1979-83	88.2	75.0	72.1	72.9	66.7	65.5	71.3	74.8

Source: Villiers et al (1985)

ESCOM's policy of maintaining acceptable loss of load probability was based on planning for a 17 percent reserve margin and on achieving an average annual availability in excess of 80 percent (de Villiers *et al* 1985: 54-55). Although ESCOM's nominal reserve margin had improved to 21 percent by 1980, the lower availability of 74.7 percent meant that a reserve

[23] In contrast, Eskom maintained availability levels of over 90 percent during the 1990s when surplus capacity meant that the system was run at lower load factors.

margin of 28 percent was required to maintain the required loss of load probability (de Villiers *et al* 1985: 55, graph 2).[24] Effectively this meant that ESCOM's capacity to supply was significantly below its formal net installed capacity.

To make matters worse, ESCOM experienced four consecutive years of high demand growth from 1979 to 1982 (see Figure 1 above). During the winter peaks ESCOM struggled to maintain system frequency and had to resort, as in the 1950s, to pre-arranged and automatic load shedding of municipalities and the gold mines (Financial Mail, 1982a; McRae, 1997).[25] These problems forced ESCOM to use older, less efficient plant with higher coal costs in a mid-merit or even base load capacity, increasing its fuel bill for 1981 and 1982 (Financial Mail 1982b). Further strategies for coping with the crises included the postponement and rescheduling of planned maintenance (ESCOM, 1981) and postponing the de-commissioning of older generating sets (ESCOM, 1982).

This experience left an indelible impression on the senior engineers running ESCOM and strengthened their resolve to ensure that it should happen "never again" (Kok 1999, McRae 1997 and Rubberts 1997). In agreement with organisational objectives of ensuring an "abundant" and reliable supply of electricity, ESCOM's Chief Executive Officer, Jan Smith, believed that if one were to err it would be desirable to err on the side of surplus power (McRae, 1997). Again it was decided to accelerate plans for constructing generation plant. Ian McRae, recalls that "It would have been the biggest sin to have been responsible for holding back economic growth [by constraining electricity supply] so it was just go, go, go!" (1997).

By the end of the 1970s senior ESCOM officials in the finance department had been exposed to new ideas about demand side management and special tariffs to induce load shifting in response to demand growth. ESCOM's large mining load presented much potential for this posibility. Although load shifting was successfully used in the supply crises in the early 1980s, ESCOM's engineering dominated management refused to see it as a viable economic alternative to increasing supply side capacity (Harper, 1999).

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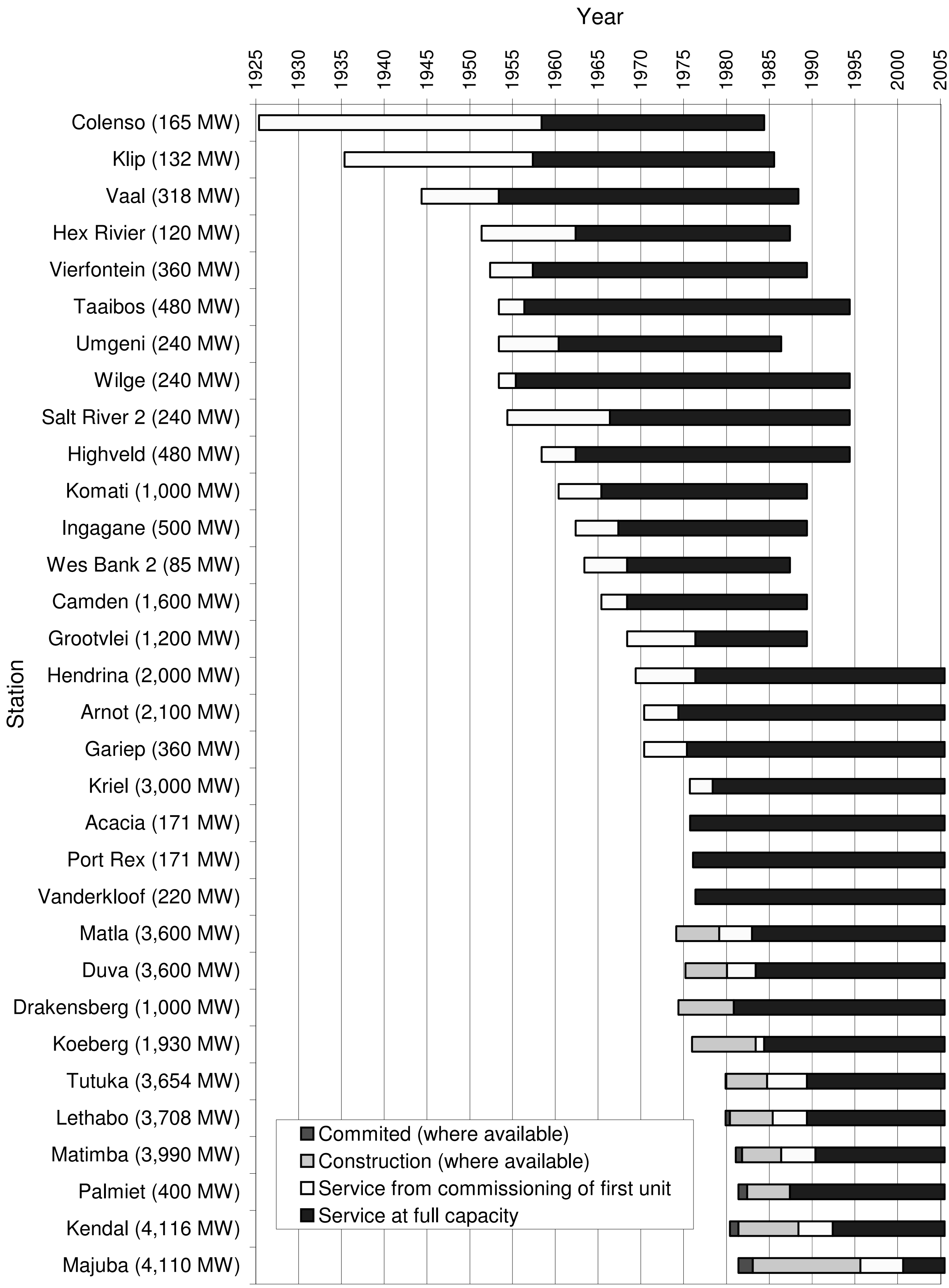
[24] In addition to increasing the loss of load probability in the short term, if low availability levels are not improved, higher reserve margins are required thereby increasing investment in plant which is effectively unproductive.

[25] Promoted to General Manager (Operations) in February 1980 McRae bore the primary responsibility for maintaining the system integrity (ESCOM, 1981). He remembers vividly getting up at 05h00 on the many critical mornings to phone the main stations to find out whether they would be able to meet the morning and evening peaks. Despite the near crises proportions of this critical situation, it only received a brief statement in the 1981 annual report: "Potential maximum demands in excess of 15 000MW could not be met" (ESCOM 1982). McRae was later appointed ESCOM's first Chief Executive Officer after the De Villiers reforms.

By 1982 ESCOM was foreseeing a capital expenditure programme of R65 billion which would *treble* its capacity to 70 000MW by the end of the century (Ryan, 1982). Despite concerns expressed by ESCOM engineers that it did not have enough skilled personnel to conduct such a large programme and concerns by the financial personnel that it was becoming increasingly difficult to fund the programme, the CEO Jan Smith insisted on constructing even more plant. ESCOM proceeded to place boiler and turbine orders for three additional 4000MW class stations, Matimba, Kendal, and Majuba on the basis of the four tenders submitted for Matimba. CEO Jan Smith also signed a letter of intent for the turbines for a further station, Lekwe. All these stations were to utilise “dry” cooling. Construction on Kendal[26] commenced in January 1982, on Matimba in June 1982 and on Majuba in January 1983. By the end of 1983, after the extraordinary spate of ordering over the previous four years, ESCOM had generation plant totalling 22 260 MW under construction or on order. This was equivalent to 97 percent of its total plant in commission.

Figure 4 shows the nominal capacity and operating life of Eskom's power stations that were in commission in the 1990s.

[26] By March 2000 Kendal was still the world’s largest coal fired station (World Coal Institute, 2000).



Source: Eskom Statistical Year Books (various years)

Figure 4: The operating lives of Eskom power stations

3.1.2.5 Technical change and technology choice

The stations ESCOM ordered in the early 1980s employed a range of new, and in many cases, only partly proven technologies. Senior Eskom engineer Alex Ham explained that in many ways ESCOM engineers were given "incredible freedom to do what you [they] wanted" (1997).[27] Important examples of significant technological changes include the incremental adjustments to enable Lethabo to burn low energy coal, and the perhaps more revolutionary changes, of using "dry" cooling in Matimba, Kendal and the first three units of Majuba.

The tenders for coal supply to Lethabo proposed to discard approximately 20 percent of the mined coal which, with an energy content of 9 to 10 MJ/kg, was below the ESCOM standard of 20 MJ/kg. While Lethabo was ordered as a copy of Matla, Ham and other engineers decided that the economic value of the coal reserves would be significantly increased if the station were designed to burn lower energy coal. In the end, the Lethabo designs were changed to enable it to utilise 15 to 17 MJ/kg coal with an ash content of up to 42 percent.[28] This required significant modification (enlargement) of the boilers, complete redesign of the burners for the pulverised coal, modification of coal handling and milling, and of ash removal systems (*ibid*). Most of these designs were still being finalised while the station was being constructed; the furnace walls of the first two units were under-construction as plans for the burner and boiler were being completed (Ham, 1997).

On the basis of the experience with the Grootvlei 200MW set indirect dry cooled station and the even smaller 30MW set Van Eck direct dry cooled station in Windhoek, Namibia (with which ESCOM was closely associated) it was decided that both Kendal and Matimba should employ dry cooling (ESCOM, 1985). At the time no 600 MW unit direct-dry cooled system existed in the world (Rubberts, 1997).[29] Rubbert and Ham could not agree on which option to employ. The Management Committee was also divided so it was decided that one of each should be built: Matimba was to have direct dry cooling and Kendal indirect-dry cooling. With direct cooling, low pressure steam leaving the last stage generator turbines is condensed back to water in a condenser which is cooled by a high speed flow of ambient air. In an indirect dry cooling system the steam is condensed by a secondary water circuit, which is itself cooled by ambient air in large cooling towers. Indirect cooling has the benefit that

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[27] Alex Ham, later appointed Executive Director: Technology in the newly restructured Eskom, and Pierre Rubbert, were senior engineers in ESCOM's "New Works" Department and were central players in the technology choices made for the final tranche of plant orders in the early 1980s.

[28] This compared well to the specific energy values of around 20 MJ/kg and average ash content of approximately 12 percent for most coal used in stations in Europe (Beaumont, 1987; Ham, 1997).

[29] At the time the only other direct dry-cooled schemes known to ESCOM were the 160MW system in operation in Utrillos in Spain, and a single 365MW unit in Wyodak in the US (ESCOM, 1985).

the cooling systems for each unit can be interconnected, potentially increasing system reliability. Direct dry cooling is, however, more efficient (Rubberts, 1997).[30]

Dry cooling was a relatively new technology of which little operational experience existed and which had never been built on the scale envisaged. Committing to building three large new stations (a total nominal capacity of 10 077MW) using different dry cooling systems, many aspects of which were not fully proven (Ham, 1997), exposed ESCOM to considerable uncertainties. However, Ham's view was that: "I like to take calculated risks and introduce new technologies – but do it responsibly. I do not like to do repeats" (*ibid*).

