The electricity poverty tariff in South Africa: possibilities and practicalities

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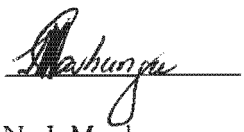
DECLARATION

I declare that this half thesis is my own, unaided work. It is being submitted in fulfilment of the requirements for the degree of Master of Philosophy (Energy and Development Studies) at the University of Cape Town. It has not been submitted before for any degree or examination in any other university.



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LIST OF ABBREVIATIONS

AC	Average cost
ANC	African National Congress
EDI	Electricity distribution industry
ESI	Electricity supply industry
ERIC	Electricity Restructuring Interdepartmental Committee
LRMC	Long-run marginal cost
MC	Marginal cost
NELF	National Electrification Forum
NER	National Electricity Regulator
NUM	National Union of Metalworkers
RDP	Reconstruction and Development Programme
REDs	Regional electricity distributors
ROR	Rate-of return
SRMC	Short-run marginal cost

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CHAPTER ONE:

INTRODUCTION

1.1 Background and rationale

On 22 October 1998, the South African National Electricity Regulator (NER), which regulates the electricity industry, announced the introduction of a new poverty tariff in a form of an income-related rebate. The intention was to implement the new tariff at the beginning of 1999. However, soon after the announcement by Magate Sekonya, the then Chairman and Chief Executive Officer of the NER, he resigned with some other board members. Consequent to that resignation the NER has put the issue of the poverty tariff on hold pending further investigation. Against this background this study investigates the possibilities and practicalities of a poverty tariff for electricity in South Africa.

1.1.1 Need for a poverty tariff

The basis of the new proposed poverty tariff (the income-related rebate) is that people who earn less than a certain level (for example, R500 per month) should receive small amounts of electricity for free, or at a reduced rate.

The primary objective of a poverty tariff is to get rid of barriers to entry and to address the key issue of affordable electricity pricing for the poor. The second objective is to redress the past exclusion of the majority black population from electricity services and improve equity through widening access to electricity services. Thirdly, a poverty tariff seeks to bring socio-economic relief to poor people. Indeed, the issue of affordability of electricity is still a major obstacle to poor people wishing to get access to electricity. The Government is trying to address the complex issue of poverty and equity. Given that South Africa is characterised by a highly unequal distribution of income and wealth, with the majority living in poverty, there is a need to improve equity through widening access to services. According to Eberhard and Van Horen (1995) this is a legitimate and significant goal of development, with measurable and immediate benefits to the poor.

The study on a poverty tariff by Hartog *et al* (1999) found that some of the municipal town engineers interviewed agree that the existing measures that attempt to address poverty in electricity are inadequate. Some argue that a new measure should be devised for those who cannot pay other than for those who do not want to pay. This introduces the issue of trying to separate unwillingness to pay from inability to pay.

1.1.2 Restructuring of electricity distribution industry (EDI)

Three types of distributors comprise South Africa's EDI. These are Eskom's distribution division, a large number of municipal distributors and a handful of other distribution agencies. Each distributor is required to obtain a license from the National Electricity Regulator (NER), which also has jurisdiction over prices. Licence conditions include a requirement that the distributor fulfils an electrification programme (Davis and Steyn 1998).

The EDI is characterised by a number of challenges that could undermine the electrification programme if they are not addressed immediately. Government through the Electricity Restructuring Interdepartmental Committee (ERIC 1997) highlighted the following issues:

- The current fragmentation of the EDI,
- The substantial differences in the financial health of municipal distributors,
- Disparities in prices paid by various customer segments that cannot be explained by differences in costs associated with serving these segments,
- Unfair pricing from Eskom,
- Economies of scale, skill and specialisation are not being captured by many of the small distributors,
- Electrification needs are not evenly distributed across regions, and some distributors cannot fund their targets, which places the national electrification programme at risk, and
- Certain distributors are not financially viable at present, but collectively the industry can fund both electricity supply and electrification over the long term.

The crucial issue that requires urgent attention is the tremendous financial burden that electrification places on electricity supply authorities. According to Pickering (1994) most local authorities are unable to mobilise the required finance for electrification. At this time, no mechanisms existed whereby funds might be collected centrally and disbursed to the many components of the EDI to assist with electrification. The NER attempted to rationalise the EDI through its first licensing round, but the initiative failed. Ultimately an Electricity Working Group was appointed to investigate the possible restructuring of the financial relationship between local government and the electricity sector, and to develop proposals for the rationalisation of the EDI.

Given all these problems it is indisputable that there is an urgent need for the EDI to be restructured. After considering a number of options, government has proposed the formation of Regional Electricity Distributors (REDs). This model appears to offer the

greatest benefits compared to other alternatives (Barberton 1998). The benefits of REDs include balancing the need to capture economies of skill and scale with the need for local input and ownership of the distribution industry, facilitating more transparent performance standards between distributors, and preparing the industry for customer choice. The important point from the perspective of this study is that distribution restructuring will necessarily entail price reform.

1.1.3 Access to electricity and electrification

Historically, South Africa has had a very low domestic access to electricity, especially among the black population. This was not due to constraints of inadequate generation capacity, but is attributable to apartheid policies, which led to a racially based development that left the majority of South Africans without electricity. In contrast the white population is largely well served by a quality supply of grid electricity.

Eskom embarked on a national electrification programme in 1991, motivated by three factors that have been identified by Eberhard and Van Horen (1995: 88-9). First, provision of electricity services became increasingly politicised in the 1980s. Second, the political transition from minority rule to democratic national government stepped up existing pressures on local authorities and Eskom to address the needs and demands of the majority. Third, the juxtaposition of these strong increasing political demands for electricity, against the over-capacity of Eskom's generation system, became increasingly untenable in the new political environment.

The launching of this national electrification programme saw Eskom facilitating the connection of households in areas where local authorities held supply rights. The African National Congress (ANC) through its Reconstruction and Development Programme (RDP) took this up to the national political debate. Electrification became a key policy of the new government of national unity (Eberhard and Van Horen 1995).

The Government set a national target of 2,5 million household connections by the end of 1999, with an annual target of 450 000 new connections. As a contribution to the RDP Eskom set itself the target of delivering 1,75 million household connections (300 000 per annum). It was agreed that municipal distributors would be responsible for the remainder. By 1999 household electrification levels had increased to almost 63% from 36% in 1994 (Business Day February 18, 1999). The EDI has kept pace with its annual target of 450 000 new connections each year. However, there are problems that relate to the continuation of the programme. These include high capital costs that are expected to increase three times when electrifying remote rural areas, low sales due to low consumption, as well as non-payment problems. The programme required capital

investments of up to R2 billion per annum when it started and it was expected that the program will incur operating losses of up to R300 million per annum during the early years (White Paper Energy Policy 1998). The big question is who is supposed to pay for these.

1.1.4 Establishment of the National Electricity Regulator

In 1995 the National Electricity Regulator (NER) was set up as a successor to the Electricity Control Board. The NER exercises control over the electricity industry to ensure order in the generation and efficient supply of electricity. The role of the NER entails the following:

- Licensing generation, transmission and distribution
- Regulating electricity tariffs
- Settling disputes between licencees within the electricity industry
- Mediating any conflicts that may arise (Langa, 1999).

The underlying objective of the NER is to ensure that customers are provided with adequate reliable services at prices that are affordable and reflect acceptable levels of efficiency on the part of the distributor. The fragmented industry has led to a wide disparity in the pricing and cost of supplying electricity. The NER is making some progress regarding narrowing the vast differences of tariffs. The ultimate goal of the NER is to develop a coherent price regulation system that is still lacking.

1.1.5 Tariffs rationalisation

Electricity pricing regulation is one of the major challenges facing the electricity industry. The problems currently faced by the electricity industry stem partially from fragmentation of local authorities and price variation and date back to apartheid South Africa. Before 1995 there was limited regulation of electricity pricing in South Africa. The Electricity Act of 1987 (Act No.41 of 1987), which defined the structure, functions and responsibilities of the Electricity Control Board determined electricity pricing. Municipalities were excluded from the ambit of the Electricity Control Board. As a result of this limited central regulation, politically elected bodies of local authorities determined local electricity tariff structures and levels in a virtually autonomous fashion. Consequently, a profusion of tariffs and tariff policies emerged resulting in glaring disparities in electricity prices in neighbouring areas (Pickering 1994). These problems need to be addressed urgently for the sake of energy equity and the reduction of poverty among the black majority who were excluded from electricity supply. One of the key proposals currently on the cards for the electricity supply

industry (ESI) is to introduce a national electricity tariff system[1]. The NER has made some progress in rationalising the prices within metropolitan councils and the transitional local councils to reduce the more than 2000 tariffs that existed in 1994 (Du Plessis 1997).

1.2 Thesis objectives

The general objective of this thesis is to investigate what price system will result in a sustainable electrification programme, a viable EDI, fit into the regulation system and address issues of equity and poverty.

Specific attention is paid to the proposals around poverty tariffs for low-income domestic users. This research examines the form, level and financial implications of poverty tariffs in South Africa. The following are the specific objective of the thesis:

- To evaluate the current system of prices in South Africa
- To investigate what poverty tariff structures are possible and
- To investigate the financial implications of poverty tariff options and their sustainability.

1.3 Research methodology

1.3.1 Limitation of scope

In this thesis the point of departure is to analyse the NER's proposal for a poverty tariff. The thesis makes use of existing data on household income categories (as referred in section 1.3.2) and it does not investigate other welfare measures, which could be alternatives to an electricity poverty tariff. Furthermore the thesis is restricted to the institutional and administrative proposals put forward by the NER, and does not discuss alternative institutional and administrative arrangements such as those which might arise in the context of future regional electricity distributors. (With regard to the regional electricity distributors only financial implications are discussed, not possible institutional implications).

1.3.2 Literature review and secondary data

An extensive literature review on the theory of electricity pricing and the underlying theory of the five tariff structures, which have been investigated, was done. Apart from literature review, inputs from experts in the field of electricity pricing were considered.

Some of the key areas that have been addressed entail review of the existing system of prices of electricity, the five possible poverty tariff structures, and the financial implications

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[1] A national electricity tariff system does not mean national tariffs, but common methodology of arriving at tariffs that should be fairly similar for the different distributors (Energize November/December 1998: 14).

of those tariff structures. For the review of the system of prices, the National Electricity Regulator database 1995/6 was used extensively. Information on South African households' income and its correlation with access to electricity was obtained from Statistics South Africa (Income and expenditure of households 1995) and their web-site http: //www.statssa.gov.za, Eskom's SA to Z 1996 edition and the National Electricity Regulator's 1997/8 Annual Report.

1.3.3 Interviews

A number of semi-structured telephone interviews and a round-table discussion were held.[2]

1.3.4 Modelling

Microsoft Excel spreadsheets were used to analyse the NER database and the financial implications of the different poverty tariffs.

1.4 Thesis outline

Chapter one is the introduction. Chapter two presents a theoretical framework of the subject of electricity pricing. It moves on to discuss the general guidelines used in the pricing of electricity. The trade-off between pricing for efficiency and pricing for equity, which is the basis of a poverty tariff debate, is discussed. Different theories of pricing are also discussed.

Chapter three reviews the existing tariff systems and the price levels. It begins by examining the current electricity tariff system in South Africa. The chapter goes on to discuss the possible rationalisation through establishment of Regional Electricity Distributors (REDs). Mossel Bay Municipality is used as a case study, focussing on its tariffs for different consumers, their consumption and the income that it gets from these customers.

Chapter four discusses the possible poverty tariff structures. It starts with a discussion of the motivations for the poverty tariff structure proposed by the former management of the NER. This is followed by the current debate on poverty tariffs, the purpose being to capture

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[2] The following people were interviewed telephonically, Shirley Salvodi (Small Customer Pricing Manager-Electricity Pricing Department) of Eskom, Mark Pickering of Palmer Development Group and Okert Bothma, Town Engineer (Electro-technical) of the Mossel Bay Municipality. The round table discussion involved Charles Dingley who has published quite extensively in the electricity sector, three Masters students (Vera Hartog, Filip Schiettecat and Luc Winters) from the University of Vlerick Leuven Gent Management School- Belgium who were on an exchange programme with the university of Stellenbosch. They were based at the Electricity Pricing Department of Eskom during the time of their study. Their study topic is "Financing Strategies for Electrification in South Africa." A special note of thanks from the bottom of my heart goes to all of you. Your time and unselfishness is highly appreciated.

the views of other stakeholders. Thereafter five possible poverty tariff structures are discussed mainly focussing on how each structure works, key features and the advantages and disadvantages.

Chapter five explores the financial implications of the possible poverty tariff structures discussed in chapter four. It begins by giving a background of household income levels and the levels of electrification, which is followed by the cost of supplying individual households with electricity. Against this background this chapter examines the financial implications of the possible poverty tariffs trying to show this at three different levels of electrification (46%, 60% and 100%). Thereafter the possible method of financing the poverty tariff is discussed briefly. Finally, chapter six draws out the critical conclusions of the thesis and puts forward some policy recommendations. The chapter gives a brief summary of the preceding chapters before presenting a set of conclusions and recommendations.

CHAPTER TWO:

ELECTRICITY PRICING THEORY AND POVERTY TARIFFS

2.1 Introduction

This chapter outlines a broad theoretical approach in electricity pricing the purpose being to build a framework of the central discussion of the thesis, which is poverty tariffs. Pricing refers to the process of setting prices and price is the money value charged for a particular product (Conradie and Phike 1999). "Both in theory and practice, electricity pricing is a difficult and complex subject" (Teplitz-Sembitzky 1992: i). Madzikande (1992: 35) shares the same sentiments arguing that electricity price setting or tariff design is considered both an art and science, because a certain amount of judgement and expert opinion is required. Pricing decisions in the electricity industry have to be made in the context of uncertainty and limited or no information on some matters. Other constraints include distortions in the pricing system, technical feasibility and imperfect institutions. Besides, there is a need for simplicity and clarity as well. There are also usually a number of constraints from political, financial and equity objectives (Vedavalli 1989: 24).

Section 2.2 explains the general guidelines in the pricing of electricity. The underlying argument of these guidelines is that the price of electricity should be based on the cost of supply while fulfilling certain objectives. Section 2.3 moves away from a general discussion on pricing to a more focused discussion. It discusses the issue of trade-offs between pricing for efficiency and equity and explores the motives underlying the new proposed poverty tariff in South Africa. Section 2.4 discusses various theories of pricing, which include marginal cost[3](MC) pricing; average cost (AC)[4] pricing, two-part tariffs, contestability and the price cap and rate-of return approaches. Section 2.5 concludes by summarising the main findings of the chapter.

2.2 General guidelines in the pricing of electricity

This section sets out the basis of electricity pricing by explaining the importance of price regulation and the principles which should be considered when establishing electricity prices. The general pricing objectives are economic efficiency, equity for all customers,

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[3] To Samuelson and Nordhaus (1989: 514) marginal cost denotes the extra or additional cost of producing 1 extra unit of output.

[4] *Ibid:* page 516 define average cost as the total cost divided by the number of units produced.

viability for the electricity distribution industry (EDI), implementability, simplicity and a number of other political, social and economic requirements.

The price of electricity should be based on the cost of supply while fulfilling certain objectives or criteria, not all of which are mutually consistent. Prices that communicate the cost of changes in consumption give incentives to consumers to adopt levels and patterns of consumption for which they are prepared to pay and mobilise resources to enable the distributor to finance new investments.

2.2.1 Price regulation in the electricity supply industry (ESI)

Prices that reflect economic costs are an essential part of a policy to achieve efficiency in the ESI. It is for this reason that price regulation is important in order to prevent utilities with market power from charging rates above the economic costs of supply. The principal objectives of regulation are allocative efficiency (which in principle in a competitive market, is achieved when price equals marginal cost), productive efficiency (incentives to minimise costs) and distributional equity (no "excess" profits and equitable prices for different categories of customers). Each of these is briefly discussed below:

First, allocative efficiency (also known as Pareto efficiency)[5] occurs when no possible reorganisation of production can make anyone better off without making someone else worse off. Under conditions of allocative efficiency, therefore, only lowering someone else's utility can increase another person's utility (Samuelson and Nordhaus 1989: 548). Efficient allocation of the firm's output involves the consumer paying a price for his or her marginal unit equal to the cost of producing that unit. The output is efficiently allocated if the firm offers a price to all consumers that equals marginal cost. Second, productive efficiency refers to production of any output at the lowest attainable cost for that level of output, given a certain technology choice. The first condition for productive efficiency is that each firm should produce any given output at the lowest possible cost (Lipsey *et al* 1990: 969).

The difference between allocative efficiency and productive efficiency is that the former concerns the relative quantities of the different commodities to be produced. Achieving allocative efficiency ensures that the bundle of goods actually produced is an efficient one. The latter has two aspects, one concerning production within each firm, that is, it requires that production be allocated among the firms in any one industry so that all firms have the same marginal cost. The other aspect concerns the allocation of production among the

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5 This concept of efficiency is also called "Pareto efficiency," after Vilfredo Pareto (1848-1923), the Italian economist who first devised the concept.

firms in an industry; thus, an economy is said to be allocatively efficient when it is on rather than inside its production possibility boundary (Lipsey *et al* 1990).

The third and last objective of regulation is distributional equity. Distortions in distributional equity are most likely to occur where a firm charges prices above average costs. The main concern of regulation should be to maximise the sum of consumer surplus[6] and profit, while preventing the firm from making excess profits. In the case of electricity pricing, "setting price equal to average cost signifies the compromise between a desire for allocative efficiency- setting price near to marginal cost - and the need for the firm to break even" (Armstrong *et al* 1994: 18).

2.2.2 Principles for electricity pricing

The following guidelines can be used in the pricing of electricity. These are quite general guidelines. They will be adapted to inform more specific criteria to evaluate various tariff structures in Section 4.4 in Chapter Four.

1. Utilities should set tariffs which are effective in yielding total revenue requirements
2. Prices should ensure that revenue is stable from year to year
3. The tariff or rates themselves should ensure a reasonable degree of stability with a minimum of unexpected changes and avoid large fluctuations that will have adverse effects to existing consumers
4. Such tariffs should be practical, simple, understandable and should be acceptable to consumers or customers
5. Such tariffs should be applicable with ease in terms of legal authority, administration competence, information requirements or billing procedures
6. In general tariffs should avoid undue discrimination in cross-subsidisation. However, other economic and political requirements may also be considered, for example subsidised electricity supply to certain sectors to enhance growth, or to certain geographic areas for purposes of regional development. Such tariffs should encourage efficiency in the use of utility services. National economic resources must be allocated efficiently, not only among different sectors of the economy, but within the electricity power sector itself. Cost-reflective prices must be used to indicate to the electricity consumers the true economic costs of supplying their specific needs, so that supply and demand can be matched efficiently (Madzikande 1992 and Vedavalli 1989).

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[6] Samuelson and Nordhaus (1989: 456) define it as the gap between the total utility of a good and its total market value.

The following key features distinguish electricity pricing from pricing of any other item.

1. First, electricity is non-storable or at least storage is costly; it is generated at different times to serve loads of different size at different priority levels. Thus, power generation is a multiproduct industry in which time of use and priority of service can index the products.
2. Second, power generation is an example of joint production that exhibits economies of scope from horizontal integration and, thus, is cheaper than separate production.
3. Third, economies of scope entail multiproduct economies of scale. By the same token, the incremental costs of generating a particular load fall short of the corresponding stand-alone generation costs.
4. Fourth, power sector investments contain sunk costs[7] meaning that the worth of the sector's assets cannot be recovered entirely upon exit.

From the foregoing discussion it is evident that the process of developing electricity tariffs faces a number of challenges that reflect the technical attributes of the power sector and which make the process completely different from putting a price tag on any other item.

2.3 Pricing for efficiency versus pricing for distributional equity

This section seeks to raise the issue that forms the core of the debate on poverty tariffs namely the trade-off between pricing for efficiency and pricing for equity. The nature of this trade-off debate is to attempt to examine poverty tariffs, which can provide electricity to the poor without significant loss of efficiency. Achieving this trade-off is very complex because on the one hand utilities need to design tariffs that will enable them to recover their costs of providing electricity. On the other hand electricity tariffs, which ignore equity, may have an adverse effect on income distribution, because poor households are likely to spend a greater proportion of their income on electricity than wealthy households are. "The conflict between equality and efficiency is our biggest socio-economic trade-off, and it plagues us in dozens of dimensions of social policy. We can't have our cake of market efficiency and share it equally" Arthur Okun (1975) in (Samuelson and Nordhaus 1989).

Efficiency refers to the use of economic resources that produces the maximum level of satisfaction possible with the given inputs and technology (Samuelson and Nordhaus 1989:

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[7] Samuelson and Nordhaus (1989: 969) define sunk costs (also called fixed cost) as the cost a firm would incur even if their outputs for the periods in question were zero. Total fixed cost is made up of such individual fixed costs as interest payments, mortgage payments and director's fees.

971). Equity and fairness are often used interchangeably. Boland and Whittington (1999) argue that equity requires that equals be treated equally. In public utility tariff design, this could mean that users pay amounts that are proportionate to the costs they impose on the utility. Fairness is wholly subjective. Each participant in a tariff design process may have a different notion of the meaning of fairness. One may think it fair to set a high price for industrial electricity use while another may not. One may charge all customers the same price while another may believe that fairness requires subsidies to some customers.

Tariffs, which charge customers according to the burdens they impose on the system, would satisfy the particular notion of distributional equity referred to above. Such cost-reflective pricing should also promote economic efficiency. However, the result would be that low-income consumers, with lower electricity consumption levels but similar fixed costs of electricity supply, would pay proportionally more for their electricity than larger consumers would. This would go against the normal political idea of equity in South Africa, which is that the poor should not be disadvantaged and that there should be a measure of redistribution of income to assist the poor. One version of a redistributive tariff is the provision of a minimum level of service to customers who may not be able to afford the full cost. This would represent a lifeline tariff or special poverty tariff. One question is to what extent such a tariff would impact on allocative efficiency.

There are many public programmes such as child nutrition or free public education that may both increase equality and increase total output, notwithstanding other cases wherein conflict between equity and efficiency arises. When a country considers its income-distribution policies, it should weigh the increased fairness of redistribution against the reduction in national income that occurs because of redistribution. In some instances steps to reduce the extent of inequality may harm the efficiency of the economy, by reducing the amount of the national income available to distribute. In this vein the following two critical questions need to be discussed briefly.

2.3.1 Should South Africa invest in a poverty tariff?

The proposed electricity poverty tariff is meant to satisfy the distributional equity goal by way of providing wider access to electricity to poor people. This implies subsidies or cross-subsidies. However, if electricity equity is deemed an ethical good, it is one worth incurring some cost for.

The supporters of redistribution by means of a poverty tariff raise two concerns. Firstly, they argue that holding the electricity price down is the best or even the only practical way to get fairer distributive results. They reject the argument that the electricity price could rise and simultaneously subsidise the poor and tax the rich. They substantiate their rejection by

arguing that the political process is a potential stumbling block. The other argument is that basic commodities such as food, housing and energy should be provided to households cheaply, whatever the real opportunity cost[8]. They believe that the inefficiencies resulting from prices that do not reflect opportunity costs are a burden worth bearing to ensure that even people with very low incomes can afford the basics.

The other important argument that may justify the debate of pricing for distributional equity is what Badsha in Wilson and Ramphele (1989: 4) referred to as three interlocking factors that show the uniqueness of South African poverty. First was the width of the gulf between rich and poor, that is, the degree of inequality. Second, was the extent to which the poverty existed as a consequence of a deliberate policy. The third aspect has to do with the way in which material poverty in South Africa was reinforced by racist policies that are an assault on people's humanity.

Two intertwined issues emerge from the above discussion: how are these issues related to access to electricity services and how would electricity poverty tariff alleviates these issues? It should always be borne in mind that the exclusion of the majority blacks from access to electricity was a result of a deliberate apartheid policy. In this respect one can argue that it will need a deliberate policy to redress the issue of access to electricity acknowledging the degree of inequality that exists. The massive electrification programme was introduced to address this problem. However it seems to be insufficient owing to the gap between the rich and the poor. The majority of poor households still cannot afford to use much electricity. Ultimately a poverty tariff was proposed to address this issue of affordability with the purpose of making electricity service more accessible for the poor.

It is argued that 'trickle down' benefits of economic growth have failed to bridge the gap between the rich and the poor. Those who argue for a poverty tariff believe that it would help to bridge this gap. It could alleviate the problem of material poverty in different ways. For example, by having electricity some people could start small businesses, rural women could be relieved from the burden of collecting fuel-wood and students could have quality light for studying purposes.

2.3.2 How does electricity pricing for distributional equity affect efficiency?

Inequality in the provision of social services in South Africa is essentially visible. It is the responsibility of the representative democratic government to distribute social services as

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[8] To Lipsey *et al* (1990: 967) opportunity cost is the cost of using resources for a certain purpose, measured by the benefit given up by not using them in their best alternative use.

equally as possible. At the same time government must use the redistribution of social services as part of a broader strategy of income and wealth redistribution. However the question that must always be born in mind is can we achieve an appropriate efficiency-equity trade-off?

In an attempt to answer this question Lipsey *et al* (1990: 432) state:

> One way is to let the price system do the job of signalling relative scarcities and costs, thereby ensuring some efficiency in the allocation of resources, but at the same time to use taxes or expenditures to transfer income to achieve redistributive goals.

This approach would not seek to help the poor by subsidising the electricity price, but instead seeks to provide the low-income households with sufficient income by providing direct income transfers. Advocates of this method state that "it is surer, more direct, and less costly in its side effects than the method of subsidising the prices of particular goods. Moreover, the price subsidy method surely ends up subsidising some who are rich and missing some who are very poor" (Lipsey *et al* 1990: 432).

If poor households received a direct income transfer, they would not necessarily spend this extra income on electricity. Instead, they could choose according to their priorities. In principle, that should lead to a larger increase in the satisfaction of their various needs compared with an equal subsidy which was dedicated to electricity. This illustrates one way in which a dedicated electricity subsidy, in some form of poverty tariff, could be economically inefficient. It could have the effect of distorting household choices, with preference going to increased electricity consumption, whereas their own preferences might lie elsewhere, for example more food, housing or school fees.

According to Moll *et al* (1991) a redistribution-growth trade-off might not hold because many redistributional efforts do nothing for either growth or redistribution. Large numbers of redistributional strategies have failed to reach the targeted beneficiaries - poor people; instead the rich, middle classes or organised urban working classes end up benefiting from the programme. Electricity equity is no exception to this failure; the poor rural people may not benefit from this poverty tariff. Electrifying people does not automatically means that people will use electricity and do away with other sources of energy such as fuel-wood.

Finally the discussion on trade-off between pricing for efficiency and pricing for equity poses the most critical challenge to the debate on a poverty tariff in South Africa. Government has to deal with one of the difficult tasks, to reach a compromise between these two goals. The aim of a careful tariff design would be to provide wider access to electricity to poor people without any significant loss of efficiency.