3.1.2.6 Investment planning and project appraisal[31]

Investment planning was primarily oriented around the objective of providing a "cheap and abundant" supply of electricity with priority generally given to "abundant" over "cheap" (Harper, 1999). ESCOM followed conventional utility investment planning techniques, which consisted of compiling demand projections and calculating the discounted life cycle cost per annum of competing supply options expressed per unit of capacity (stations of equivalent capacity or per kW). By the late 1970s ESCOM had refined the approach with the introduction of the loss of load probability (LOLP) methodology (McRae, 1997).

Demand projections were prepared by ESCOM's distribution undertakings and municipalities (Baasch and Colley, 1970). By the early 1980s, during the tranche of plant orders after the second oil crisis, demand projections continued to assume that the same level of energy intensive electricity consumption investments would continue as before despite the fact that higher electricity prices meant that no such projects were being developed (Harper, 1999). Following the electricity price increases in the 1970s demand growth had in fact levelled off significantly. Consequently, during the late 1970s and 1980s ESCOM planners consistently overestimated demand growth for the 1980s and beyond (de Villiers et al, 1985).

During the under supply crises in the early 1980s an ESCOM investigation estimated the cost of power not supplied to be R2.20/kWh versus the cost of 10c/kWh for power supplied (Forbes, 1997). These figures strengthened the resolve of ESCOM's CEO, Jan Smith to err on the side of surplus capacity. This approach grossly over-simplified the nature of the electricity consuming market by ignoring the fact that, on the margin, voluntary demand

[30] However, when one or two turbines or boiler units are taken out of service for maintenance work during the hot summer months, interconnected indirect dry-cooling systems have the benefit of potentially increasing the efficiency of the remaining units, which are able to share the cooling towers.

[31] Before the establishment of the De Villiers Commission of Enquiry in the early 1980s (discussed below) ESCOM investment practices were not subject to public scrutiny. There is consequently not much information available on its investment appraisal practices.

shifting in response to a price incentive, could have been much cheaper than risking expensive over capacity.

In late 1982, in response to public criticism of its large investment programme and price increases (discussed below) ESCOM engaged the services of consultants, Ernst and Whinney, to evaluate its demand projections and its financial and tariff policies. The investigation concluded that ESCOM's demand projections were too high. It pointed out that investments in energy intensive projects played an important role in the higher growth in the 1960s and 1970s. While already committed energy intensive projects were being completed no further such projects were initiated since the 1976/7 price hikes (see section 3.1.3.4 below).[32] Ernst and Whinney thus advised the Management Committee to cancel some of ESCOM's plant orders. However, against this advice Jan Smith decided to proceed with the construction of all the stations on order (Rubberts 1997 and Harper 1999).

Despite the many dissenting views,[33] there is no evidence that risk and uncertainty was systematically considered during project appraisal.

3.1.3 Finance and pricing

The nature of ESCOM's financial system played an important role in shaping its investment behaviour.

3.1.3.1 Foundations

ESCOM's founding statutes stipulated that the utility had to finance itself from loan capital and had to operate at "neither at a profit nor at a loss". (South Africa, 1922a; South Africa, 1958). This policy allowed prices for each ESCOM undertaking to be set, on the basis of estimates of the following year's sales, so as to generate revenue that would only be sufficient to cover production costs, contributions to the Interest Fund (to cover expected annual interest charges), contributions to the Loan Redemption Fund (to provide for loan amortisation), and small contributions to the Reserve Fund (used to finance the eventual replacement of existing plant). Depreciation charges where not allowed, and there was thus no way to build up internal resources to contribute to funding increases in capacity.

The 1922 Act determined that ESCOM's loans would be preferentially guaranteed by all its income and assets. Lenders were afforded special access to the courts and rights to

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[32] The Alusaf Bayside Aluminium smelter was commissioned in 1971 while the much larger Hillside smelter came online in 1996 (AFSA, 1999).

[33] In addition to concerns from within ESCOM and from Ernst and Winney, the press, including the leading South African business journal the Financial Mail, was also expressing criticism (Financial Mail, 1982c; Financial Mail, 1983).

determine tariffs and recover monies if ESCOM were to be in breach of its repayment or debt servicing obligations (South Africa, 1922a: Schedule, par. 19 - 22).

Initially ESCOM was capitalised by Government advances totalling £8 million (van der Bijl, 1932).

Even at this early period concerns were expressed, in this case by the General Manager of Railways and Harbours (one of ESCOM's largest customers), about whether ESCOM's financial governance would ensure sufficient scrutiny to ensure appropriate behaviour:

> The Commission is in a unique position that as a Corporation its finances are not subject to Government control and audit, and having obtained its funds from the government instead of by public subscription it is also immune from criticism from shareholders, debenture holders and such-like critical people, to which public corporations are ordinary subject. (More, 1932)

3.1.3.2 Increasing funding requirements and financial reforms

For many years this system functioned without major problems, but by the early 1970s ESCOM's rapidly growing investment programme placed large demands on its financial resources. The economic boom of the 1960s, which led directly to the rapid growth of its construction programme, also resulted in a general capital shortage in the economy and a concomitant increase in interest rates by the end of the decade. This happened at the same time that ESCOM had to finance its growing construction programme and thus significantly increased its cost of capital. In 1970 the yield on ESCOM bonds increased from 7.3 percent to 8.8 percent and again to 9.3 percent in 1971. ESCOM complained that the increased finance costs all but cancelled the major savings achieved by the interconnection and up-scaling of its power stations (ESCOM, 1981).

The potential dangers of ESCOM's debt-dominated capital structure were now becoming apparent. After investigating the options to improve the situation it was decided that the long-standing policy of financing new capacity from debt alone had to be relaxed and that ESCOM should be allowed to retain substantially more earnings to build up its own capital. This view was also being propounded by the World Bank which was engaged in lending to South Africa in the late 1960s. Part of the reasoning was that as construction lead times increased with larger power stations, lenders wanted utilities to increase their funding participation (Harper, 1999).

The Electricity Amendment Act (South Africa, 1971) enabled ESCOM to accumulate retained earnings by making contributions to a new Capital Development Fund (CDF). Capital Development Fund contributions had to be invested in ESCOM bonds and interest and profits earned on these investments would also accrue to the Capital Development Fund (South Africa, 1958: section 13, as amended).[34]

In contrast to the controversy about ESCOM's financial control in the 1920's, this change, which significantly increased the utility's financial leeway, passed through Parliament without much upset.[35]

The Electricity Act was amended for a second time in 1971, which involved legal changes to allow ESCOM to consolidate its generation and transmission activities into a national Central Generation Undertaking that could henceforth supply power to its regional distribution undertakings. The change also removed the last theoretical possibility of regulatory involvement in its investment planning.[36]

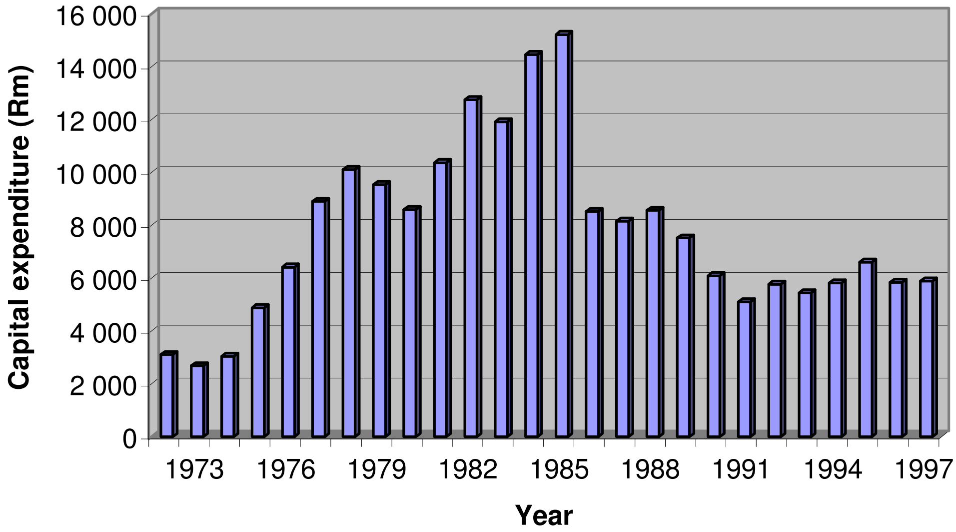
3.1.3.3 Growing capital expenditure and the Capital Development Fund

Figure 5 below shows ESCOM's annual capital expenditure. From 1975 to 1985 capital expenditure increased *three-fold* in real terms (or eleven-fold in nominal terms).

[34] In other words, the Capital Development Fund would purchase ESCOM stock with its funds and, as with all other ESCOM stock, ESCOM would have to pay interest on the stock held by the Fund. When sufficient funds had been built up by the Fund, interest earnings were expected to be its main source of income. This was considered to be desirable as it was thought to reflect more closely the economic reality by allowing prices to reflect the capital cost of assets funded by internal resources (Harper, 1999).

[35] However, when ESCOM further raised prices to start generating revenue for the Capital Development Fund in 1977 its irate customers woke up to the fact that the organisation's easily understood, "fool proof" break even financial system had been changed to a system where prices could be adjusted at ESCOM's discretion to increase internal funding (see section 3.1.3.6 below).

[36] Recall that previously undertakings were limited to specific geographic locations and had to be licensed by the ECB.

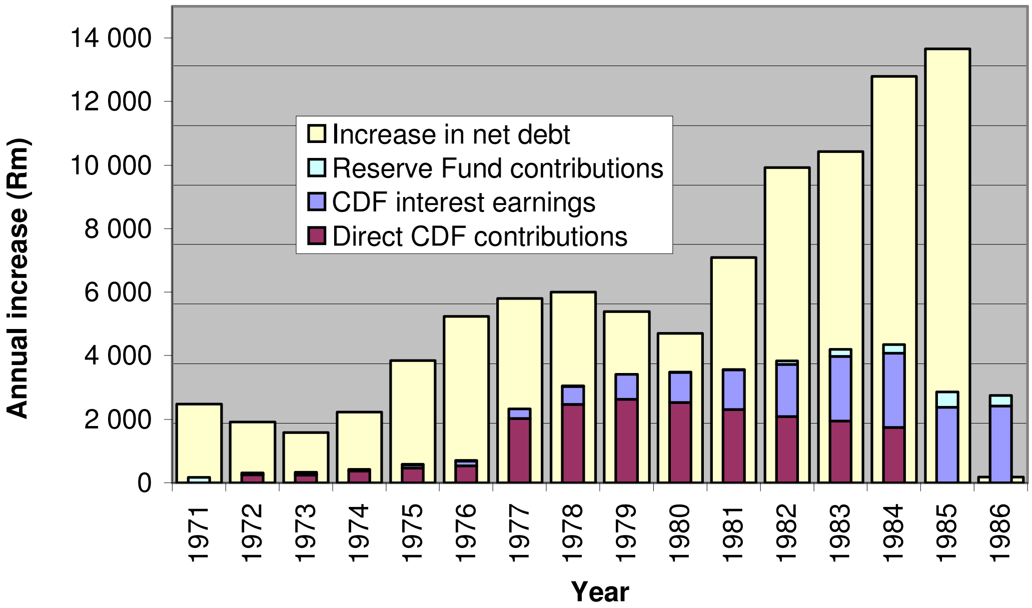


Figures are expressed in January 1998 Rands using the producer price index.
Source: De Villiers et al (1985); ESCOM Annual Reports (various years).