2.4 Theories of pricing

The purpose of this section is to review some of the theories of pricing, and to explore those relevant to the issue of an electricity poverty tariff in the South African context. This is done by way of describing the approach, its relevance to the electricity sector generally and its relevance to a poverty tariff.

John Hopkinson made the first notable contribution to the theory of electricity pricing. He explained his views on electricity pricing by constructing an elaborate hypothetical example of a utility required to produce 2,500 units of electricity per hour. Hopkinson distinguished the costs of being ready to supply the 2,500 units from the costs of actually supplying this level for a year. The difference, of course, is that the cost of being ready to supply includes the costs of the generating and distribution equipment (that is, the fixed costs) while the costs of actual supply adds fuel and maintenance costs (that is, the variable costs). He deduced that these two costs should be separately recovered within the tariff schedule. A corresponding method of charging includes a fixed charge per quarter proportional to the greatest rate of supply the customer will ever take, and a charge by meter for the actual consumption (Hausman and Neufeld 1984). Given this background, some approaches to electricity pricing are examined below. They include marginal cost pricing (both short-run and long-run marginal cost); average cost (AC) pricing, two-part tariffs, contestability and the price cap and rate-of return approaches.

2.4.1 Marginal cost (MC) pricing

MC is defined as the increase in total cost resulting from raising the rate of production by one unit, or the rate of change of cost with respect to output (Lipsey *et al* 1990: 965).

The fundamental principle that guides the design of modern electricity tariffs is that they should closely reflect the pattern of utilities' costs. This principle is grounded on the fact that the level of prices in tariff structures convey information (signals) to customers and influence their use of electricity.

Schram (1991) and Teplitz-Sembitzky (1992) argue that the fundamental objective or the rationale for MC pricing is that it is necessary for an efficient allocation of resources that maximises aggregate welfare. The underlying argument is that output should be increased to the point where the willingness to pay for an additional unit is equal to the change in costs that results from supplying this unit (Teplitz-Sembitzky 1992). However, Mountain (1994) argues that the proof of the maximisation of the welfare function through marginal costs is based on a number of assumptions. Such assumptions may have no or limited basis in reality and hence the proof only has value as the solution to a highly theoretical problem.

One major assumption that may not hold in reality is that MC pricing is sufficient for economic efficiency. MC pricing may even be inefficient since it can entail financial losses that the utility seeks to avoid as pointed out by Teplitz-Sembitzky (1992: 22). He argues that whenever marginal cost pricing would entail financial losses in a socially warranted project it will be feasible to cover total costs at the expense of the consumers' surplus. Alternatively, the losses could be borne out of tax revenues. But allocating the fixed costs across taxpayers may have a redistributive and, thus, distortionary impact.

Another assumption is that "the rest of the economy in which the electricity supply industry operates, has already adjusted to marginal cost prices and there is an absence of externalities, or other factors which may distort a state of perfect competition" (Mountain 1994: 29).

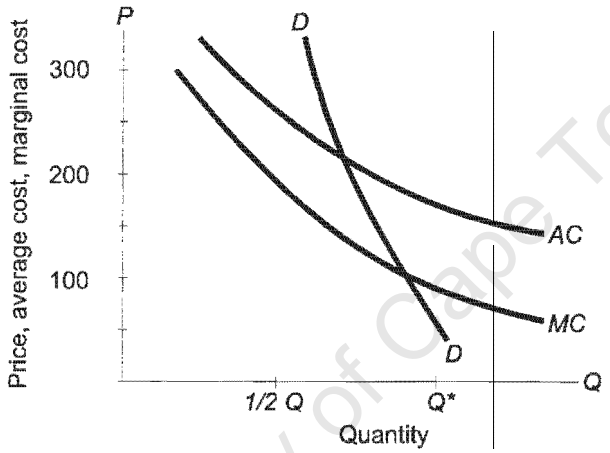

FIGURE 2.1: Cost curves for a natural monopolist
Source: Samuelson and Nordhaus (1989: 590)

Requiring that price equal marginal cost, which is the ideal target for achieving economic efficiency in a perfect competitive market, gives rise to one serious problem for a utility that enjoys economies of scale[9]. A firm that has declining costs with increasing scale (that is, a natural monopoly), and produces where price equals MC, will incur a loss, which is a practical setback with marginal cost-based tariffs (both short-run and long-run marginal cost). Figure 2.1 illustrates this. If average cost (AC) is falling, then MC is less than AC, so setting price equal to MC implies having price less than AC. When price (or average revenue) is less than AC, the firm is losing money. Hence the ideal regulatory solution requires the government to subsidise the decreasing-cost producer, presumably by funnelling tax revenues to the firm. The requirement to raise taxes to pay for the ideal

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[9] Lipsey *et al* 1990: 960 defines the economies of scale as the reduction of costs per unit of output resulting from an increase in output; a negatively sloped LRAC curve over a range of output.

regulatory solution has prevented this approach from becoming a popular one, and it is only rarely employed (Samuelson and Nordhaus 1989: 590).For a typical natural monopolist, the *AC* curve is still falling at the point where it cuts the industry's DD (demand) curve. Thus efficient production at that level of output requires output to be concentrated in a single integrated firm. MC pricing is not in general sufficient for maximum production efficiency although it is favourable for allocative efficiency and (in the absence of other distortions) maximising aggregate welfare.

Real world conditions rarely lend themselves to first-best solutions as noted by Teplitz-Sembitzky (1992). One major limitation with the MC pricing rule arises out of the fact that perfect price discrimination[10] cannot be practised. Ultimately it calls instead for setting all prices equal to the one single MC at which the cost of supply is equal to the last increment in someone's willingness to pay. However, this can result in extraordinary financial profits to the supplier if MCs are rising and above the average costs of supply, or it could lead to financial losses if MCs are falling and below average costs.

2.4.1.1 Short-run marginal cost (SRMC) and long-run marginal cost (LRMC)

Campbell (1999: 2) contends that utilities measure short-run and long run marginal costs in different ways. Warford and Munasinghe (1982: 23) argue that SRMC may be defined in economic terms as the cost of meeting additional electricity consumption with fixed capacity. LRMC is the cost of meeting an increase in consumption, sustained indefinitely into the future, when capacity adjustments are required. In the same vein Campbell (1999) argues that "Short-run marginal costs are the additional costs of providing increments of output over a time period when the utility's capital stock (or electric plant) is fixed. Short-run marginal costs include such non-capital costs as fuel, materials and supplies, variable operation and maintenance expenses, and so on. Long-run marginal costs are the additional costs of providing increments of output when the utility's capital stock varies. Long-run marginal costs include capital costs and short-run marginal costs".

There are varying opinions on the question of whether prices should be based on SRMC or LRMC. There is an argument that LRMC will provide a more stable basis in price setting than SRMC. LRMC comes closer to the ideal of full cost recovery and will provide stability, but will not, in theory, maximise welfare. To solve the large price fluctuations of SRMC, which could be disruptive and unacceptable to consumers, the LRMC approach could

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[10] To Samuelson and Nordhaus (1989: 619) price discrimination refers to a situation in which a firm sells the same product to different customers at different prices for reasons not related to cost or meeting competition.

provide the required price stability while retaining the principle of matching willingness to pay and incremental supply costs. Teplitz-Sembitzky (1992) concurs that the issue of stability is critical since the use of stable price signals will improve efficiency by providing customers with smoothed information about the future prices. However, he questions why electricity customers should be protected against volatile tariffs, when in other energy markets, for example oil, prices are allowed to fluctuate. LRMC pricing would fail to recover total costs accurately but would keep accounting losses at a lower level than SRMC pricing. This is especially so where the utility has excess capacity.

However, Teplitz-Sembitzky (1992: v) contends that "LRMC are a misleading benchmark for electricity pricing. Unless the power sector invests and operates in a steady-state equilibrium, LRMC cannot be justified on efficiency grounds". Consumers would be responding to price signals not directly related to their present consumption choices. A further argument against LRMC is that they could only be calculated with any certainty for models that assume a perfectly known future.

SRMC comes closer to welfare maximisation but introduces large fluctuations in the price. Where demand increases require lumpy capacity investments, pricing on the basis of SRMC will result in wide price variations, resulting in increased uncertainty in the medium to long term decision making of the utilities (Warford and Munasinghe 1982: 52). They argue that the large price fluctuations of SRMC will be disruptive and unacceptable to consumers.

In summary, the first-best pricing option in a perfect competitive market generally involves setting price equal to marginal cost. But for firms with increasing returns to scale, such pricing would result in the firm making a loss. This would not be sustainable, without additional sources of revenue. A second important point is that perfect price differentiation (reflecting actual marginal costs) would be impractical. This reflects on the fact that electricity supply is a "multi-product" commodity (see Section 2.2.2), with actual marginal supply costs varying between different groups of customers and at different times of day.

However, estimated marginal costs in different supply situations could provide a guide to a tariff system which sets tariff levels that are roughly proportional to marginal costs but which also fulfil an objective of total cost-recovery. This would provide pricing signals, which promote allocative efficiency within the electricity sector, at the same time as being financially sustainable for the utility. Two-part (or multi-part) tariffs which combine a fixed charge and a variable charge can be adapted to this philosophy, especially if the variable charge incorporates a declining block energy charge rate (lower rates for higher quantities of monthly consumption) and time-of-use variations.

2.4.1.2 Relevance of MC pricing principles to a poverty tariff

This theory could be relevant to a poverty tariff. The following points could be made in this regard:

- Although MC electricity pricing appears to be impractical in a pure form, and in any case would not guarantee maximum economic efficiency, it is likely that tariffs should bear some relation to MCs, if the price signals are expected to promote allocative efficiency.
- The SRMC of supplying more electricity to poor households (assuming fixed generation capacity and distribution infrastructure) is relatively low, and much lower than the total costs of this electricity supply, including fixed service costs and capital redemption.
- An argument could be made for a poverty tariff, which charges low-income households at a rate close to SRMC. This would mean that this group of customers is not meeting the full costs of their electricity supply, and that the capital and fixed service costs would need to be subsidised by other customers, government, or other sources.
- Assuming this subsidy can be mobilised, the utility would not be adversely affected in the short-term; low-income customers would gain greater welfare; and the pricing signal to them would not seriously distort efficient national consumption of electricity, being close to SRMC.
- The implication, however, is that other customers would have to cover the total remaining costs of total electricity supply, assuming there is no general tax revenue allocated to the subsidisation of electricity. This would mean that their electricity payments would need to cover the average (not the marginal) costs of their own supply, plus the deficit arising from low-income households.
- This would push the tariffs for non-subsidised customers further away from actual marginal costs. The questions, related to the "efficiency–equity trade-off" are, firstly to what extent would the tariffs of non-subsidised consumers be affected? Secondly what would the impact be on allocative efficiency, within the electricity sector, in the energy sector and also between sectors?
- The LRMC of increased supply to low-income households could be significantly higher than SRMC. Peak domestic loads could accelerate the need for expansions in the generation capacity. Increased electricity consumption by poor households (often in poorly constructed, thermally inefficient dwellings) is likely to accentuate winter peak loads, calling for new generation plant and reducing overall system efficiency. This concern would be of particular concern to a combined generator/distributor like Eskom.

2.4.2 Average cost (AC) pricing

Average cost (also called average total cost) is total cost of producing a given output divided by the number of units of output; it can also be calculated as the sum of average fixed costs and average variable costs (Lipsey *et.al* 1990: 957).

AC pricing in the electricity sector prevents monopoly pricing by natural monopolists. It wipes out monopolistic profits, which leads to what people feel to be a more equitable distribution of income. AC pricing sets price equal to average cost, which is best in terms of overall welfare subject to the constraint that the firm breaks even. Figure 2.2 illustrates public-utility regulation. The underlying argument is provided that the firm has increasing returns, price being greater than average cost; welfare could be increased by a price reduction that allows the firm to break even. As a result it must be optimal to require the firm to charge a price equal to AC. Setting price equal to AC reflects the compromise between a desire for allocative efficiency—setting price at MC—and the need for the firm to break-even (Armstrong *et al* 1994: 18).

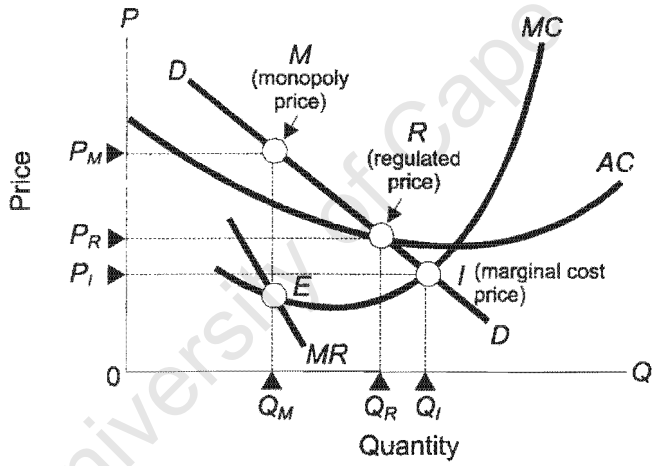

FIGURE 2.2: Ideal and practical regulation of monopolists
Source: Samuelson and Nordhaus (1989: 590)

Point *M* (associated with output *QM)* is the unregulated profit-maximising output of the monopolist. At this point the monopolist maximises profit, as reflected by the intersection of marginal revenue and long-run marginal cost at point *E* with price above marginal cost. This results in consumption below the social optimum, and results in monopoly rates being extracted by the monopolist. Regulators customarily require prices to be at *R* - where the demand curve intersects the long-run average cost curve. This wipes out excess profit. More importantly, it brings price closer to marginal cost. Ideally, the price should be forced all the way down to *I*, where *P=MC* and where marginal social costs and benefits are appropriately balanced. At Point *I*, there is no allocative efficiency loss from price being

above marginal cost. This theory is relevant to a poverty tariff because it strives for the firm to break-even without sacrificing efficiency. It makes sure that excessive profit of the monopolist is wiped out by bringing price closer to MC.

2.4.3 Two-part tariffs

Two common types of two-part tariffs can be distinguished. The first form has a fixed monthly charge and a variable monthly charge for usage. The second form is a time-of-use two-part tariff. Both are widely used in the electricity sector.

John Hopkinson is the advocate of the first two-part tariff discussed at the beginning of this section. Briefly his theory asserts that the ideal way of determining each customer's share of total demand costs is to divide up the system peak demand each month in proportion to customers' demands at the exact time of the system peak. However, to calculate these proportions exactly, a phenomenal, if not impossible, amount of computation and analysis would be necessary.

Teplitz-Sembitzky (1992: iv) argues that in the presence of consumers with diverse preferences, any uniform price charged per unit of output and exceeding marginal costs can be improved (from a Pareto-efficiency view) by an additional optional two-part tariff, consisting of a fixed entry fee and a usage charge. This is because an increase in the scope for choice, if properly designed, can make some consumers better off without making others, including the utility, worse off. However, there are problems with charges that do not vary by time of day.

The idea of time-of-use tariffs is to charge different rates for electricity use at different times of day, reflecting the higher costs of electricity supply at times of peak demand. Alfred H. Gibbings, the first and one of the most sophisticated advocates of time-of-day pricing, proposed a rate structure with the following characteristics: a two-part tariff, with the higher price charged only during hours of maximum demand. Furthermore, all fixed charges were allocated to the station peak (making the off-peak rate about 60 per cent of the on-peak rate); and, finally, no quantity discounts were offered. With regard to the high peaks in the central station load curves, no tariff system could do more to eliminate these than to charge the higher price at the period of maximum demand upon the station.

Each of these forms of two-part tariffs could improve allocative efficiency, compared with a uniform price per unit of output. However, in relation to a poverty tariff, they could each have adverse impacts on very low-income households. A tariff, which contains a fixed monthly charge, would make the average cost of electricity more expensive for households, which use the least electricity. A time-of-use tariff would also raise the cost of electricity of

typical low-income households, because their hours of higher consumption generally coincide with peak demand times in South Africa.

However, two-part tariffs with a fixed monthly charge could have further relevance to a poverty tariff, resting on the fact that energy charges are no longer required to cover all costs, and a fixed charge can be used to make up any shortfall in profits. If customers were given the choice between a uniform rate per kWh (with no fixed charge), or a two-part tariff, which has a fixed monthly charge but a lower energy charge per kWh, then smaller consumers such as low-income households could choose the former and larger consumers choose the latter. In principle, the fixed monthly charge of high-consuming customers on the two-part tariff could be set so as to achieve overall cost-recovery, allowing for the possible cross-subsidisation of the poorest households choosing the uniform rate per kWh.

2.4.4 Contestability

According to Armstrong *et al* (1994: 103) "the theory of contestable markets is about the potency of potential, as distinct from actual, competition". The theory of contestable markets[11] counts on the merits ascribed to the threat of competition. Assuming that the fixed cost is not sunk but recoverable in the event of exit from the industry that gives room for a "hit-and-run" entry (that is a short-term entry mainly for profit and then a quick exit). Armstrong *et al* (1994) point out that "if any opportunity comes about, no matter how transitory, a rival can profitably enter the industry and undercut the incumbent and take away its business. The incumbent can prevent this only by behaving in a way that no such profits exist, which requires productive efficiency and average pricing (given uniform pricing)". The theory of contestability provides a competitive benchmark that, unlike the conventional model of perfect competition, does not require a vast number of small firms. However this is achieved only when the standard welfare properties of allocative efficiency, productive efficiency and zero supernormal profits all hold at equilibrium in a contestable market. Contestable market theory is not valid in situations where utility industries have vast sunk costs. In effect the sunk costs are a barrier to entry. Larger sunk costs allow existing firms to realise larger profits without attracting new entrants.

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[11] See Baumol, Panzar, and Willig (1982), Baumol (1982), and Baumol and Willig (1986) for exposition and defence of the theory. Critical appraisals of the theory and its applicability include Brock (1983), Schwartz (1986), Shepherd, (1984), and Spence (1983).

In the electricity supply industry this theory cannot easily be applicable because of the oligopolistic[12] nature of the industry. The electricity generation market is not highly contestable due to large sunk costs of entry. Potential entry cannot be relied on to hold profits down (Lipsey *et al* 1990). The idea of contestability would be applicable to energy trading activities where there are not large sunk costs. All markets require at least some sunk costs of entry hence contestability must be understood as a variable. The lower are the sunk costs of entry, the more contestable is the market. The theory has no relevance to a poverty tariff.

2.4.5 The price cap and rate-of return approaches

2.4.5.1 Price capping approach

Price capping is a form of pricing that has recently become popular. The basic idea behind price capping is that utilities should be allowed to maximise profits subject to a price constraint. The argument is that, as long as it does not raise prices above a fixed or indexed level, a utility with a profit incentive will act to decrease costs in order to increase profits (Armstrong *et al* 1995: 43-4). The price cap approach would require frequent reviews of prices, both because regulators have limited ability to commit themselves, and changes in the firm's operating environment could give it excessive rents or drive it to bankruptcy.

The production efficiency gains, which might be achieved by such price capping rest on the assumption that the utility would act in an entrepreneurial manner, to maximise profits. If so, this approach is "likely to score better on efficiency than clumsy price regulation" (Templitz-Sembitzky 1992: v)

A price cap approach, which at the same time encourages a utility to maximise its profits, would seem to be incompatible with a poverty tariff cross-financed within the electricity supply industry (ESI). This cross-subsidisation would decrease the potential profits, and a profit-maximising utility would avoid this unless forced to do so by other additional regulations. However, if the source of subsidy for poverty tariff came from outside the ESI (for example government funds) then this could be compatible with a poverty tariff, under a price-capped tariff regime. In fact, a government subsidy for electricity consumption would need to be accompanied by some form of price control to avoid a profit-seeking utility making profits out of the subsidy, which is intended to benefit the poor rather than the utility.

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[12] Oligopoly refers to an industry that contains two or more firms; at least one of which produces a significant portion of the industry's total output (Lipsey *et al* 1990; 967).

This is relevant to a poverty tariff considering the argument for a poverty tariff that holding price down is the best or even the only practical way to get fairer distributive results. For instance government can allow Eskom to maximise profit at the same time holding selected electricity prices down in order to allow low-income households to afford electricity.

2.4.5.2 Rate-of return (ROR) approaches

Rate-of return is the ratio of net profits to total invested capital (Lipsey *et al* 1990: 309). One possible representation of ROR regulation is price that accurately reflects actual observed costs. In this case allocative efficiency is nearly attained and there are no excessive profits, but the firm has only weak incentives to act to reduce costs. Allocative efficiency may be adversely affected in a long lag regulation (delays in both fiscal and monetary policy), which on the other hand provides good incentives for productive efficiency.

Rate-of-return regulation reviews generally need to be frequent, and the regulatory lag is endogenous because either side can request a review, whereas under price caps the lag is relatively long, and the date of the next review is fixed in advance. The difference is one of degree rather than kind (Armstrong *et al* 1994: 172). The ROR has no relevance to a poverty tariff because it focuses on the annual net return of invested capital.

2.5 Conclusions

This chapter provided a general discussion of electricity pricing theories. The general guidelines in electricity pricing and the issue of trade-off between efficiency and equity have been discussed as the basis for a poverty tariff debate. The theories that have been discussed are of significant importance with regard to electricity pricing in general and not directly relevant to a poverty tariff. Any regulator needs guidance, supervision, well-defined rules of the game, and arm's-length obligations with sense rather than putting the utility into a confined particular pricing policy.

Turning to the issue of the relevance of these theories to a poverty tariff most of these theories argue more for economic efficiency than distributional equity. The theory of MC pricing generally involves setting price equal to marginal cost. However, for firms with increasing returns to scale, such pricing will result in the firm making a loss and ultimately MC pricing is not in general sufficient for economic efficiency. AC pricing involves setting price equal to the average cost, which is best in terms of overall welfare subject to the constraint that the firm breaks even. The price capping approach argues that utilities should be allowed to maximise profits subject to a price constraint. However, such prices must not rise above a fixed or indexed level

CHAPTER THREE:

TARIFF SYSTEMS AND PRICE LEVELS

3.1 Introduction

This chapter provides an overview of the system of domestic electricity tariffs and the price levels used in South Africa. The price of electricity is usually announced publicly in the form of electricity tariffs. Tariff systems are the integrating mechanisms through which an electricity utility sets its tariff structure. Tariffs are fixed price structures for electricity that are available to different types of consumers, depending on their electricity demand patterns and consumption. Price level refers to the level of money value charged for the electricity consumed. The purpose is to examine the glaring price level disparities between different distributors, which led to about 2000 tariffs by late 1995. Lack of effective regulatory governance of the distributors' tariff policies led to a large number of tariffs. Price levels charged by about 400 distributors vary significantly across the country. Distributors purchase the bulk of their electricity from Eskom. The financial dependence of many municipalities on electricity revenues to cross-subsidise other services also contributes to this variation of tariffs. The other contributing factor to many tariffs is the different cost-structures of the distributors.

Section 3.2 reviews the existing tariff systems. This discussion revolves around the establishment of the National Electrification Forum (NELF), which embraces a brief discussion on the status of tariff rationalisation by the National Electricity Regulator (NER). Section 3.3 discusses the costs of supplying electricity. This includes the bulk supply tariff system, the question of regional variations in bulk supply tariffs, regional average prices and the poverty rate, regional and localised variation in end-user tariffs, and the question of cross-subsidies to domestic customers. This is followed in section 3.4 with a focus on the possible rationalisation through establishment of Regional Electricity Distributors (REDs) and their potential impact on prices. The NER 1995/6 database is used as the main source of information for both discussions. This database includes information on all the municipal distributors in South Africa. However, it has some limitations, the most important one being the age of the data. Information collected since the 1995/6 financial year (June to June for municipalities) has not been properly verified and cannot be relied on with any confidence. Section 3.5 is a case study of the Mossel Bay Municipality. Sources of information used for this case study include documents from the Municipality and

telephone interviews with the Town Engineer Electro-technical[13]. Section 3.6 concludes the discussion.

3.2 The electricity tariff system in South Africa

Local authorities determined local electricity tariff structures and levels in a virtually autonomous fashion before the establishment of the NER in 1995. These different tariffs failed to address the question of poverty and electricity equity. Instead these tariffs were often barriers to access to electricity because majorities of low-income households could not afford to have electricity. This section discusses the establishment of the NELF, which preceded the establishment of the NER, with specific focus on tariff rationalisation. The other issue discussed is tariff differentiation between customer groups.

3.2.1 The establishment of the National Electrification Forum (NELF)

In 1994 the NELF was established, which preceded the establishment of the NER. All the recommendations made by NELF were transferred to the NER for implementation.

NELF proposed a national domestic tariff structure, which is still unresolved. Davis (1996) pointed out that imposing a national tariff system while making provision for poverty tariffs for low-income customers would have obvious benefits with respect to equity. NELF recommended financial transfers between distributors faced with different costs and different revenues on the basis of a national formula. This would also ensure necessary flow of funds from Eskom to all the electricity distributors implementing tariffs designed for greater equity. NELF deemed cross-subsidies to be desirable and it recommended that transfer mechanisms be made more transparent and equitable. However, Pickering (1994: 24) noted that the issue of cross-subsidy would to a large extent be a function of the tolerance of wealthier consumers to higher electricity prices. It should be borne in mind that wealthy households have the ability to move away from electricity to other fuels, such as gas for cooking and water heating, if they feel that electricity is too expensive. Should a large number of wealthy households move away from electricity this might leave the supply authority short of revenue, leading to longer-term difficulties.

NELF further recommended that Government should assist in providing cheap capital and should contribute towards the capital costs of electrification in rural areas. The cost per connection of supplying electricity in rural areas is often more than double that in urban areas and revenues are generally lower. The revenue of distributors would be affected by a national tariff system with uniform monthly payments throughout the country. Davis (1996:

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[13] The Mossel Bay Town Engineer is Mr Okert Bothma.

479) pointed out that "those in areas where supply costs are low will benefit, whereas those in areas where supply costs are high such as the rural areas, will not. Unless surpluses can be transferred between distributors, a national tariff system may penalise certain electrification projects, as the revenues of some distribution authorities will be insufficient to cover costs. Although a national tariff may raise sufficient revenue on average, net income will be unevenly distributed across the country."

3.2.2 The NER and tariff rationalisation

Prior to the establishment of the National Electricity Regulator (NER) in 1995 there was a limited regulation of electricity prices in South Africa. The NER was established as a successor of the Electricity Control Board to deal with among other issues electricity price regulation. Ideally the NER has to ensure that customers are provided with adequate reliable services at prices that are affordable and reflect acceptable levels of efficiency on the part of the distributor.

Regarding the NER and tariff rationalisation to date, progress has been made. The tariff structures are being streamlined and vast price differences are narrowed. Tariff increases are restricted or not allowed in cases where monthly payments prove high in relation to neighbouring towns and costs of supply. Tariff rationalisation is an ongoing process at the NER (Langa 1999).