Figure 5: ESCOM's total annual capital expenditure

The financing implications were enormous, and it is arguable that ESCOM realised the mistake of delaying the generation of internal resources too late (Smith 1977 and Financial Mail 1977b). South Africa's abortive invasion of Angola and the series of national strikes culminating in the Soweto uprising in 1976 had taken its toll. By 1977 international loan finance was becoming increasingly difficult to obtain (Financial Mail 1977b), and South Africa was having difficulty raising international finance even at twice the going market rates (International Herald and Tribune, 1978).

By the early 1980s, ESCOM was forced to greatly increase its borrowings, albeit under more favourable circumstances (see discussion below), *and* greatly increase contributions to the Capital Development Fund to increase the proportion of investment funds sourced internally. Figure 6 shows the annual increases in debt and in retained earnings in the form of contributions to the Capital Development Fund and the Reserve Fund.

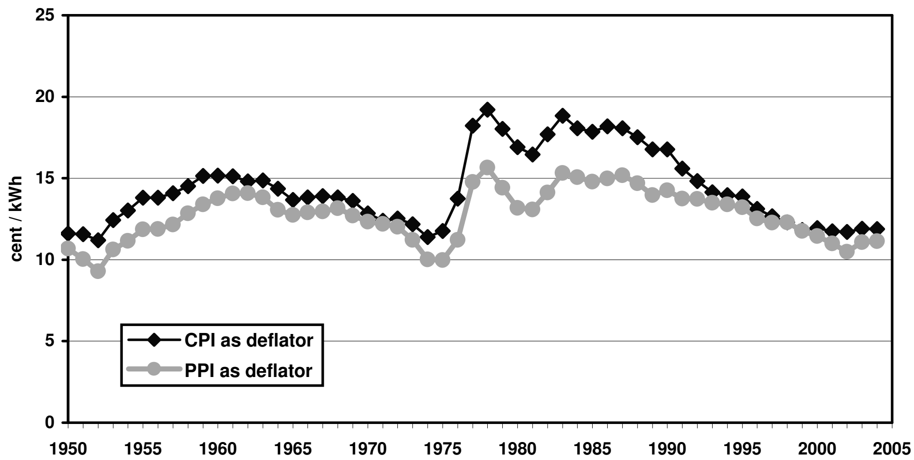


Figures are expressed in January 1998 Rands using the producer price index.
Source: De Villiers et al (1985); ESCOM Annual Reports (various years).

Figure 6: Increases in debt and Capital Development Fund and Reserve Fund contributions

3.1.3.4 Price increases

The increases in debt and capital development fund payments contributed to large increases in retail price levels. Figure 7 below shows ESCOM's average electricity prices and price increases over the period. The fact that it was ESCOM's stated intention of ultimately financing 50 percent of capital expenditure from internal resources further increased concerns that price hikes would continue to affect consumers for some time (Financial Mail, 1983).



Figures are expressed in year 1998 currency
Source: Eskom private communication.

Figure 7: ESCOM's average electricity prices.[37]

Figure 8 shows the main cost components underlying ESCOM's prices. Fuel costs constituted the primary driver behind the modest price increases between 1974 and 1976. In real terms fuel costs increased 4.3 percent in 1974, 23.7 percent in 1975 and 21.8 percent in 1976. The increases were the result of a three-fold increase in real wage levels in the coal and gold mining industries between 1971 and 1975 (Christie, 1984). However, these average price increases were small compared to the effect of the 15 percent tariff hike announced in April 1976, the 13 percent increase announced in September 1976 and the 25 percent increase announced in January 1977 (Financial Mail, 1977b).

The effect of these tariff hikes on revenue was reflected in the average prices of 1977 and 1978 shown in Figure 8. The extra revenue was used to contribute to the funding of the growing investment programme by increasing Capital Development Fund contributions, and later to cover rising interest costs. After 1978, prices declined again in real terms only to be increased again for three consecutive years from 1981 onwards, this time causing a national outcry.

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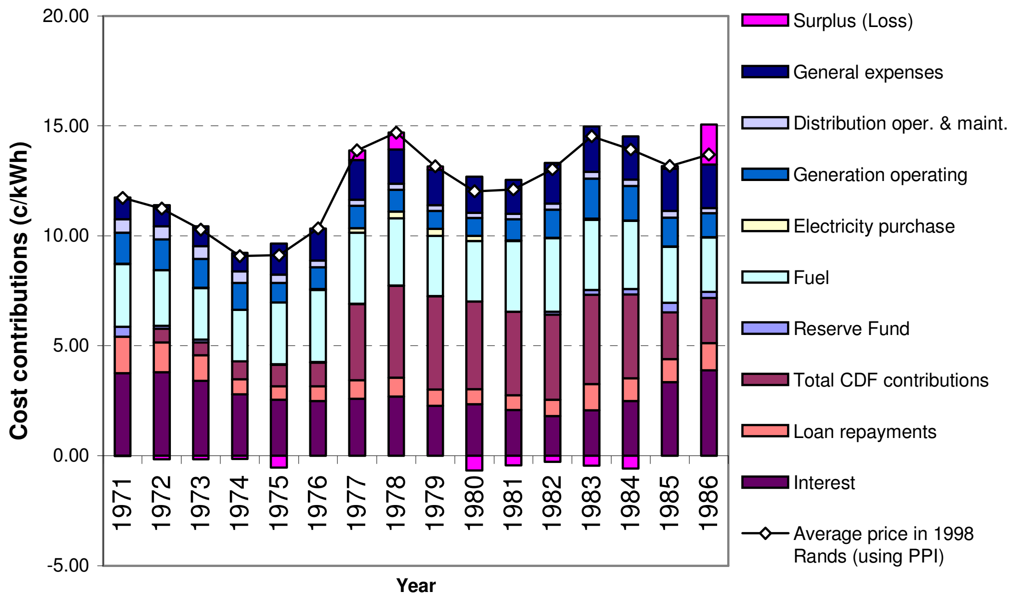
[37] Although the price levels derived using the producer's price index (PPI) and the consumer price index (CPI) differ in their absolute levels, the trends are almost identical.



Figures are expressed in January 1998 Rands using the PPI
Source: ESCOM Annual Reports (various years).

Figure 8: Components of ESCOM's average price per kWh.

3.1.3.5 Improved access to finance in the late 1970s and early 1980s

In stark contrast to 1976/7, finance had become exceedingly easy to obtain by the early 1980s. In 1980 the gold price reached $800 per fine ounce. South Africa's economy grew on average 4.45 percent over the four years between 1978 and 1981. The country became an attractive market for foreign capital (Harper, 1999).

ESCOM managers soon realised that they where in a strong bargaining position with overseas equipment suppliers. South Africa was one of the few countries expanding its power sector during a period when there was surplus capacity in the equipment supply industry worldwide. Equipment suppliers thus put pressure on their governments to provide highly attractive export credit facilities (Harper 1999, McRae 1997 and Forbes 1997). ESCOM's overseas loan financing was further facilitated by subsidised long-term exchange rate forward cover provided by the South African Reserve Bank,[38] and by Government Guarantees for foreign loans (Harper, 1999; Davis, 1999).

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[38] The South African Reserve Bank carried the cost of providing forward cover. Between April 1981 to the end of January 1998 a total loss of R26,4 billion was recorded on the Bank's Forward Exchange Contracts Adjustment Account. Of this amount R19,1 billion was directly attributable to long-term forward cover granted to the parastatals, primarily ESCOM, in the late 1970's and early 1980's (The South African Reserve Bank, 1998).

Where financing considerations could often play a role in restraining excessive investment programmes, the attractive financing terms available to ESCOM further encouraged the decisions taken between 1979 to 1982 to effectively double its installed capacity by constructing six large coal fired stations and the Palmiet pump storage scheme.

3.1.3.6 Engineers and politicians: The causes of the De Villiers Commission

Towards the late 1970s ESCOM and the Government ran into a head-on confrontation which would ultimately lead to the appointment of the De Villiers Commission of Enquiry on 20 May 1983. Following the commission's report important changes to ESCOM's governance regime were made.

The steep tariff increases of 1976 and 1977 caused a political outcry. It was particularly the protest from the white farmers, an important constituency for the governing National Party, that had effect (McRae, 1997). In the early 1980s increasing fuel, generation operations, and interest costs meant that ESCOM was forced to increase real prices again. An across the board tariff increase of 13.1 percent was announced for 1982. When a 16.7 percent increase in average tariffs was announced for 1983 it caused "a storm of protest" (Financial Mail, 1983). ESCOM's financial policies were again being criticised as being informed by "misplaced arrogance" and its "massive" investment programme was causing wide-spread concern (Financial Mail 1983 and Ryan 1982). For ESCOM managers there was no question of reducing the investment programme. They rather chose to balance price increases with short-term adjustments to their financial policies. The level of direct contributions to the Capital Development Fund were allowed to fall in real terms to cushion the effect of the growing interest charges for the ESCOM stock held by the fund (Financial Mail, 1983).[39]

Despite the political sensitivity of the tariff question ESCOM merely wrote to the Government to inform them of the planned increase and stated that if no response was received within a month they would proceed as planned (Oosthuizen, 1999). After the announcement for the 1983 tariff increase the Prime Minister, PW Botha, summoned the Commission to a meeting in Pretoria. ESCOM's chairman Jan Smith led the delegation.[40]

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[39] While direct contributions to the Capital Development Fund were reduced in real terms every year from its peak in 1979, Figure 6 shows that total contributions grew slowly in real terms because of growing interest charges (which were reinvested in ESCOM bonds), until the last direct contribution was made in 1984. The opaque arrangements around the Capital Development Fund in the end contributed to widespread suspicion and misunderstanding of ESCOM's financial practices and of its use of the Capital Development Fund (Lindique, 1999).

[40] By all accounts, Smith was a highly regarded engineer and well respected as such in the organisation, but he had little interest in, or understanding of, the political sensitivities that surrounded ESCOM. He also failed to

Apparently misled by the initial pleasantries, Smith underestimated the seriousness of the confrontation. When given the floor, instead of offering a concession of some kind, he proceeded to explain the justification for the tariff increase without demonstrating understanding for the political concerns that had been aroused by ESCOM's expansion programme and tariff increases. When he finished speaking Botha thanked the delegation for their "trouble" and told them that they were excused. While Smith thought the meeting went well, others knew better. Without previously informing the Commission, Botha appeared on television shortly afterwards to announce that ESCOM's 16.7 percent tariff increase would be reduced to 14.5 percent.[41]

Botha's intervention was merely a short-term crises management measure. ESCOM's public image was at an all-time low and deteriorating. There was an increasing impression that ESCOM was being mismanaged and that electricity consumers were footing the bill. While ESCOM survived the 1977 crises, this price hike to fund the large capital expenditure programme was the last straw. The Financial Mail argued on 13 May that the organisation could "arrogantly" hike prices to fund its "massive" capital expenditure programme seemingly with little regard for the impact on consumers (Financial Mail 1983: 21-22).

Botha finally intervened a week later by appointing a "Commission of Inquiry into the Supply of Electricity in the Republic of South Africa" (De Villiers et al 1985, hereafter referred to as the De Villiers Commission after the name of its chairman). Irrespective of its formal mandate, the Commission's main objective was to ensure the removal of Jan Smith as chief executive (Keys 1999, Davis 1999 and Oosthuizen 1999). In the words of Derek Keys, former member of the de Villiers Commission: "... And in simple language I think PW Botha just decided to fix Jan Smith ... That is why I think the Commission was appointed" (1999).

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appreciate the intricacies of good public relations and how to deal with the press (McRae 1997, Oosthuizen 1999 and Davis 1999).

[41] This version of events was constructed from an article in the Financial Mail (1983) and the account of Ters Oosthuizen (1999) who was present at the meeting in his capacity as Secretary to the Electricity Supply Commission.