3.3 The bulk supply tariff system and prices

Bulk supply tariffs are tariffs for electricity supplied at high voltage to large industrial customers and re-distributors of electricity. They differ from low voltage tariffs in two respects: the costs of distribution have not been accounted for; and diversity is less of an issue (either because customer load factors are high or because a time-of–use structure automatically takes care of diversity) (Campbell 1999).

The quantity of electricity supplied can influence the complexity of the tariff structures used for different groups of customers. "For bulk supply to distributing companies and high voltage supply to very large customers, the expense of metering equipment that permits tariffs to be varied in step with changes in marginal costs is justified by the absolute changes in demand that such tariffs induce" (Campbell 1999: 1). A number of bulk supply tariffs exist, for example Eskom's two-part tariff, the British seasonal time-of day or multi-unit rate tariff and the French Green tariff. Four important tariff elements are common in modern electricity tariffs for bulk supplies, which include: 1) a maximum demand charge in R/kW, 2) a maximum demand charge in R/kVA, 3) an active energy rate in c/kWh, and 4) a reactive energy rate in c/kVArh. In addition fixed charges in R may be applied, and the

rates can also be varied with time-of-use. The tariff designer is faced with the challenge of reflecting the complex cost of supply using two or three of these rates (Campbell 1999).

3.3.1 Costs of supplying electricity to different distributors

Davis (1999) pointed out that prices decrease with size of distributor, since costs also decrease. Figure 3.2 shows that the costs of power purchase as well as other distribution costs exhibit the same logarithmic relationship with distributor size.

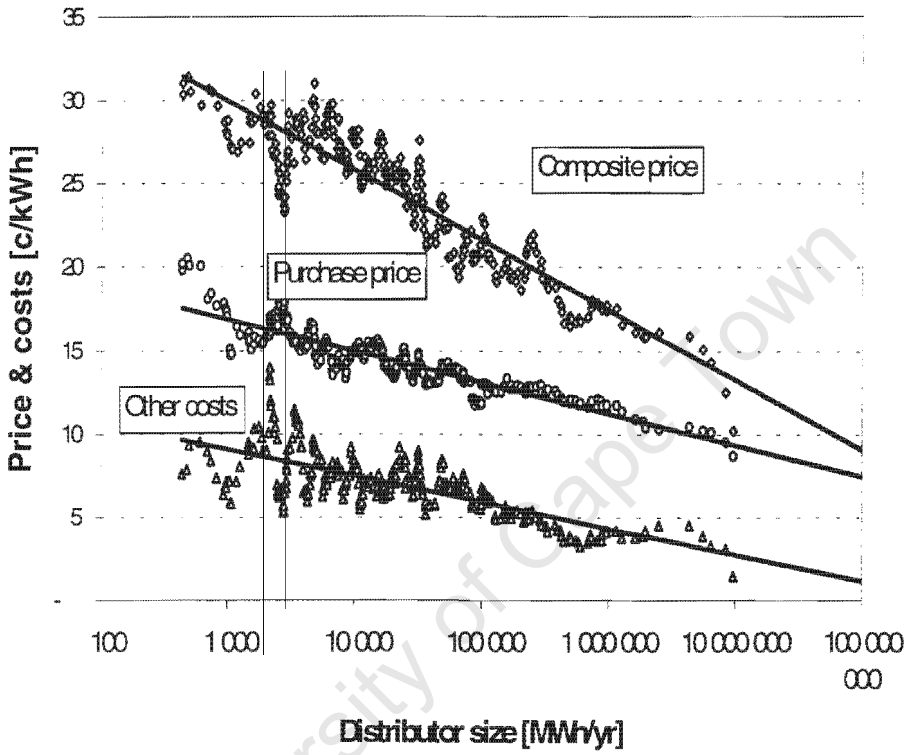

FIGURE 3.1: Costs and prices against distributor size
(Prices and costs are 10 point moving averages)
Source: Davis (1999)

While the costs of power purchases and other distribution costs tend to decrease with size in a similar manner, this is much steeper than the average price charged, as demonstrated by the composite price.[14] This suggests that distributor's margins also decrease with size.

3.3.2 Regional variation in bulk supply tariffs

One reason for these differences is the distance from the major coal power stations in Mpumalanga and Gauteng province. However, these are relatively small, and mainly reflect the distances and transmission costs from the main power stations. This transmission

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[14] Composite price represents the total revenue divided by total sales, and indicates the revenue requirement of a distributor.

cost variations may be applied as a transmission surcharge. Eskom's surcharge is dependent on the customer's distance from Johannesburg and varies from 0% to 3% as shown in Figure 3.2 below.

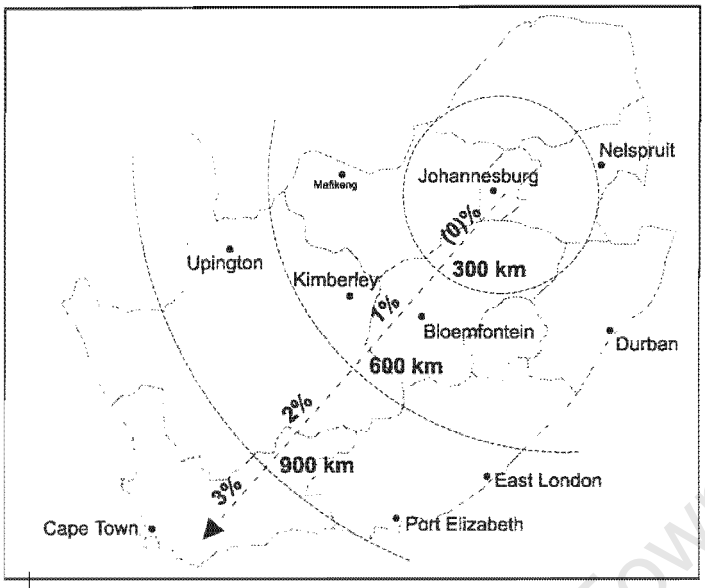


FIGURE 3.2: Regional variations in bulk supply tariffs

More likely, the local price variations probably reflect a combination of factors, including (a) differences in bulk supply payments, (b) the size and efficiency of the distributor, (c) the customer mix and (d) municipality policy on using (some) electricity sales to cover other costs. Table 3.1 shows municipalities around different provinces according to sizes and their average prices.

3.3.3 The spread of distributors' sizes amongst the provinces

Table 3.1 shows how distributors' sizes are spread amongst the provinces. Municipalities with consumers less than 50 have not been included (such as Tongaat Hulett Sugar in Kwazulu Natal province, with 6 consumers), nor Eskom distributors.

Table3.1: Municipal distributors' sizes and their average prices
Source: Own analysis of database, NER 1995/6

Provinces	*Distributors' sizes*											
	50-300	*301-500*	*501-768*	*769-987*	*988-1559*	*1560-2754*	*2755-4238*	*4239-7527*	*7528-17705*	*17706-430031*	*Total*	Av. price
E. Cape	6	9	2	5	2	3	4	3	3	2	39	26
Free State	11	9	6	8	8	2	3	4	4	2	57	25
Gauteng	1	1	1			1	1	6	4	15	30	19
KZN	1		4	3	1	4	4	4	4	2	27	21
Mpumalanga	1	1	2	1	1	4	5	4	3	3	25	23
N. Cape	6	3	4	8	6	3	2		1	1	34	29
N. Prov.	1		1			3	2	5	1		13	23
N. West	2	3	5	1	1	2	3	5	1	3	26	23
W. Cape	5	8	6	7	13	10	7	6	10	6	78	26

Note: E. Cape- Eastern Cape; KZN- Kwazulu Natal; N. Cape- Northern Cape; N. Prov.- Northern Province; *N. West- NorthWest and W. Cape- Western Cape.*

Gauteng has fifteen of the largest municipalities and only five with less than 5 000 consumers. In contrast, Northern Province does not have any municipal distributor with more than 1700 consumers.

The average prices for domestic consumers in 1996 ranged between 19 c/kWh and 29 c/kWh, which indicates a difference of 10 c/kWh between the highest average price of 29 c/kWh in Northern Cape and the lowest average price of 19 c/kWh in Gauteng. There is a difference of 9 cents between Western Cape and Gauteng. Johannesburg M C, Ennerdale area, which is in the Gauteng province, is the institution that charged the lowest average price of 9 cents per kWh. Bitterfontein, which is in the Western Cape province, charged the highest price of 45c per kWh. It is worthy to note that there is a price range of 36c/kWh and a standard deviation of 6c/kWh. Regarding equity of access to electricity these average prices of different municipalities in different provinces indicate that it will still be difficult for most poor households in those provinces like Eastern Cape, Kwazulu Natal and Northern Province to afford to pay for electricity.

3.3.4 Regional average price of electricity and the poverty rate

Given the different average prices in different provinces, this section compares these with estimated poverty rates. This aims to raise the question of cross-subsidies between regions. Table 3.2 presents the provincial average price and the provincial poverty rate. The poverty rates are derived from Central Statistical Service (1995) and are defined as the percentage of households earning less than R500 per month. The table shows that poverty

is uneven among South Africa's nine provinces. Figure 3.2 illustrates this unevenness and the electricity average prices according to provinces. Table 3.2 shows Eastern Cape to be the poorest province, while Northern Cape has the highest average price.

Table 3.2: Provincial average price and poverty rate
Source: Income and Expenditure Survey, CSS 1995

Province	*E. Cape*	*Free State*	*Gau-teng*	*K./ Natal*	*Mpu-malanga*	*N. Cape*	*N. Province*	*N. West*	*W. Cape*
Ave. price	26	25	19	21	23	29	23	23	26
Poverty rate	70.7	63.4	17.3	51.9	57.3	54.9	59.1	62.1	28.0

If provinces such as Eastern Cape, Kwazulu/Natal, and Northern Province, with the majorities of poor rural people, continue charging their current prices, it will remain difficult for poor people to have access to electricity. It should be noted that these regions have considerable electrification potential since most of the people do not have electricity.

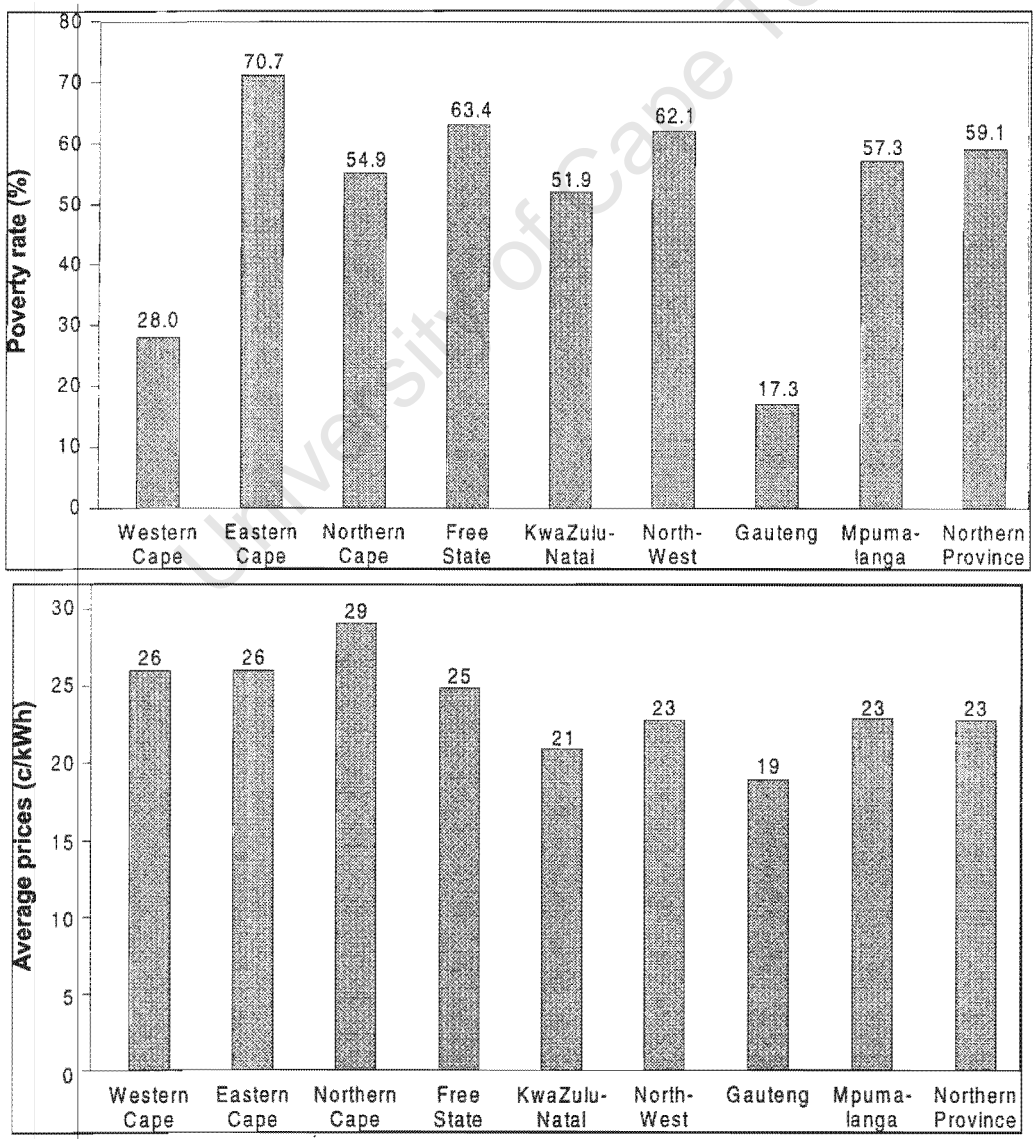


FIGURE 3.3: Provincial average prices and poverty rates

3.3.5 Regional and local variations in end-user tariffs

Regional tariff differentiation is critical for the question of sustainability of the electrification programme. Customers of different provinces or regions pay a vastly different price of electricity because of distributors different cost of purchasing bulk electricity from Eskom. The quantity of electricity supplied can influence the degree of complexity of tariff structures used for different customer groups. The costs of supply are also affected by quantities consumed, load factors, and other variables. For these reasons, different prices exist for different customer categories such as domestic and industrial customers.

Table 3.3 shows the national average electricity prices for each customer group. The total number of consumers and the MWh sales are given for each customer group and the total of all these customer groups. All the municipal distributors as well as Eskom distributors are considered.

Table 3.3: National average electricity prices to different customer groups
Source: NER 1998

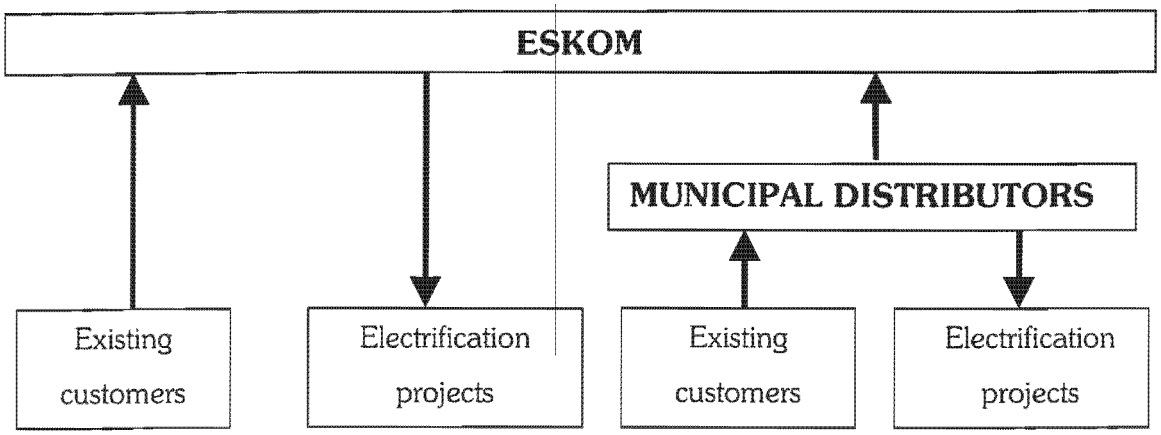
	Domestic	*Agricultural*	*Commercial*	*Mining*	*Manuf./Ind.*	*Transport*	*Total*
No. of consumers	5 638 541	169 976	214 364	18 037	60402	466	6 115 260
MWh sales	32 503 948	4 296 320	12 426 245	32 078 657	82 798 910	4 187 826	170 943 724
Average price c/kWh	24	26	23	12	13	15	16

Note: Average prices are rounded

3.3.6 Cross-subsidies to domestic customers

Subsidies for electrification come almost exclusively from within the electricity industry. Eskom uses revenue from all sales to cross-subsidise its electrification programme. Municipalities also use cross-subsidies from within their own customer base, but are required, through the purchase of electricity from Eskom to contribute to Eskom's programme as well. Davis (1996) suggested that a more equitable system would require mechanisms to transfer subsidies from one region to another, either through direct transfer or differential pricing of bulk supply.

Van Horen and Davis (1996: 7) argued at the time that since Eskom acts both as a supplier to municipal distributors and as a distributor in its own right, it effectively subsidises its electrification customers from bulk sales as well as revenue from direct sales to its own non-municipal customer base. Figure 3.4 illustrates these subsidy flows.



Arrows denote subsidy flows

FIGURE 3.4: Cross-subsidisation within the electricity supply industry
Source: Van Horen and Davis (1996: 8)

The implication was, for example, that Durban municipality's consumers cross-subsidise electrification in Durban as well as Eskom's electrification projects in other, mostly rural, areas. The estimated annual burden of cross-subsidies to electrification is R1.6 billion and the question is how that is shared among consumer groups. The disparity in tariffs countrywide makes it possible that this burden is shared in a different way for each distributor. Bearing in mind that domestic consumption makes up only 15% [15]of the total electricity consumption, it is likely that non-domestic consumers currently provide most of the cross-subsidies (Davis 1996).

NELF's approach to cross-subsidised electrification for the poor assumed a rationalisation of the Electricity Distribution Industry. This did not happen (mainly because some strong municipalities did not want to give up their revenues from electricity, which subsidised other municipal services). In the absence of rationalisation

- disparities between different distributors continued
- municipalities responsible for more new electrification (poor communities) often lacked the resource base to fulfil this task
- Eskom retained its numerical electrification targets, while not gaining the anticipated rights of supply in most urban areas, leading to an emphasis by Eskom on rural electrification (more expensive)

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[15] This percentage had risen to 19% in NER'S (1998) statistics shown in Table 3.3.

- Municipalities struggled with urban electrification and Eskom offered money, via NER, to compensate them.

All this was quite "ad hoc", pending the slow process of moving towards a compromise solution of regionally rationalised REDs.

3.4 Possible rationalisation through establishment of REDs and the impact of REDs on prices

This section attempts to examine the potential impact of REDs on electricity prices. The aim is to investigate whether the impacts of REDs on prices could reduce the need for a poverty tariff. The analysis is drawn from Davis (1999). Government has called for the establishment of a certain maximum number of financially viable regional electricity distributors. This call follows the Electricity Restructuring Interdepartmental Committee's (ERIC) recommendation with regard to the formation of REDs. The following table shows consumers and their consumption in each proposed RED.

Table 3.4: Electricity consumers and consumption in each RED, 1995/6 Source: Davis 1999

RED	*Domestic consumers*	*Non-domestic consumers*	*Total consumers*	*Domestic consumption (GWh/yr)*	*Non- domestic consumption(GWh/yr)*	*Total consumption (GWh/yr.)*
A-Northern	1,012,035	75,685	1,087,720	4,173	**55,254**	**59,428**
B-Western	701,159	61,779	762,938	4,355	**8,639**	**12,994**
C-Central	871,817	70,087	941,904	**3,669**	**13,021**	**16,691**
D-Eastern	878,490	33,086	911,576	**10,119**	**20,810**	**30,929**
E-Wits	980,794	52,769	1,033,563	**9,503**	**30,103**	**39,606**
Total	**4,444,295**	**293,406**	**4,737,701**	**31,820**	**127,828**	**159,648**

Western (RED B) would have the smallest total number of consumers, and the lowest total consumption level (12,994, 9GWh per year, based on 1995/96), while Northern (RED A) would have the highest number of consumers. RED B will have the smallest number of domestic customers, while RED D (Eastern) would have the smallest number of non-domestic customers.

Davis (1999) argues that without knowing the relationship between costs and consumer categories, it is only possible to estimate these relationships based on the existing price patterns. Applying this to the price levels indicated in Table 3.6, gives estimated end-user price levels as shown in Table 3.6. Note that in Table 3.6 adjustments have been made for

inflation so price levels are reported in 1999 terms (this adjustment is from June 1996 to December 1998 and is a factor of 1.21).

Table 3.5: Estimated end-user prices after rationalisation-1999 [c/kWh]
Prices are adjusted by inflation to reflect 1999 terms
Source: Davis 1999

RED	*A-Northern*	*B-Western*	*C-Central*	*D-Eastern*	*E-Wits*
Domestic	16.5	19.3	17.6	17.5	17.0
Commercial	18.0	18.9	19.9	18.9	19.9
Industrial	13.7	15.0	16.2	14.0	15.9
Mining	9.9	15.3	18.8	18.1	12.8
Total av. price	15.0	18.4	17.8	16.5	15.8

Cross-subsidisation from consumers in larger load centres to consumers in smaller centres is a much stronger effect than the economies of scale reaped through rationalisation (Davis 1999). He further argues that it is assumed that bulk purchase prices tend to converge to the weighted average of existing prices. Table 3.6 shows these to be between 7.9 and 9.2 c/kWh. It is also assumed that distribution costs will approach those of a large distributor as shown in Table 3.6.

It is assumed that regional distributors would be run on a commercial basis, and would be expected to earn a positive return on assets. Acknowledging the difficulty to get a true value of the distribution industries' asset base, or to know how much of this is debt-financed, an indication is that Eskom has a debt-equity ratio of approximately 1, and earns a profit of 15% on turn-over.

Table 3.6: Estimate of price build up for REDS- 1995/6 (C/kWh)
Source: Davis 1999

RED	*A-Northern*	*B-Western*	*C-Central*	*D-Eastern*	*E-Wits*
Purchase price	7.9	9.2	9.0	8.5	8.2
Other distribution costs	1.8	2.8	2.7	2.2	2.1
Local authority tax	1.0	1.0	1.0	1.0	1.0
Profit	1.7	2.1	2.0	1.9	1.8
Total av. price	**12.4**	**15.1**	**14.7**	**13.6**	**13.1**
Existing av. price	20.6	25.4	25.9	21.3	17.4
Reduction	39%	40%	42%	36%	25%
Existing weighted av. price	12.5	18.7	16.1	16.4	15.1
Reduction	1%	19%	9%	17%	13%

would give a total average price between 12.4 and 15.1 c/kWh, as shown in table 3.6. This is some 25% to 40% lower than existing average prices found in the industry, and most municipal consumers would see substantial price reductions. Notwithstanding, when estimated prices are compared with the existing weighted average (weighted by sales volume), the new prices are much closer to existing levels. Finally consumers, particularly in small towns are likely to benefit from substantially reduced prices because that cost is shared over a much larger consumer base. However, customers currently served by large distributors will see only relatively small changes in the prices charged to them.

3.5 Case study: Mossel Bay Municipality

This case study examines the Mossel Bay Municipality's tariffs for different consumers, their consumption, and the income that the municipality gets from these consumers. Bothma (1999) provided this information.

3.5.1 Consumer groups' tariffs, consumption and the municipal income

Mossel Bay serves different consumer groups, which include domestic, commercial, light and large industrial and agricultural. The municipality derives income from these consumers that vary according to their consumption.

The first two tariffs shown in table 3.7 (pre-paid and credit metering) are for domestic consumers. Noteworthy is the amount of 48c/kWh for the small/bulk industrial, which is higher than 28c/kWh for the bulk/large industrial customers[16]. The important point to note from Table 3.4 is the income that different consumers contribute. For instance, household consumers (both pre-paid and credit metering) contribute an income of R17.5 million from a total number of 1,396 consumers. On the other hand industrial consumers' contribution of R13.7 million is huge considering the fact that it is from only 95 industries (including light, large and small industries). Compared with the average national patterns (for example, see Table 3.5) the industrial consumers pay relatively high prices in order to recover the capital costs and finance other municipal services.

16 Bothma (1999) acknowledges this difference, and the municipality is rectifying that.

Table 3.7: Mossel Bay tariffs for different consumers
Source: Bothma 1999

Tariffs	*Consumers*	*kWh*	*Income*	*Average c/kWh*
Pre-paid	8,321	26,417,807	R7,333,667	R0.278
Credit metering (household)	5,639	34,378,744	R10,202,594	R0.297
Commercial	825	19,368,812	R7,554,574	R0.390
Light industrial	56	8,760,180	R2,701,610	R0.308
Bulk/large industrial	36	39,047,573	R10,822,264	R0.277
Small/bulk industrial	3	438,294	R208,758	R0.476
Mossgas	1	4,888,704	R969,404	R0.198
Agricultural	9	379,718	R95,041	R0.250
Street lights	0	3,145,465	R458,918	R0.146
Total	14890	136,825,297	R40,346,831	R0.295

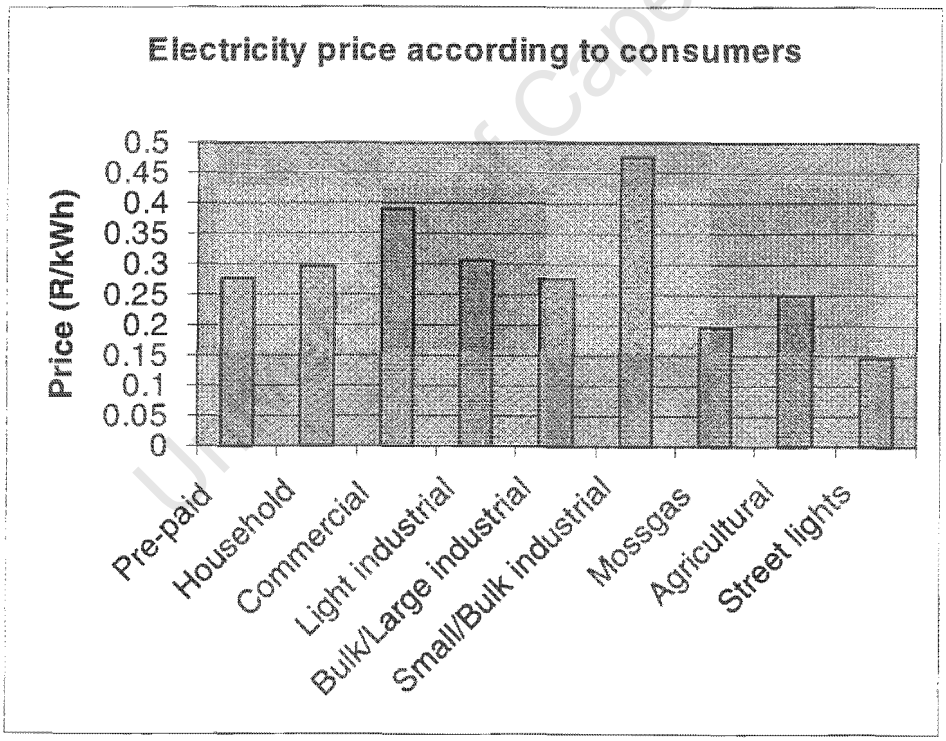

FIGURE 3.5: Graph of Mossel Bay's different consumers' price levels

Figure 3.5 illustrates prices that different consumer groups pay for electricity. Noteworthy from Figure 3.5 is that the municipality pays the lowest price of 15 c/kWh for the streetlights. There is a difference of 2 cents between those households who are on pre-paid meter and credit metering. Mossel Bay also supplies Mossgas, which pays 20 c/kWh.