3.2 Eskom

This section examines the findings of the De Villiers Commission and the institutional reforms that followed it. A critical interpretation of ESCOM's post De Villiers investment behaviour suggests that the utility's investment incentive problems, some of which were identified by De Villiers, were not resolved, and that too many excessive and inappropriate construction projects continued despite the unavoidable downscaling of the power station construction programme. Key institutional elements, which together created managerial incentives to construct excessive and inappropriate power plant projects, survived the De Villiers reforms. These included: the shifting of financing and business risk on to ESCOM's consumers and the state; greater professional and pecuniary benefits for managers associated with larger, more complex, and thus economically more risky projects; and information asymmetries with respect to stakeholders about the true risk exposure of these project investment decisions.

The focus of the discussion is primarily on the ten-year period following the De Villiers Commission.

3.2.1 The De Villiers Commission and institutional reforms

During the proceedings of the Commission (1983 – 1985) ESCOM's public profile continued to deteriorate. A joint submission to the De Villiers Commission by a group representing most of ESCOM's industrial consumers was critical of ESCOM's investment policies and argued that "an increase in the growth rate [of ESCOM's generating capacity] has the greatest impact on tariffs" (Financial Mail 1985a). ESCOM also received bad press for the large construction cost overruns incurred at the controversial Koeberg nuclear plant and for its forced shut down after hair cracks were discovered in its cooling system (Cape Times, 1985). Headlines such as "Stop the Rot" (The Natal Mercury, 1985) and "The ESCOM Fiasco" (Cape Times, 1985) in the daily press did not help either.

3.2.1.1 The de Villiers Commission's findings

The Commission found that, while ESCOM was "fundamentally oriented towards providing an abundant supply of electricity" (translated from de Villiers et al 1985: 216) the events following the oil crisis called for a different approach. It argued that an unquestioning policy of providing an abundant supply at any cost would not suffice anymore. The Commission further found that ESCOM's captured consumer base guaranteed the necessary cash flows thus removing the risks of financial problems associated with over investment. The report suggested that for ESCOM managers the route of minimum risk involved the avoidance of public and political criticism about the utility's possible inability to supply power (as they had indeed elicited in the past). This resulted in "over insurance" and unnecessary costs, which could in turn be automatically recouped by increasing prices (1985: 216). Elsewhere the report suggests that the danger exists that "it would make absolutely certain that there would not be a shortage of electricity in the future", even at a cost that could not be justified (1985: 223).

The Commission found that the consequences of ESCOM's propensity to guarantee supply without consideration of risks and costs were exacerbated by the fact that construction lead times of the larger plant had become unacceptably long and that works under construction were forming a large proportion of assets (see Figure 3). It also suggested that the econometric load forecasting techniques, as practised by ESCOM, had become unreliable because they did not adequately account for the discontinuity caused by the oil crises and its effects on future electricity demand.

Importantly, the report further suggested that ESCOM should reduce capacity risk by improving co-operation with consumers, namely adjusting demand forecasts to their consumption requirements, and establishing a more flexible construction programme.

With regards to ESCOM's revenue and tariff policy the Commission recommended that the principle of operating at neither a profit nor at a loss should be discarded in favour of a "sound assets and income structure". However, the report suggested that ESCOM's tariff levels should be "consumer privileged" rather than based on long-run marginal costs. In other words, because of the dividend free status of its equity capital (consisting mostly of reserves) ESCOM's consumers should benefit from tariffs that are lower than they would have been if its equity consisted of dividend paying share capital.

3.2.1.2 Institutional reforms

In April 1985, the Electricity Amendment Act (South Africa 1985) replaced the Electricity Supply Commission with a body corporate known as Escom (or Evkom in Afrikaans) governed by a new Electricity Council. The Electricity Council was established as a non-executive body and initially consisted of up to 19 persons, appointed by the Minister of Mineral and Energy Affairs. Members would represent major electricity consumers, municipal electricity distributors and government, or would be appointed as independent experts. It was significant that the Electricity Council would now include a large number of Escom's private sector customers who would participate in the joint public-private control over it. The Electricity Council appointed the Management Board in which the executive authority of ESCOM is vested.

Escom's new chairman John Maree in practice managed to limit the role of the Council as a body representative of external stakeholder views. He argued that Council members should behave as members of a company board of directors and put the interest of the company first (over that of their individual constituencies).[42]

The Eskom Act (South Africa, 1987) abolished the Reserve Fund, the Capital Development Fund and the Redemption Fund. The Act also gave the utility the single name of “Eskom”. Where assets from these funds were invested in Eskom loans (bonds) they were to be transferred to Eskom's financial statements as a general reserve, thus reflecting the fact that these financial assets were funded by retained earnings. Eskom presented its accounts in terms of the normal business depreciation accounting convention from 1987 onwards.[43]

The Eskom drafters also managed to include a clause in the new Electricity Act exempting Eskom from the requirement to have a licence issued by the Electricity Control Board, and thus effectively from having its prices controlled by the Board (Morgan, 1997).[44]

Sections 17 - 19 of the Eskom Act also carried over from the previous Electricity Acts the powers of lenders to approach the courts to set tariffs and seize assets to recover interest and outstanding capital amounts should Eskom default on its debt servicing obligations.[45]

3.2.1.3 Summary

The De Villiers Commission identified many of the investment incentive problems, which encouraged ESCOM managers to over-invest in generation plant. The Commission’s proposed solution was to appoint a stakeholder body, the Electricity Council, to govern Eskom, however, in practice its role as stakeholder representative body was severely limited by the moral obligation placed on Council members by the new chairman.

The opportunity to introduce improved regulatory or parliamentary oversight was also not seized. The net effect was that Eskom’s performance was still not subject to any significant external review.

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[42] This position was strongly opposed by Ters Oosthuizen, secretary to the Council and Eskom's Legal Manager. In his role as secretary to the De Villiers Commission, Oosthuizen had worked closely with Wim de Villiers and played a central role in conceptualising the new Eskom control structure (Oosthuizen, 1999). Oosthuizen wanted to get a clarifying court order to pronounce on the correct interpretation of the Eskom Act regarding the role of the Electricity Council but was not allowed to proceed.

The intention of Eskom’s creators was not that it should have had an interest of itself – The “consumer privileged status of its financial structure reflected the fact that its consumers’ interest was supposed to be its interest.

[43] The 1987 annual report also re-stated the 1986 accounts in terms of depreciation accounting.

[44] With the establishment of the National Electricity Regulator (NER) in 1995 legislative changes subjected Eskom to regulation by the NER. Furthermore, the Eskom Conversion Act, 2001 changed Eskom’s status from a statutory corporation to a public company with share capital held by the state.

[45] The same provisions have been carried over to section 7 of the Eskom Conversion Act (South Africa, 2001) and are still in force.

Maree responded to the poor management practices of the past by implementing modern commercial management practices and drastically elevating the finance functions in the corporation. Having learnt from the problems of the poor communications with their political masters in the past Maree worked to improve communication channels with government and restore confidence in Eskom.

None of these reforms, however, changed the way in which the economic and financial risks of Eskom's construction projects were shifted onto its consumer base. As will be demonstrated below, this paradoxically worked against the public service objective of its "consumer privileged" capital structure, by encouraging inappropriate construction projects that resulted in the destruction of a large amount of publicly owned economic value.

3.2.2 Investment

By 1985 ESCOM had revised its demand projections downwards for a number of years and it became clear that its expectation for demand growth in the early 1980s was significantly exaggerated. Effectively this meant that ESCOM was committed to the cost of constructing more generation capacity than was needed. The focus now turned to dealing with ESCOM's looming surplus capacity problem and improving its many finance related problems including changing its accounting system and turning around its soaring debt.

3.2.2.1 Generation investment and operations

The first step in addressing ESCOM's growing surplus capacity problem was to open negotiations with its equipment and fuel suppliers to assess the possibility of deferring or reducing its construction commitments (ESCOM, 1986). This was largely achieved by deferring the construction of generating sets of Tutuka, Lethabo, Matimba, Majuba and Kendal power stations and cancelling plans for a further large (4000MW) station, Lekwe (Financial Mail, 1986). As before with Illanga, Lekwe was finally only cancelled because the Government refused to give permission for further borrowing to finance the station (Harper, 1999).

By early 1987 Eskom announced that it would now pursue a strategy of continuing with the construction of the new plant and either mothballing or reducing the use of older, less efficient plant (ESCOM, 1987). It argued that this strategy was justified because the favourable financing arrangements associated with the equipment supply contracts had become even more attractive in the context of South Africa's debt standstill[46] and the

[46] The Nationalist Government imposed a foreign dept standstill following P W Botha's disastrous "Rubicon" speech, , which disappointed international expectations that apartheid would be abolished and precipitated a loss of confidence in the South African economy and a fall of the Rand against other currencies. Pressure from some

growing threat of financial sanctions against South Africa. It was considered unlikely that it would be possible to obtain such favourable terms if new contracts were to be re negotiated at a later stage (Harper 1999; ESCOM 1987). However, Davis (1999) nevertheless explains that Eskom planners had little appreciation for the economic cost of building excess plant and that he found it necessary to go around the organisation to make presentations on “economic imperatives” and the economic cost of excess capacity.

The next step in dealing with the surplus capacity was to reduce the amount of older plant on the system. In addition to closing uneconomic plant Eskom also mothballed[47] some of the older plant that could still be operated economically if required. This decision was understood as a choice between the additional cost of capital of building the new stations and of incurring the higher operating costs of the older stations. Eskom’s loan finance did not include a cost reflective risk premium because its monopoly position and founding statutes shifted the financial and economic risk of its construction projects to its consumer base by allowing it to set tariffs to service its debt irrespective of the economic performance of its assets. The ostensibly lower cost of capital meant that the option of financing new plant was perceived to be the most attractive (Roos, 1997). By 1991 Ingagane, Camden, Highveld, Taaibos, Grootvlei and Komati, totalling more than 5000 MW, had been mothballed (1991b).[48]

In the late 1980s Eskom considered cancelling the construction of the 4110MW Majuba station. In the end, on the basis of the perspectives shaped by the attractive financing available to Eskom, and the difficulties with cancellation, as explained above, it was decided that the utility would proceed with a delayed construction programme of units one to three and mothball the plant on completion, while units four to six would remain on order. Eskom's chief executive during the late 1980s and early 1990s, Ian McRae, acknowledges that Eskom was perhaps still “somewhat optimistic” about demand growth when decisions about Majuba were made and that if they “had known what is known now” they would have cancelled the entire station (McRae, 1997).

In 1992 Eskom suspended the plans for the construction of the last three units of Majuba. Rand Coal, the station's coal supplier had commenced with the mine development and had discovered diagonal faults in the coal seam that were not detected during the geological

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of the larger banking groups such as Nedcor played an important role in the decision. These banks had made excessive use of the low cost short-term petrodollars available in the capital markets in the early 1980s and now faced hugely inflated costs to refinance these loans (Harper 1999).

[47] This refers to taking generation plant out of service and placing them in protected storage with the intention to recommissioning at a later date.