3.5.2 Mossel Bay municipality's domestic tariffs

Mossel Bay basically uses two different domestic tariffs, which are credit metering and pre-paid metering. Since 1994 credit and prepaid meters that include a poverty tariff have been used. Bothma (1999) pointed out that research found that the disadvantaged community that wishes to replace candles, paraffin, and burning wood for cooking purposes for a family of six requires basic energy of 200 units (kWh) per month. These units enable that household to use basic electrical appliances, such as a two-plate stove, a kettle, an iron and four lights.

The criteria used to identify customers that qualify for the poverty tariff are:

1. A registered permanent user living on a single residential erf with the total municipal valuation of the building not exceeding R50 000 or
2. A registered user who can show that his/her yearly income does not exceed R30 000.

Only the prepaid meters include a poverty tariff. For the first 199kWh per month customers on the breadline or poverty tariff pay 22,9c/kWh, which is basically the purchase price of electricity of about 14c/kWh plus electricity department running cost of about 8c/kWh. Units above 200kWh cost 30,4c/kWh, which actually subsidises the breadline tariff. The total net profit at 30 cents per unit is 30%.

Credit meter customers pay a basic monthly charge of R53, 92 and purchase a unit at 20 cents. Consumers with consumption above 700kWh on pre-paid meters pay more compared to those on credit meters. For example to consume 800kWh a consumer on a pre-paid meter pays R243 (vat inclusive), while it costs R214 (vat inclusive) for a consumer on a credit meter. This encourages rich households with high consumption to use credit meters. Basically, this tariff is structured in a manner that the higher users of electricity are charged more than lower users of electricity. The municipality makes a net profit margin of 20% from the 6 000 meters installed.

3.6 Conclusions

This chapter examined the current tariff system and price levels in South Africa. It has shown that tariff systems and price levels vary widely among distributors and across provinces. The size of the distributor and the province has a major influence on the price. However, it is hoped that rationalisation of the EDI will alleviate this problem of price differentiation, and estimates were presented, which suggested that rationalisation into five Regional Electricity Distributors could lead to a reduction in average prices as well as a reduction in price differentials.

Mossel Bay Municipality presented a good case study. A huge number of its customers (8,321) use pre-paid meter, which includes a poverty tariff, and they contribute revenue of R7 million to the municipality. Noteworthy is that even though the municipality is implementing the breadline tariff, it still generates profit, which presents a good case for a distributional equity tariff that can be implemented without significant loss of economic efficiency. The municipality makes an income of R10 million from credit metering, which is used by 5,639 consumers. This shows that electricity generates significant revenue for municipalities, which is used to finance other services, a situation likely to change with REDs. Control over surpluses from municipal electricity sales is a critical issue and presently sales contribute to local government finances and provide cross-subsidies to support electrification projects.

CHAPTER FOUR:

MOTIVATIONS FOR A POVERTY TARIFF AND POSSIBLE POVERTY TARIFF STRUCTURES

4.1 Introduction

This chapter reviews a number of the existing tariff structures in order to assess their suitability as possible poverty tariffs. Tariffs set out the components of the price or the parameters used to determine the charges for recovering the required revenue or allocated costs. Broadly, a poverty tariff is intended to help address the issues of poverty and equity in South Africa in relation to electricity use. The possible poverty tariff structures need to address specific electrification pricing objectives, which include addressing access to electricity, reducing barriers to entry and increasing affordability.

Section 4.2 first discusses motivations for a poverty tariff, giving attention to the benefits that accrue from electrification. Section 4.3 is dedicated to the recent debate in South Africa about the poverty tariff. The sequence of the debate is as follows:

- Government's views on a poverty tariff, as reflected in the White Paper on Energy Policy
- Views put forward by the National Electricity Regulator (NER) during the period of Sekonya to the current period of Mkhwanazi
- The Department of Minerals and Energy's (DME) views
- Eskom's views
- Other perspectives

Section 4.4 discusses electricity tariff options. Tariff structures that are discussed include the income-related rebate tariff (the poverty tariff proposed by the NER), the two-part tariff, the inclining block tariff, the straight-line tariff and the fixed charge (with load limited supplies) tariff. Section 4.5 concludes the chapter.

4.2 Motivations for a poverty tariff

According to the National Electricity Regulator (NER) electricity is a basic service that holds significant benefits for households. This section discusses some of the benefits that have been put forward as motivations for a poverty tariff.

The Electricity Regulator Journal (1998: 2) states that the energy situation in South Africa is characterised by the combination of urban and rural poverty, high electricity generation capacity, unacceptable levels of air pollution and substantial disparities in access to domestic electricity. Realising the role that electricity plays in the economy of the country, the former management of the NER motivated for the adoption of an income-related rebate poverty tariff.

The objectives of a poverty tariff are firstly, to reduce barriers of access to electricity by addressing the key issue of affordable electricity pricing for the poor. Secondly, to redress the past exclusion of the majority of black people and improve equity through widening access to electricity services. Thirdly, to bring socio-economic relief to the people of South Africa. Before discussing the benefits of electrification it seems apt to briefly raise the issue of whether access to subsidised electricity is a right or a concession. The main reason is to examine if government is bound to provide electricity to all the people, including those who can not afford the service, or only to those who can afford to use it.

- *Access to subsidised electricity: a right or a concession?*

This question can not be satisfactorily addressed in this thesis, since it prompts the most complex debates in politics, economics, ethics and legal theory. Suffice here to argue from a more personal point of view that access to subsidised electricity by means of an income-related rebate is a concession not a right. In fact it should not be access to electricity but rather to affordable energy, which should be deemed as a human right. In this regard one would argue that it is everyone's human right to have to satisfy their basic human needs, energy for cooking and heating being one of them, and that it is the responsibility of the government to provide for the basic needs of all its citizens without discriminating. People can live without electricity but without energy they cannot, meaning that electricity is only one possible source of the energy that people need in order to survive. Investing in an electricity poverty tariff may not be an optimal investment in either social or economic terms. As Hattingh *et al* (1993) observe it may not be justified for government to provide electricity to people who are not able to pay for the service and who may not even use it after being electrified; rather government should strive to ensure that everyone has access to affordable energy.

On the other hand, South Africa's rapid electrification programme has already resulted in many low-income households receiving an electrical connection, but not being able to gain much benefit because they are not able to afford the costs of consuming electricity. A poverty tariff could make electricity consumption more affordable in such cases, and help users gain greater benefits from the investment of the electrification programme. Whether

this is justified requires some assessment of the benefits of electrification and expanded electricity use, both for the intended beneficiaries or a poverty tariff, as well as to the country as a whole. These issues are discussed below, while financial implications are examined in Chapter five.

4.2.1. Benefits that accrue from electricity

Benefits can be realised at different levels, which include benefits to the country as a whole (for example macroeconomic benefits and broadly environmental benefits), to the development of small enterprises to social services and to households. Some of these benefits are linked to electrification itself, while others are more dependent on actual usage of electricity. The idea of a poverty tariff is aimed primarily at increased usage of electricity by low-income households, but would also have implications for the electrification programme as a whole, so it is relevant to consider benefits associated with the electrification programme as well as those associated with electricity usage.

The benefits, which will be considered here, include economic benefits, environmental benefits, health benefits, social benefits and political benefits.

4.2.1.1 Economic benefits

- *Macroeconomic benefits*

All the studies that attempted to estimate the economic benefits from large-scale electrification programmes reached a common conclusion that electrification will result in major benefits to the national economy. However, it is acknowledged that the quantification of these benefits leads to very different results. The study by Van Horen (1994: 45) used the approach of assessing the more direct effects of electrification, focusing particularly on the actual capital expenditure related to new connections, and the appliance purchases, which result. This confirmed that there would be positive impacts in terms of employment creation although obviously at a much more modest level due to the focus only on direct effects. Eberhard and Van Horen (1995: 145) argued that the impact of electrification on other macro-economic variables such as the balance of payments, fiscal revenue and expenditure would be relatively moderate. To date South Africa is the world-leading exporter of prepayment meters, which offset the outflows on the current account. In the case of government revenue and expenditure the effect on the fiscus was expected to be relatively small, even if the state provided grant finance for the excess of actual connection costs over the 'cost of connection' payments.

- *Benefits to the development of small, medium and micro enterprises*

One of the short-term policy priorities stated in the White Paper on Energy Policy is to stimulate economic development. This is done by encouraging energy sector actors to facilitate economic empowerment, through the creation of small, medium and micro enterprises and by assisting previously disadvantaged people to gain entry to the energy sector. Impacts on the informal sector, although not quantified, are expected to be significant.

Access to electricity leads to a reduction of energy expenditure in small shops, which switch to electricity for refrigeration, lighting, powering hi-fis and radios. Once small shops shift to using electricity for a number of thermal energy services, a greater reduction in energy expenditure is experienced than for those with fewer energy requirements. On the other hand non-electrified businesses pay more for the same energy services than electrified businesses. Other small businesses may require tools and equipment, which either must run on electricity, or are more convenient to operate from an electricity supply. A further important need for electricity lies in access to modern telecommunications, which can assist the operation of small businesses.

- *Benefits to households*

A number of studies have found that energy expenditure occupies a prominent place in poor households' economies and usually accounts for a large proportion of monthly expenditure. Household energy expenditure levels may not necessarily decline once a household is electrified. However electricity can deliver certain services more cost effectively than other energy carriers such as candles and batteries. The income, which is realised by switching to a more cost-effective energy source (the increased consumer surplus, in economic terms) may be redirected to consume more of that resource. An example is operating more lights for more hours during the night or purchasing new appliances such as electric refrigerators and kettles (Eberhard and Van Horen 1995: 59).

An important issue, regarding the economic benefits of electrification for poor households, is that if they cannot afford to pay for significant quantities of electricity, or suitable appliances, they continue using other fuels and appliances especially for cooking and heating. This limits the economic benefits of electrification for poor households and is one of the motivations for an electricity poverty tariff.

4.2.1.2 Health benefits

Health and environmental benefits are linked to households' usage of electricity.

- *Benefits to the whole country*

Government is spending a lot of money due to respiratory diseases, burns and paraffin poisoning. Government could realise a magnitude of savings from these causes, provided the level of electrification goes up and electrified households make full use of electricity. According to the Electricity Regulator Journal (1998: 2) the following savings could be realised: respiratory disease – R356 million and burns and paraffin poisoning – R406 million. However the NER did not give an indication of what period of time these savings would be realised and on what basis these were calculated.

- *Benefits to households*

Exposure to fine particulates as a result of high levels of indoor air pollution associated with coal and biomass fuel use increases the incidence of respiratory diseases. In such cases access to electricity can help in drastically reducing indoor air pollution, provided it effectively replaces these fuels.

The NER Journal (1998) based on Medical Research Council's information estimated that the burn fatality rate in South Africa is four times higher than that of the industrialised world, due to house-fires in homes and informal settlements. Burns among coal, biomass and paraffin and candle users are normally due to close proximity to stoves, lamps and 'naked' flames[17].

Paraffin is very widely used. Carbon monoxide, nitrogen dioxide and particulates are the more significant by-products of paraffin combustion. Exposure to these pollutants in significant quantities can have severe health impacts, resulting even in death in case of inadequate ventilation.

Paraffin poisoning is also widespread among small children. Access to basic electricity can be one of the most effective means of combating paraffin poisoning, which according to 1995 statistics was the main cause of some 16 000 hospitalisation cases annually. Ultimately the health sector will have savings as a benefit.

4.2.1.3 Environmental benefits

- *Benefits to the whole country*

Environmental benefits and health benefits overlap due to the fact that human health is very much a product of the immediate environment in which people live and this has been seen to be heavily influenced by the patterns of fuel use. Serious atmospheric pollution occurs in densely settled areas of South Africa where low-income households use coal or

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[17] See Medical Research Council (MRC) on cause of fatal childhood burns.

wood for cooking and heating. Electrification could be an agent for improved environmental equity, by reducing environmental effects in such areas through the substitution of electricity for other fuels.

South African electricity generation, from coal, itself causes serious pollution; it is argued that this pollution is less localised and better controlled than the effects of burning coal inside homes. However, the net environmental benefits would depend on the extent to which people stop using the dirtier fuels (which can be much cheaper than electricity, in parts of the country where coal is cheap or wood is freely available). In relation to energy poverty, Hartog *et al* (1999: 87) argue that the environmental cost is not only borne by the society at large, but also to a large extent by the poor themselves.

Electrification has little observable effect on the rate of fuel-wood depletion, partly because fuel-wood collection is only one among many uses for wood or causes of woodland degradation, and partly because poor households dependent on collecting wood often cannot afford to use electricity for their main cooking and heating needs.

4.2.1.4 Social benefits

- *Benefits to the whole country*

Crime is increasing at an alarming rate in South Africa. It is generally argued that electricity may help in the reduction of crime as a result of street lighting. Street lighting can also help to ensure women's safety and, hence, their ability to participate in community activities, which may be held in the evening. A typical example of using electricity for this purpose is when the former president Nelson Mandela requested Eskom to install streetlights in Magoda and Indaleni as a means of combating the night killings of people in the area.