[48] Ingagane, Highveld and Taaibos where later scrapped.

mapping of the site (Eskom, 1993). During 1993 Eskom agreed with Rand Coal to close the Majuba colliery and that Rand Coal would supply the first three units by other means,[49] while Eskom would continue evaluating whether it should continue with the construction of units four to six (Eskom, 1994). By early 1995 Eskom announced that units four to six remained under review. In November 1995 Eskom decided to continue with the construction of the last three units. The decision was controversial and not unanimously agreed to, even in Eskom.[50] There was also concern about the closed nature of the final decision and with the way in which the coal supply problems were resolved (Ham, 1997). The extra costs in coal supply arrangements (which now required rail and road transport) and delays in construction meant that by 1997 Majuba, one of South Africa's largest coal stations, was supplying power at a marginal cost of approximately 16.5 c/kWh (Fabricius, 1997).[51] Despite being designed for base-load operation, the higher than expected marginal costs of running that station forced Eskom to operate the station in a mid-merit two-shift basis (www.power-technology.com, 2005).

In 1994 Eskom also took further steps to decommission older plant, thereby reducing its net maximum capacity by 1 710 MW or 4.5 percent (see Figure 1 on page 13). Although these plans went largely unchallenged, the National Electricity Regulator did write to Eskom to protest the closures.

In addition to the decommissioning of plant Eskom also initiated a campaign to market its surplus capacity for use in minerals beneficiation projects. It negotiated an interruptible supply agreement with the Alusaf Aluminium smelter. Eskom provided a 300MW supply to Alusaf in 1993 and a further 760MW in 1996. Similar supplies, totalling 370MW, to the ferrochrome industry were provided in 1996 and a further 1470MW was planned to be connected between 1997 to 2000 (Eskom, 1997).

Improving plant availability also remained an important objective, and by 1986 average availability reached 78.5 percent (up from 71.9 percent in 1983). In addition, ESCOM looked for other opportunities to implement a commercially oriented approach to reduce operating expenditure. It implemented a policy of reducing its staff numbers from a peak level of 66 000 in 1985 to 40 000 in 1993. ESCOM estimated in 1985 that through this and other

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[49] Eskom prepared to sue Rand Coal for damages, but Maree declined to proceed (Rubberts 1997). In the end Eskom negotiated an agreement with Transnet to transport coal from alternative sources and agreed to pay Rand Coal R200 million for the closure of the mine.

[50] Eskom's Executive Director of Finance, Mick Davis, who left the organisation in 1994, described the fact that he was "unsuccessful in getting Majuba cancelled" as a "big failure" on his part (Davis 1999).

[51] This compares poorly with the average cost of electricity from a new coal station, which Eskom estimated (on the basis of tenders for the completion of units 4 – 6 of Majuba) to be 5.6 SA c/kWh (Eskom, 1997).

initiatives it would be able to achieve a reduction in operating costs of R1 400 million between 1986 and 1989 (ESCOM, 1986).

Of the original over ambitious investment programme, which gave rise to the appointment of the De Villiers Commission, only one station, Lekwe, was cancelled – and only because the Government would not approve the issue of additional debt paper to finance the station. Eskom proceeded with the entire remaining construction programme, albeit with a delayed schedule. This programme resulted in the development of a reserve margin of approximately 40 percent by the early 1990s (see Figure 1 above), the displacement of substantial capacity of older, but otherwise still economic plant, and a long-term surplus capacity problem. Seventeen years after the initial investment decisions, Eskom was foreseeing that its surplus capacity could last up to 2010 (Financial Mail, 1997).

3.2.3 Finance and pricing

Eskom's pricing and financial performance enabled the firm to achieve very low price levels in the 1990s, despite its excessive investment programme. Financial performance indicators failed to reveal the poor economic performance of its investments during this period thereby contributing to substantial information asymmetry problems.

3.2.3.1 Prices

ESCOM's financial policies were affected by the temporary foreign debt standstill announced by the South African Government in August 1985 after State President PW Botha's "Rubicon" speech.[52] The debt standstill meant that Eskom could not refinance its loans in the overseas market and was thus limited to the small domestic capital market where the utility ran the risk of inflating interest rates with its large demands.

Table 2: Eskom nominal price increases and general price inflation

[52] See footnote 46 on page 35.

Faced with financing constraints as well as pressure to reduce its capital and operating expenditure, Eskom decided that it was also necessary to improve its self-financing ability by increasing revenue. Assisted by his new General Manager Finance, Mick Davis, Maree now capitalised on his good relationship with the Government. Through careful explanation, Maree persuaded Government of the necessity of ten percent price increases in January and again September of 1985, and in January and July of 1986 (Harper 1999 and ESCOM 1986). The strategy of combining capital expenditure and operational cost cuts with revenue increases was so successful that ESCOM could state in its 1986 annual report that "current price levels will be sufficient to meet our financing goals in 1987 and price increases in 1988 and 1989 will be below the inflation rate" (ESCOM 1987: 24). See Table 2 for Eskom's nominal price increases. This optimism prevailed despite the Government's decision to scrap the prescribed assets rule for financial institutions which had given Eskom a captive market for its bonds and which amounted to a subsidy to Eskom's financing activities (Davis, 1999).

	% Increase	CPI[1]	CPIX[2]	PPI[3]
1985	21.00 (10&10)	18.5	-	21.6
1986	21.00 (10&10)	18.3	-	16.2
1987	12.00	14.7	-	11.7
1988	10.00	12.5	-	14.2
1989	10.00	15.5	-	14.8
1990	14.00	14.4	-	13.3
1991	8.00	16.4	-	8.6
1992	9.00	9.5	-	7.2
1993	8.00	9.5	-	6.1
1994	7.00	9.8	-	9.7
1995	4.00	6.9	-	8.4
1996	4.00	9.3	-	8.8
1997	5.00	6.2	-	4.0
1998	5.00	9.0	7.3	4.1
1999	4.50	2.2	6.8	7.2
2000	5.50	7.0	7.7	9.9
2001	5.20	4.6	6.5	8.3
2002	6.20	12.4	10.8	12.4
2003	8.43	0.3	4	-1.8
2004	2.50	3.4	4.3	1.9
2005	4.10	3.6	4	5.1

[1]Consumer Price Index (year ending 31 Dec)
[2]CPI excluding interest rates on bonds (year ending 31 Dec)
[3]Producer Price Index (year ending 31 December)
Source: Various Eskom annual reports; Statistics South Africa

Price increases for 1987, 1988 and 1989 had been significantly below inflation while Eskom's debt levels remained high. Davis decided that a higher price increase than in the previous years was required to establish Eskom solidly on a virtuous circle of declining investments, debt and eventually also prices. His first annual price increase presentation to the Electricity Council as General Manager Finance in 1989, in which he proposed a fourteen percent average increase for 1990 (which was still just below the expected inflation for 1990). This increase passed without hitch by the Cabinet presided over by the newly appointed State President, FW de Klerk, but it did incense sympathisers of the nationalist Government on the Electricity Council (Davis, 1999). A year later the Council again approved the increase Davis proposed, but this time the nationalists on the Council did not leave the matter there. Since the last tariff increase, they had established an alliance with Wim de Villiers who was now a newly appointed Cabinet minister responsible for economic affairs.[53] Eskom was faced with the possibility that Government could be persuaded to overrule the Electricity Council decision. To resolve the deadlock, Davis held a series meetings and presentations with Government bureaucrats and ministers. Despite a number of confrontations between de Villiers and Davis, in the end the Government did not attempt to block the price increase.[54]

Davis now decided that he wanted to "depoliticise" the annual price increase process. Influenced by the French contract plan model for managing the relationship between the French Government and EDF, and in the spirit of Maree's outcomes-based arm's length relationship with the Government, Davis planned to establish a multi-year pricing framework with the Government. First he established a number of financial "norms" within which he wanted the firm to operate. This involved setting targets for indicators such as the return on assets, debt-equity ratio and interest cover. The second step was to look at Eskom's costs and estimate the productivity improvements that could be achieved. Lastly he constructed a financial model to calculate the price levels that would be required to achieve the desired "norms" given the cost and other assumptions. In the end Eskom proposed a "pricing compact" for the period from 1992 to 1996 to reduce real prices by 20% over the same period (from 1991 levels). Eskom asked for and was granted an opportunity to present the plan to the Cabinet. At the end of the presentation Davis suggested that "... if you agree with that, then I want you guys to go away for five years and every year we will notify you that we are actually on plan" (1999). The proposal was accepted.

In the end Eskom's pricing compact target and its success in achieving it was probably more ambiguous than might have been evident from first impressions. By the end of 1996 Eskom had achieved a real reduction in its *average* prices over the pricing compact period of 13.5 percent relative to the consumer price index (CPI).[55] Eskom's formally approved nominal price increases are shown in Table 2 on page 38. Average prices and cumulative price reductions are shown in Figure 9.

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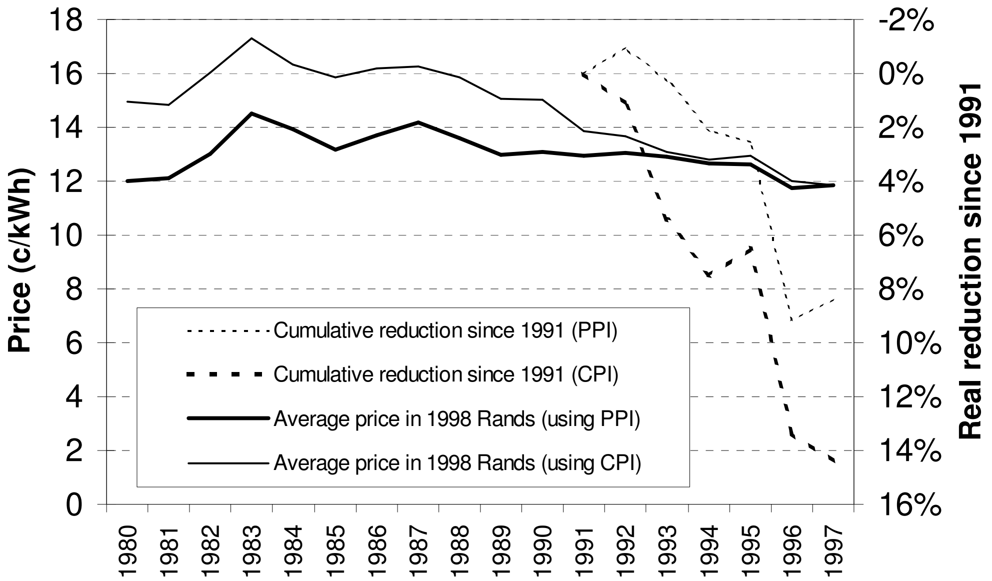
[53] The rest of this account related to the background of the pricing compact is based on the interview with Mick Davis (1999).

[54] At the meeting, which Davis describes as "probably just the most unpleasant meeting I have ever had in my whole life", it became evident that de Villiers did not understand the rationale behind Davis' recommendation and, worse, did not trust Eskom's motives.

[55] Eskom calculates the percentage price reduction by summing the annual differences between the nominal percentage price increase and the *average* percentage increase in the monthly annual consumer price index over the year. The result is reported as 16.8 percent in the 1996 Eskom Annual Report.



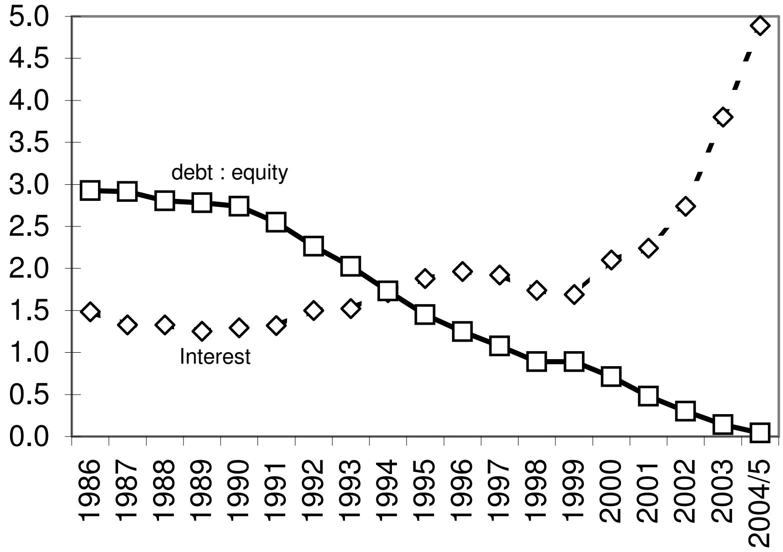
Source: Various Eskom annual reports
Figures are expressed in January 1998 Rands using the producer price index (PPI)

Figure 9: Eskom's average prices and price reduction from 1991

Real average prices expressed in terms of the CPI have been falling since 1987 following significant price increases in 1983 and again in 1986 and 1987. In real terms, prices thus showed a modest decrease over the pricing compact period and were 20 percent lower in CPI terms ten years after the De Villiers reforms in 1994.

3.2.3.2 Financial performance

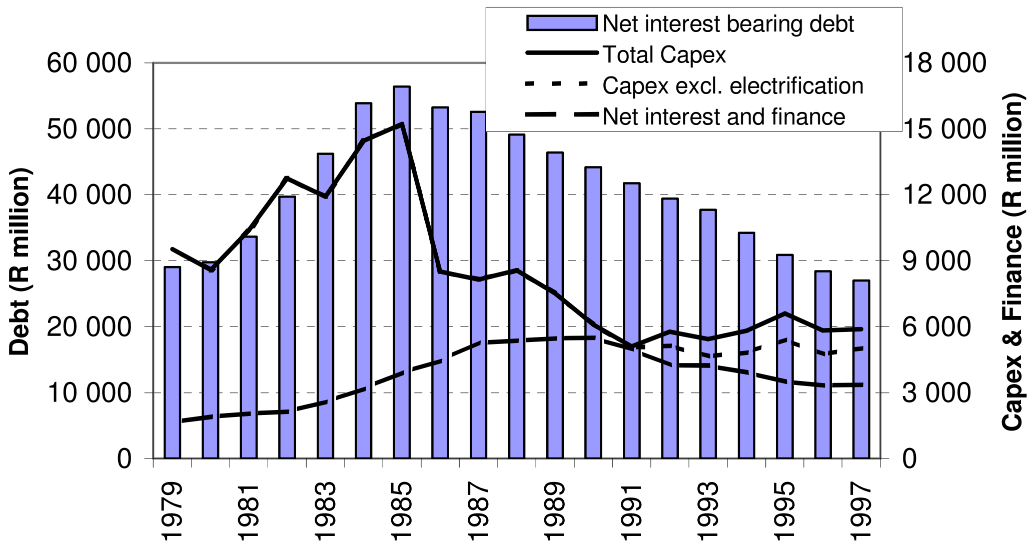
Eskom's financial performance showed a significant improvement from its poor financial state in the early 1980s. The utility's historic cost debt-equity and interest cover figures, depicted in Figure 10, demonstrate the improvement in its financial position.



Source: Various Eskom annual reports

Figure 10: Eskom's historic cost debt-equity and interest cover

The substantial reduction in annual capital expenditure and the maintenance of adequate price levels drove the improvement in Eskom's financial position. Figure 11 shows Eskom's annual capital expenditure, its net interest bearing debt and finance costs. Debt levels declined dramatically and gearing ratios improved.



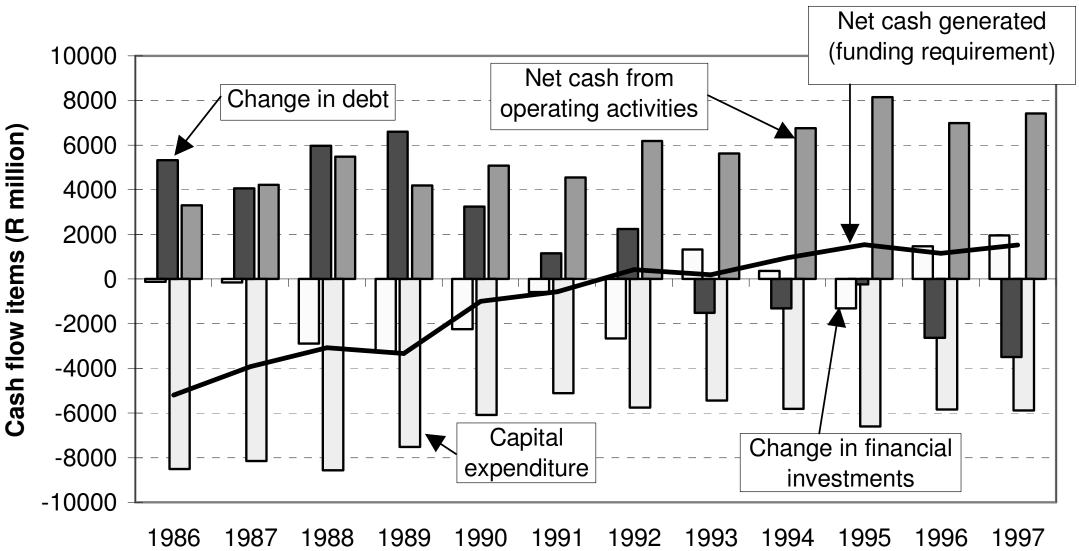
Figures are expressed in January 1998 Rands using the producer price index (PPI)
Source: Various Eskom annual reports and de Villiers et al 1985

Figure 11: Eskom's investments, debt and financing costs.

3.2.3.3 Eskom's cash-flow

The effect of the reduction in capital expenditure and financing costs and the benefits of a tax-exempt "consumer privileged" capital structure (see below) are clearly visible from

Eskom's cash flows. Figure 12 shows the items from Eskom's cash flow statement grouped under the headings of Net cash from operating activities, Capital expenditure, Change in debt, and Change in financial investments. It can be seen that during the period 1986 to 1991, cash from operating activities[56] was inadequate to cover capital costs (investment activities), resulting in a funding requirement that had to be met by increasing debt and decreasing financial investments.[57] In the period 1992-1997, the opposite occurred: cash flows from operations exceeded capital requirements. The net cash thus generated was absorbed in the financing activities by reducing debt and increasing financial investments (with the exception of 1995 when financial investments were reduced).



Positive amounts refer to cash generated, and negative amounts to cash expenditure.
Cash from operating activities – Capex = Funding requirement (or net cash generated if positive) = Change in debt – Change in financial investments
Figures are expressed in January 1998 Rands (PPI)
Source: Various Eskom annual reports

Figure 12: Items from Eskom's cash flow statement[58]

The increase in cash from operating activities in the second half of the 1980's, driven first by real price increases and then by increased sales growth in 1987/8, was the main initial contributor to the reduction in the funding requirement. Between 1989 and 1991 the cash utilised for investment activities reduced again (following on from the significant decrease in 1985, see Figure 11) and contributed to a further reduction in the funding requirement,

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[56] Cash generated by trading operations (sales) minus interest and finance charges paid.

[57] However, from 1986 onwards debt increases were below inflation resulting in a real reduction in debt (see Figure 11).

[58] The basis for the preparation of Eskom's cashflow statement was changed in 1997 without explanation. The figures for 1996 were restated in the 1997 annual report. The figures presented in the earlier annual reports are presented here while the figures for 1997 are estimated pro-rata to the two sets of figures available for 1996.

bringing it close to zero. Then in the rest of the 1990s Eskom generated a cash surplus, which grew at a modest pace as cash from operating activities was boosted by falling finance charges and growing sales.

Table 3: Eskom's return on assets

Year[1]	Nominal %	Real %
1988	9.9	5.6
1989	10	5
1990	11	5.1
1991	10.6	4.4
1992	10.5	4.2
1993	10.8	4.1
1994	11.5	4.3
1995	11.5	4.3
1996	11.7	3.9
1997	11.3	3.6
1998	9.7	2.3
1999	8.3	1.4
2000	9.8	2.5
2001	10.2	1.2
2002	11.9	1.7
2003	10.6	0.5
2004/5	9.3	n/a

[1] Eskom changed its financial year-end during 2004 from December to March, with the effect that the 2004/5 year covers the period from 1 January 2004 to 31 March 2005. The ROA for 2004/5 has been normalised to 12 months to enable comparison with the other figures.

Source: Various Eskom annual reports

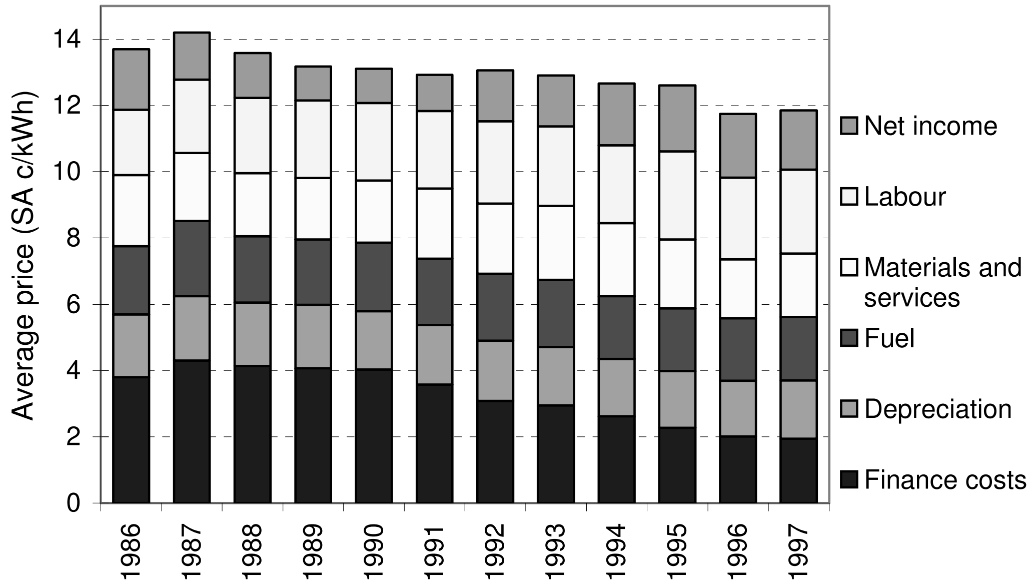
Table 3 shows Eskom's nominal and real return to assets. The increase in net income has allowed a fairly constant rate of return on assets, which has remained between 10 and 12 percent over the period. In an inflationary environment, this parameter may misrepresent financial returns due to the under valuation of the historic cost asset base. In principle Eskom's current cost accounts which re-value assets and allow the calculation of a real rate of return should overcome this problem.[59] Despite the growth in net income the real rate of return on assets has declined from 5.6 percent in 1988 (the earliest year for when these figures are available) to 2.5 percent in 1998 as Eskom's asset base and surplus capacity has grown.

A virtuous cycle has been established whereby lower debt leads to reducing finance charges, which in turn increases net cash flows from operating activities, and so more cash is available to fund investments or reduce debt. This cycle has been reinforced by the continuous growth in sales and revenue. In addition, Eskom's exemption from taxation until 2001 and its ability to retain all net income generated, has allowed management to pursue this strategy to its full potential (see the discussion under section 3.2.3.5 below).

[59] The methodology for the preparation of current value statements has proven to be controversial in the key areas of provisioning and reserve accounting for the Central Electricity Generating Board in the UK before privatisation (see Heald 1989). Although current cost accounting embodies important theoretical advances over historic cost accounting, it allows greater leeway to yield to the temptation to manipulate asset values and profits.

3.2.3.4 Trends in Eskom's cost elements

Important changes have occurred to Eskom's costs since the 1990s. Figure 13 shows the main elements of Eskom's income statement costs as finance charges, depreciation, coal costs, materials and services, and wages. Costs and net income are expressed in real terms per unit of electricity sold to remove the effects of inflation and increasing variable costs as sales volumes grow. Fixed cost elements, however, show a reduction per unit as sales increase.



Figures are expressed in January 1998 Rands using PPI
Source: Various Eskom annual reports

Figure 13: Eskom's average price showing costs and net income/kWh

Net interest and finance charges show a significant decline over the period. Meanwhile, net income increased 32 percent per kWh (75 percent total increase) between 1988 and 1997.

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. Interest charges and finance costs are related to the price of debt and the level of indebtedness. Debt levels are influenced by the magnitude of the capital investment programme and the proportion of the investment needs that has to be met by debt finance (as opposed to internally generated cash). Capital expenditure, debt and interest charges are shown in Figure 11 on page 42. During the period between 1988 and 1997, the interest rates paid on Eskom bonds varied between 13% and 15% (nominal).

3.2.3.5 Consumer privilege and the pricing compact

Eskom's tax-free status and “consumer privileged” (dividend free) capital structure greatly assisted its financial recovery. Moreover, this financial benefit was compounded by Eskom's average interest rate because the annual savings on tax and dividends contributed to lower debt levels than otherwise would have been the case. Exact calculations of the savings are complicated by the difficulty in determining how the tax authorities would have applied South Africa's tax rules to Eskom including the methodology for the valuation of its assets for taxation purposes (Eskom, 1999). It is also difficult to calculate Eskom's attempts to optimise its “tax efficiency” in response to a tax regime.

Table 4 shows an estimate of the tax and dividend savings that have accumulated to Eskom over the twelve-year period between 1986 and 1998.

The calculation assumes that capital expenditure on electrification would have been deducted from dividend payments. The total benefit from 1986 to 1998 amounts to R22 579 million.[60] This is equal to 32 percent of Eskom's 1998 historic cost balance sheet value. This calculation shows that the compound effect of Eskom's tax-free status and “consumer privileged” capital structure would have greatly accelerated its financial recovery at the price levels it maintained. The tax and dividend savings also mean that Eskom could have had lower price increases than would otherwise have been necessary to achieve the same improvement in its financial position. Or, alternatively its financial recovery was achieved at lower prices than what would otherwise have been possible.

Table 4: Estimate of Eskom's income tax and dividend savings

[60] The annual savings shown in Table 4 are assumed to have earned a financial return equal to Eskom's average interest rate between 1987 and 1998. The figure thus includes the interest savings that have been realised assuming that the savings were offset by debt.

	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986
Net income	2750	3083	3072	2716	2268	1646	1489	988	845	728	816	702	199
Taxable income [1]	3380	3894	3632	3341	2922	1859	1593	1238	916	728	816	702	199
Tax @ 35%	1183	1363	1271	1169	1023	651	558	433	321	255	286	246	70
Net income after tax	2197	2531	2361	2171	1899	1209	1036	805	596	473	530	456	130
Electrification capital expenditure	845	867	1049	1055	808	584	442	30	0	0	0	0	0
Net income after tax & electrification	1352	1664	1312	1116	1091	625	594	775	596	473	530	456	130
Dividends @ 33% [2]	446	549	433	368	360	206	196	256	197	156	175	151	43
Tax and dividend saving	**1629**	**1912**	**1704**	**1538**	**1383**	**857**	**754**	**689**	**517**	**411**	**461**	**396**	**113**

Figures are in (current) R millions

[1] Following Davis (1997: 173), provisions for nuclear waste management, provisions for management rationalisation, provisions for post-retirement medical benefits and 75% of provisions for arrear debts, were added back as required by SA tax regulations.

[2] This dividend rate was used for South Africa's publicly owned national telecommunications operator Telkom (Davis, 1997)

Source: Calculated from Eskom annual reports.

3.2.3.6 Summary

Despite the fact that Eskom continued, at a slower pace, with most of its excessive investment programme, its financial position improved substantially in the years following the De Villiers Commission. This was achieved by capturing the benefit of its consumer privileged capital structure, initially by *increasing* prices and by reducing its rate of capital expenditure after 1985. Gradually this strategy reduced its real debt levels and interest bill, allowing it to generate profits and benefit from its tax exempt consumer privileged structure, further enabling it to reduce debt. A virtuous circle of financial recovery was established. As the process developed Eskom could allow a modest reduction in its prices and effectively a substantial reduction in its return on assets.

Eskom’s financial management objectives were primarily oriented towards satisfying its debt financiers and thus emphasised debt-equity ratio and interest cover. These performance measures highlighted its performance as a borrower, but did not reflect the efficiency with which it was applying the economic resources under its control. Its prices, similarly, benefited from its consumer-privileged structure, and increasingly from the fact that more of its debt was amortised, and thus did not reflect the opportunity cost of the resources it employed to supply electricity. Eskom’s consumer privileged structure and low return to assets thus had the effect of providing misleading price signals about the efficiency with which it was applying its capital resources.

3.3 Eskom’s investment plans in 2006

Thus far the paper reviewed the historic experience with Eskom’s investment and financial performance. This section provides a brief overview of Eskom’s investment plans at the time of writing, which is an important part of the context for the discussion and conclusions presented below.

Eskom's generation capacity on the integrated network will soon be fully utilised (Eskom, 2005). Approval was obtained from Cabinet for a R84 billion investment programme over the five-year period from 2005 with the expectation that the investment programme will continue at similar rates thereafter (Financial Mail, 2005). Eskom's latest Annual Report expects the "underlying organic growth" to be "in the region of 2.3% … going forward" (Eskom, 2005: 50), while a more recent Financial Mail article cites Eskom's demand growth expectations to be "3% -4%" per year (Financial Mail, 2006).

R12 billion worth of refurbishment work to re-commission three of its "mothballed" stations, Camden, Grootvlei and Komati over the next five years is already under way. With refurbished units being brought online since 2005, by 2011 the three stations will provide an additional 3600 MW of capacity. Eskom further plans to build 1050MW of peaking open-cycle gas turbines (OCGT) by 2007 and is also at the point of committing to the construction of a new 2100MW base-load coal fired station close to Matimba in the Waterberg coal field in South Africa's northern Limpopo province (*ibid*). Plans for a further large pump-storage scheme in the Drakensberg, named Braamhoek, are also far advanced (Eskom, 2006). Together these new capacity additions are expected to average around 1200MW annually for the five years from 2007 onwards (*ibid*).

The National Energy Regulator (NERSA)[61] bases its views on power sector expansion requirements on its National Integrated Resource Plan (version 2), NIRP2, which it prepares in consultation with Eskom and other stakeholders. Eskom's own Integrated System Expansion Plan (version 9), ISEP9, produces similar results. However, the Eskom Generation Division views these plans as longer-term indicative plans and bases its implementation plans on its own "Generation Accelerated Investment Plan" which contains an accelerated construction schedule that results in higher reserve margins[62]. Eskom managed to bypass NERSA and submit this plan to the Department of Minerals and Energy and the Parliamentary Committee on Minerals and Energy for "approval".

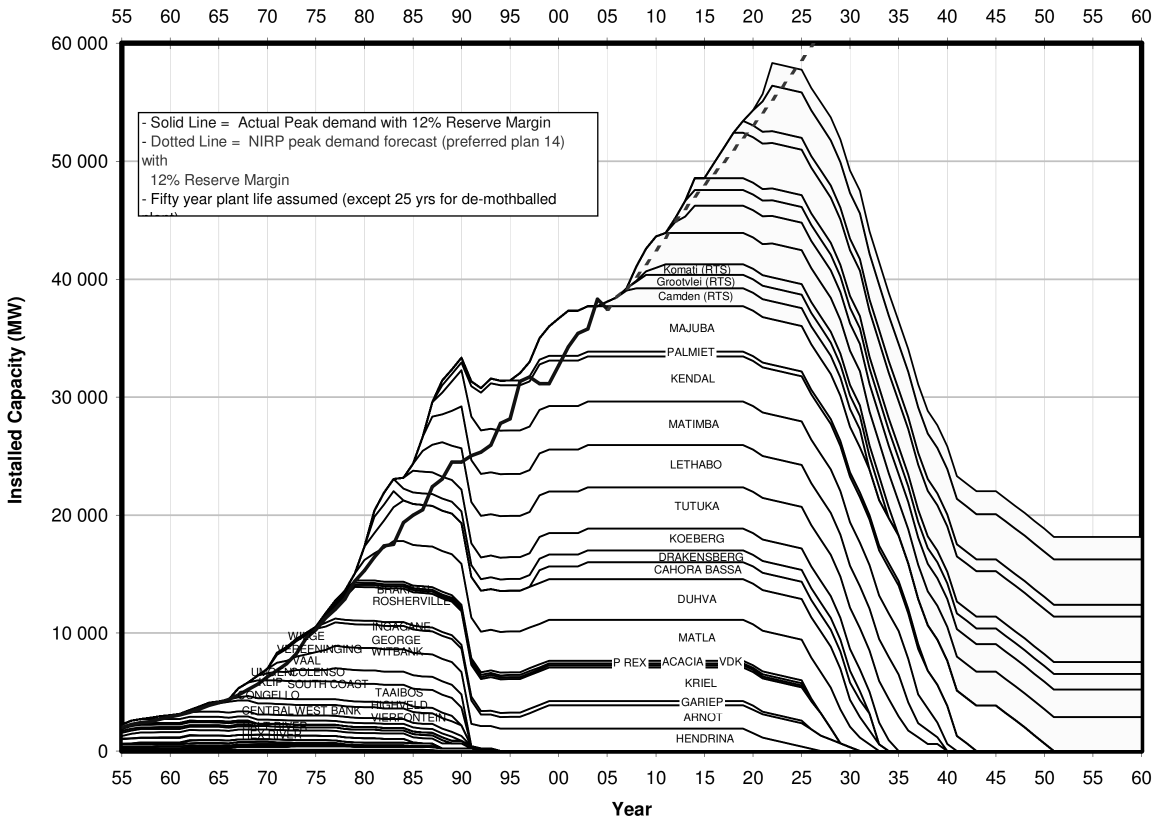
The Eskom indicative longer-term plans are shown in Figure 14 below.

[61] The National Electricity Regulator (NER) was renamed in November 2005 as the National Energy Regulator of South Africa (NERSA) with an expanded brief that now includes the regulation of gas and petroleum pipelines.

[62] In some years this plans foresees reserve margins reaching levels of up to 23%. This implies that Eskom is planning to construct more generation capacity than is required for a secure power supply with an adequate security margin.

Over the past year and a half Johannesburg, and more recently Cape Town, have experienced regular power failures. In the case of Johannesburg, the failures were the result of chronic underinvestment in distribution infrastructure by the Johannesburg municipal distributor. The power failures in Cape Town were mostly caused by failure of one generating unit at the Koeberg nuclear plant after planned maintenance; and the coincidence of failures on the transmission networks supplying the Cape, with failure of redundant power supplies to auxiliary systems at Koeberg, forcing a compulsory precautionary shutdown of the remaining reactor.

Together these circumstances have contributed to high levels of public concern about the reliability of future power supplies. The present climate resembles that of the late 1970s and early 1980s when the excessive and technologically inappropriate expansion was embarked upon, from which South Africa is only now emerging from.



Source: Eskom communication

Figure 14: Eskom planned and historic system expansion

4 Discussion and conclusions

South Africa stands at the beginning of a new investment phase in its power sector. Substantial problems resulted from Eskom's technology choice and investment decision making during the previous phase in the early 1980s. This paper sets out to review this experience, to suggest an analytical framework within which it may be understood, and to make suggestions for improving power sector investment decisions in the future.

Assessing power sector investment decisions is particularly difficult, because it entails assessing resource allocation strategies, which should strike an appropriate balance between different objectives in the face of uncertainty. The only knowledge we have about the future is that our predictions and best made plans will at times be wrong, and that entirely unforeseen contingencies could occur. As outlined in section 2.1.1, under these circumstances, strategies that limit costs by increasing system diversity and providing flexibility to adjust to new circumstances hold greater value than what would normally be apparent from conventional engineering investment appraisal techniques that often still dominate the paradigms of planners.

It is remarkable to observe that Eskom's prices only approached the levels, in real terms, of the pre-1973 oil crises era by the end of the 1990s (as depicted in Figure 7 on page 28). This was twenty years after it commenced its large programme of building technologically more advanced, larger scale plant that were intended to exploit economies of scale and reduce costs. While other factors are probably also at play here, it is a supreme irony that Eskom has not been able to supply power at a lower cost than it did with technology that was at least forty years older (from an era before the great improvements in steam turbine technology during the 1960s and 1970s). This is an important demonstration of the real world effects of uncertainty and ignorance. It is these effects that are not adequately reflected in conventional system planning methodologies. The larger size, greater complexity, longer lead-times, greater working capital requirements and thus greater exposure to uncertainty and a greater margin for error, almost certainly mean that economic costs are likely to be higher than what planners expect and reflect in their models.

4.1 Moral hazard

In order to provide focus to this study, the hypothesis was proposed that managers are subject to moral hazard with respect to the decisions associated with system and investment planning. The case material presented is reviewed here in the light of the four elements that are required for the existence of moral hazard.

Agency relationship

A principal-agent agreement exists between a public (nationalised) utility and society.[63] The Executive Management of a public utility ESCOM / Eskom executives act as agents on behalf South African society, primarily as represented by Government.

Divergent benefits for Managers (agents)

De Villiers recognised that the main reason for ESCOM's excessive investment decisions lay with a distortion in managerial investment incentives. The report suggested that for ESCOM managers the route of minimum risk involved the avoidance of public and political criticism about the utility's possible inability to supply power (as they had indeed elicited in the past). This resulted in "over insurance" and unnecessary costs, which could in turn be automatically recouped by increasing prices (1985: 216). The report also states that the danger exists that managers "would make absolutely certain that there would not be a shortage of electricity in the future", even at a cost that could not be justified (1985: 223).

Until the middle 1970s, employing bigger and better technologies could solve most of the challenges ESI managers encountered. Under conditions of high demand growth and strong economies of scale in the technology employed, *more* investment meant *lower* costs and prices.

Generally the only risk that mattered to ESCOM was the danger that it would not be able to meet demand. For managers the only acceptable way to respond was to build more and larger plant. Between 1979 and 1982 ESCOM committed to an investment programme that would double its installed capacity with little consideration of the possible risk of constructing more capacity than was required, or of constructing plant with technology that could not yet be operated reliably with South African coal. Investment decisions were made despite numerous views to the contrary from Eskom's own staff and an internationally respected consulting group retained to review the utility's investment planning.

While investment reduced from previous plans in the middle 1980s, this change can not be ascribed to governance improvements, but rather to the *ad hoc* governance effect of the De Villiers Commission and the undeniable reality of substantial over capacity. Moreover, despite the institutional reforms, investment continued on a significantly larger scale than was required, pointing to a continued governance bias towards over investment in inflexible projects.

[63] It can also be argued that a principal-agent agreement exists between a private, investor owned franchise utility - as in the traditional model in the United States - and society, by virtue of the regulatory contract.

Risk shifting

As outlined above, financing and investment risks have been borne Eskom's consumers. Eskom remains a monopoly and continues to benefit from financing risk-shifting arrangements established in its governing statutes.

Information asymmetry

The discussion identified the existence of *ex ante* information asymmetry about problems with the economic prudence of managerial system planning decisions, and *ex post* information asymmetry about the actual higher costs and poor economic performance of projects. With the exception of the extreme problems experienced in the late 1970s and early 1980s, Eskom's financial performance indicators and prices have proven to be a very poor indicator of investment - and thus its economic - performance. This is not generally appreciated. Eskom's "consumer privileged" capital structure, tax exemptions, other subsidies, and its monopoly position meant that it was possible to show strong financial performance and maintain lower prices despite a large amount of costly stranded assets.

Obtaining information about the risk bearing characteristics of an investment option is by nature difficult and costly. Eskom's principals (government departments and even its regulator) are generally not able to form a robust independent view of the efficacy of its strategies.

To the extent that Eskom's *business* risk is reduced by risk shifting, managers and financiers are likely to have weaker incentives to produce such information themselves, because they would not bear the higher costs if adverse contingencies arise. Further shifting *financier's* risk to consumers and the state (as effected by the past and present statutes relating to Eskom), would even further reduce financier and thus also managerial incentives to produce such information.

The value of reversing information asymmetries was demonstrated by the impact of the De Villiers Commision. While only a once-off intervention, it is notable that by revealing information about investment performance and managerial incentives the Commission did have an impact on Eskom's behaviour in the first few years following the publication of its findings.

Substantial evidence thus exists to support the finding that all four elements required for managerial moral hazard are still in place. In contrast to the conventional insurance moral hazard problem, information asymmetry about *ex post* outturns suggests that the prevalence of moral hazard will not be recognised *ex post*. It would thus be appropriate to refer to the problem as “persistent moral hazard”. This provides a persuasive argument that Eskom system planning will remain strongly influenced by managerial moral hazard problems unless significant steps are taken to remedy the situation.

4.2 Pricing

When the foundation of Eskom's institutional and financial framework was designed in the 1920s, it was intended that Eskom should be a non-profit organisation (later called the consumer privileged model by De Villiers). This paper has highlighted an important irony of the consumer privileged financial and pricing model. It has had unintended negative consequences on managerial incentives and economic governance with respect to investment decision-making, by creating information asymmetries and thus contributing substantially to managerial moral hazard problems. The consequential over investment and inappropriate technology choice in the face of future uncertainty has destroyed part of the economic value that was supposed to have been distributed to consumers. The practice of distributing economic rent by way of “consumer privileged” capital structure and prices, it seems, weakens economic governance, encourages allocative inefficiencies and the destruction of economic value, and thus ultimately also undermines distributional objectives.

The fact that prices where not adjusted in accordance to scarcity during large increases in demand in the 1970s, meant that ESCOM was faced with uneconomically high levels of demand. South Africa runs the risk that history will be repeated. Despite the fact that power generation capacity is again about to be depleted, current electricity prices remain at historic lows with Eskom’s average price at 16.04 SA c/kWh during 2004 (Eskom, 2005). Eskom’s prices are set in terms of historic cost accounts. The over-construction of plant in the 1980s meant that few plant have been constructed in the past fifteen years and that the utility’s asset base is now heavily depreciated and undervalued because of inflationary effects. Eskom’s 39 810MW generation capacity has a balance sheet value of only R24.7 billion while the construction of a large 4000MW power station, which would add 10% to the installed capacity would cost approximately R26 billion at $1.1million per MW – more than the entire generation asset base. Prices are thus substantially below the levels of replacement value and are probably, as before, an important additional factor behind the currently observed levels of demand growth.[64]

[64] While, following its corporatisation, Eskom has in recent years begun to make tax and dividend payments, under rate-of-return regulation, its very low asset valuation has ensured that profits levels are now sufficiently low to compensate for the payments which are also very modest as a result. This means that Eskom is for now still on a similar price path as with the “consumer privileged” model that prevailed before these changes.

4.3 Implications for present challenges

The identification of the causes of past investment problems, many of which are still in place today, may reduce the probability of similar problems occurring again while South Africa responds to the present challenges in the power sector.

Evidence of persistent managerial moral hazard problems begs the question as to how the mechanisms of this problematic incentive framework may be undone. While the separation between principal and agent is unavoidable in the modern corporation, steps can be taken to reduce the remaining three elements that contribute to the moral hazard construct: divergent managerial incentives; risk shifting away from agents; and information asymmetries with respect to the risk bearing nature of managerial investment decisions and outcomes.

With respect to the last element, improvements could be made to the information problems relating to Eskom's investment planning practices. Eskom investment plans are mostly developed on a confidential basis, and are submitted for Cabinet approval before they have been formally evaluated by the National Energy Regulator of South Africa (NERSA) or made available for public comment and reviewed by independent analysts and researchers. As a public utility Eskom should be required to make detailed information about its planning methodology, assumptions and plans available and to engage in public dialogue about its plans. Eskom should further be required to first take its plans through the NERSA approval process, which should be open to the public. By obtaining Cabinet endorsement of plans that have not been reviewed by independent parties, Eskom makes it politically nearly impossible for NERSA to respond critically or disagree.[65]

It will not be possible to address risk shifting while the industry is organised as a monopoly and it continues to effectively operate as a "consumer privileged " utility where consumers receive most of the opportunity cost of the non-equity portion of its balance sheet, in the form of below cost electricity prices.[66] It will similarly be difficult to address adverse managerial incentives while, because of Eskom's monopoly position, financial performance is not closely related to the economic performance of investment decisions, and managers gain large reputation and pecuniary benefits from constructing new technologies and large plant.

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[65] The Government Communication and Information System (2006) reported on 27 January 2006 that Cabinet had approved Eskom's "electricity generation investment plan".

[66] In other words if Eskom incurs financial losses because of poorly performing investments, it will not be possible to reduce shareholder returns to compensate, as consumers already get most of these returns in the form of below full cost prices and will thus inevitably end up footing the bill.

As outlined in section 2.1.1 above Eskom and NERSA's system planning (ISEP, NIRP, etc.) methodologies remain deeply flawed and have a strong bias towards large, inflexible, capital intensive plant, particularly large coal and nuclear. Eskom still has powerful institutional momentum to build coal plant. Important advances in system planning methodologies and in the valuation and inclusion of demand-side options have been made over the past twenty years. Eskom has even begun experimenting with some of these options, but should now be required to open its analysis and engage in public dialogue with NERSA and other analysts.

Some of the worst excesses in investment decision making occurred during the supply crises in the early 1980s when load shedding and other emergency measures had to be taken. With current short-term supply problems in the Western Cape and other areas, South Africa runs the real risk of repeating the mistakes of the past. While flexible short-term measures are needed to address the immediate problem, special care should be taken to avoid committing to an extremely costly long-term build programme based on inappropriate technology, scale and location choices, under the current atmosphere of crises and political pressure.

Eskom's depreciated historic cost accounting practices have led to price levels that misrepresent the inefficiency of past performance, the cost of electricity, and the scarcity of present supply capacity. This may have led to demand levels that are much higher than what is economically appropriate. Although a detailed analysis of this question is beyond the scope of this paper, it is likely that reforming misleading accounting practices and increasing prices to levels closer to the actual cost of supply will be the most economic way to avoid uneconomic levels of power demand and power sector investment. Care should be taken to remove the resulting surplus free cash flows from Eskom and apply them elsewhere in the economy to compensate appropriately for higher electricity prices. A review of the accounting and pricing issues which have led to the 85 year old South African industrial policy legacy of "consumer privileged", under-priced electricity, is in order.

This analysis has raised sufficient concerns to justify a comprehensive public review of: Eskom's governance and investment decision-making methodologies and procedures; and of its accounting and pricing policies.

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