- *Benefits to households*

Generally speaking electrification can be an agent of improved social equity notwithstanding that the contrary may also be true if specific attention is not dedicated to improving equity. Eberhard and Van Horen (1995: 146) provide two illustrative examples, at the macro level and at intra-household level. The macro-level example argues for the necessity of restructuring the distribution industry so as to allow for cross-subsidisation of the poor. The household-level example raises the need to ensure that women are given a greater role in decisions about the spatial location of electricity connections and about appliance purchase.

In general the high popular demand for household electricity illustrates the value which people attach to this versatile, clean and convenient energy source. In some cases it can save money spent on less efficient fuels, and usually provide improved energy services in

the home. To a limited extent it may relieve rural women from collecting wood and carrying heavy loads that cause back illnesses. Other benefits can be realised in education through lighting, access to audio-visual aids, television and computers (Electricity Regulator Journal 1998: 2).

4.2.1.5 Political benefits

In the 1980s electricity services became increasingly politicised. It should always be borne in mind that unequal distribution of access to electricity is a product of the notorious apartheid policy. The beginning of 1990s, which brought the political transition from minority rule to democratic national government, marked the deepening of pressures on municipalities and Eskom to address the needs and demands of the majority of under-serviced people. The democratic government committed itself to redress the past inequalities through improved distributional equity in providing electricity services to all the people. Abridging inequalities is the fundamental justification behind the accelerated national electrification programme. Finally, achieving the electrification targets, which appeared ambitious and daunting at the beginning, is really a benefit from the new democratic political dispensation.

- *The trickle-down of the benefits to the poorest of the poor*

Introducing a poverty tariff is just one way of attempting to create equitable access to electricity and combating poverty more generally. Even when electrified, some households continue to experience problems with access to electrical appliances, and in paying electricity bills. This prevents them from making full use of electricity (Mehlwana and Qase 1999).

The critical issue is whether poor households, once electrified, are able to take full advantage of the service, and whether they are actually able to capture all the benefits that are potentially available to them. Evidence suggests that electricity does not displace other fuels rapidly or completely, and so these supposed benefits are only partially realised. Mehlwana and Qase (1999: 56) point out that electricity cannot wholly replace the inappropriately named 'traditional' or 'transitional' fuels. Instead, electricity becomes one of the energy options that poor householders use. In rural areas, the scarcity of wood may lead to the greater use of paraffin, even if it is difficult for households to afford it.

On the other hand, some urban households normally reliant on paraffin may fall back on the use of wood because of lack of income. The speculation that a more generous poverty tariff would increase greater degree of fuel switching may be unfounded. The overriding reason here could be that most households do not have sufficient income to purchase electrical appliances, which would allow them a complete switch. For example, people who

have invested in coal stoves do not just want to do away with them after getting electricity; besides, coal is a cheaper fuel. Traditionally old people in rural areas mostly like to sit around wood-fire chatting and electricity may not displace this tradition completely.

4.3 The recent debate on a poverty tariff

On 22 October 1998, the South African National Electricity Regulator (NER), which regulates the electricity industry, held a press conference to announce the introduction of a new poverty tariff. Other stakeholders including the Department of Minerals and Energy, Eskom, the new management of NER and other experts in the field received this with mixed feelings. This section reviews the recent debate on a poverty tariff by some of the major stakeholders, acknowledging the fact that the issue has been put on hold by the NER.

4.3.1 Government's views on a poverty tariff as reflected in the Energy White Paper

The White Paper on Energy (1998: 8) states that: "Government will promote access to affordable energy services for disadvantaged households, small businesses, small farms and community services". This follows the national government's emphasis to widen access to basic services to the disadvantaged poor in the RDP policy - electricity being one of them. Typical examples of the poorest of the poor are pensioners, the unemployed, disabled persons, and single parents. The provision of these services comes at a cost that is presently not affordable to many households.

4.3.2 The NER's views on poverty tariff

The NER had been developing and evaluating poverty tariff mechanisms and their impacts on electricity prices. Principles involved were to be finalised for discussion with stakeholders, and the implementation of the tariff was targeted for the financial year 1999. The announcement of the introduction of a poverty tariff, on the 22 of October 1998 by Magate Sekonya, former Chief Executive Officer and the Chairman of the NER, lacked specific technical or other details on the proposed poverty tariff, notwithstanding the following key points that were made:

- This issue of affordability of electricity is a major problem for those classified as indigent, that is, those with monthly earnings of less than R500.
- Many of those who have access to electricity cannot take full advantage of it due to its unaffordability.

- The NER has taken steps to initiate a poverty tariff to the rest of the Electricity Distribution Industry (EDI), which will be borne by Eskom.
- The planned cost impact has been factored into the 1999 Eskom annual price increase that has been approved by the NER.
- This price increase is below the inflation rate and the poverty tariff does not place any additional burden on the rest of the electricity users.
- A mechanism will be set up to ensure the necessary flow of funds from Eskom to all electricity distributors implementing the poverty tariff.
- The targeted implementation date of the poverty tariff will be early 1999 (EE Publishers 1998: 15).

Subsequent to this announcement the chief executive officer resigned with some board members. Apparently other board members were not happy with the announcement, arguing that it was premature. The new

NER board put the poverty tariff on hold for further investigations and proper consultation with all the stakeholders.

4.3.3 The Department of Minerals and Energy (DME) views on the poverty tariff

The DME made it clear from the onset that the matter of the poverty tariff arose from the NER not the DME. The DME argued that the then chairman and CEO of the NER, Magate Sekonya, did not discuss the details of the poverty tariff with them prior to its announcement through the media. The DME pointed out that the subject of such poverty alleviation is complex and would require further investigations and consultations with the DME and other ministries such as finance and constitutional development, as well as other stakeholders (Mokoena 1998: 10).

4.3.4 Eskom's views on the poverty tariff

Following the announcement of the introduction of a new poverty tariff by the NER, Eskom appealed to government to look at other ways of addressing the issue. Eskom's chief executive officer Allen Morgan pointed out that Eskom supports the introduction of measures to bring socio-economic relief to the people of South Africa. However the introduction of such measures should be consistent with government policies and initiatives. It should always be borne in mind that Eskom is part of the Masakhane Forum that deduced that the establishment of a poverty tariff impacted all services and should be developed by the Department of Welfare, in conjunction with the relevant stakeholders (Naidoo 1998).

Eskom officials have pointed out some of the difficulties of managing poverty tariffs, especially the increased administrative burden imposed on utilities as well as the political sensitivities of implementing this structure. It would be a huge task to determine who is eligible for the tariff as well as to police it. Naturally, one of the principal objections to this tariff system is the cost which would be incurred. It is estimated that with current pricing structures, there is already a huge annual loss caused by operational losses in the distribution section, something between R0.5 and R1 billion per annum in accumulating, non-recoverable operational costs due to low usage patterns. Implementing a poverty tariff would only increase this burden because the tariff is not compatible with the existing Eskom tariffs and it will need more administrative staff.

4.3.5 Others' views

Two different views are considered below. One is based on economic position and the other is a political view. These are followed by comments on whether they are reasonable or compatible with the realities of poverty and development in South Africa.

- *Economic view*

Clarke[18] in Energize Journal (1998: 6) argues that one must be forgiven for thinking that our national policy-making authorities are under the impression that money grows on trees, and that there is a kind of "bottomless pit" into which they can continuously dip. He borrowed Abraham Lincoln's words that:

> You cannot strengthen the weak by weakening the strong; you cannot help the small men by tearing down the big men; you cannot help the poor by destroying the rich and you cannot help men permanently by doing for them what they could and should do for themselves.

Clarke (1998) poses a question "why hand people fish instead of teaching them how to fish if people are serious about nation building?" Considering the losses that are already incurred from the electrification programme the question that remains to be answered is the sustainability of this tariff. Since 1992 about R10 billion has been invested in capital expenditure on electrification and the consumption per connection is far short for the scheme to be financially viable. The annual financial viability shortfall for the more than two million consumers connected under the programme is estimated at about R720-million each year, and is rising with each new consumer on the network. The total accumulated loss is in the order of R2- billion and is growing (Clarke 1998).

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[18] Clarke M.P.P is the editor of AMEU News and the consulting Editor of the Energize Power Journal.

- *Political view*

Chalmers (1999) in Business Day, July 2 1999 said poverty tariff postponement is of concern to the National Union of Metalworkers (NUM). However he argues that by shelving the poverty tariff it was clear that the regulator wanted to embark on measures that would support gradual steps towards a competitive electricity market. The union believes a special lifeline tariff should be introduced for poor customers and wealthy customers should pay more so that those poor customers could afford electricity.

- *Comments*

Both views are reasonable, considering that they are from different schools of thoughts. From a political point of view it may be justifiable to argue that it requires a deliberate policy such as a poverty tariff to widen access to electricity to poor people since it was a deliberate apartheid policy that excluded majorities of black people from electricity services. On the other hand, electrification for noble sounding social goals to undo the past imbalance can be costly to our limited resources, which are supposed to meet the huge needs. It should always be borne in mind that investing in electrification might lead to a general increase in poverty instead of the economic prosperity, which is what is badly needed. Nonetheless government should strive for a balance between equity goals and economic goals with the ultimate goal of widening access to electricity to poor people.

4.4 Electricity tariff options

The electricity supply authorities could implement a number of tariff structures in order to achieve the objectives of a poverty tariff. Here the main focus will be on how each structure works (with some graphic illustrations); the key features; and the advantages and the disadvantages of each tariff. The issue of how well each tariff meets the objectives of a poverty tariff is also addressed using some criteria.

- *Criteria used to evaluate tariff structures*

Economic efficiency: An efficient tariff will create incentives that ensure, for a fixed supply cost, that users obtain the largest possible aggregate benefits. A different, but equivalent statement of this objective is that for a given level of aggregate benefits from electricity use, the supply cost is minimised. Generations of economists have insisted on the importance of this objective, and noted that it can be achieved by setting all prices equal to their relevant marginal costs (Boland and Whittington 1999: 4).

Equity: Equity requires that equals be treated equally. In public utility tariff design, this usually means that users pay amounts, which are proportionate to the costs that they

impose on the utility. Equity is thus a quantifiable proposition, subject to precise definition and verification (Boland and Whittington 1999: 4).

Fair to all parties: Equity and fairness are often used either together or interchangeably. However they have different meanings. Fairness is wholly subjective. Each participant in a tariff design process may have a different notion of the meaning of fairness. One may think it fair to set a high price for industrial electricity use, another may not. One may think it fair to charge all customers the same price (even when, because of cost of service differences, this is not necessarily equitable), while another may believe that fairness requires subsidies to some customers. A fair tariff should as far as possible avoid undue discrimination by distributing the burden of meeting total revenue requirements fairly and without arbitrariness and inequities among customers. A marginal cost-based tariff is expected to be equitable, but not necessarily fair (*Ibid*).

Easy to implement: The promulgation and implementation of the revised tariff should not encounter significant barriers in terms of legal authority, administration competence, information requirements, or billing procedures (Boland and Whittington 1999: 5).

Simple to understand: A tariff design should be easy to explain and easy to understand. It should be possible for most users to know what price they are paying for electricity (Boland and Whittington 1999: 4).

Five possible tariff structures are discussed, which include: the income-related rebate tariff; the two-part tariff; the inclining block tariff; the fixed charge (with load limited supplies) tariff and the straight-line tariff.

4.4.1 The income-related rebate tariff

The income-related rebate option is the form of poverty tariff that was proposed by the NER. The fundamental basis of the income-related rebate tariff is that people who earn less than a certain level (for example R500 per month) should receive small amounts of electricity free, or at least at a reduced rate. The NER estimated that 30% of households, which amounts to almost 1.9 million, fall within a monthly income range of R1 to R499. These households would qualify for an income-related rebate tariff if the cut-off point is R500 (National Electricity Regulator 1998: 2).

The income-related rebate tariffs' distinctive feature is its specific focus on low-income households. It strives for special attention to be directed at those regarded as the poorest of the poor, with typical examples being pensioners, the unemployed, disabled persons and single parents. An electricity rebate would obviously be an advantage to low-income households and the poor since the provision of electricity comes at a cost that is presently

not affordable to many households. Essentially, this structure addresses the issue of pricing for distributional equity, which is a legitimate development goal.

The question of sustainability (addressed in Chapter 5) of this structure poses a potential threat as well as the disadvantages raised by Eskom in the previous section, which militate against this tariff structure. The major thing that can hinder the implementation of this tariff is the question of scale. If the target group could be a small percentage of the overall population, maybe it could be sustainable.

4.4.2 The two-part tariff

In general, multi-part tariffs have the objective of charging customers more exactly for the provision and consumption of electricity, according to actual costs of supply. They may include fixed monthly charges for provision of service, fixed or variable charges according to maximum demand (kVA), and energy charges (for kWh consumed), which in turn may be on a sliding scale, such as declining blocks, and may incorporate time–of-use variations. Complex multi-part tariffs are more common for large consumers rather than for households. The most basic two-part tariff, which will be discussed in this section, is more typical of a common form of tariff for credit-metered households. It consist of a "monthly basic charge", covering capital redemption and regular services costs, plus a variable "energy charge", which depends on the number of units of electricity consumed.

The two-part tariff can be broadly cost-reflective insofar as it aims to recover the utility's average costs of supply (Van Horen and Davis 1996). However, two-part tariffs can be employed for cross-subsidisation, which makes them relevant to the objectives of a poverty tariff.

The structure of a basic two-part tariff is shown in figure 4.1.

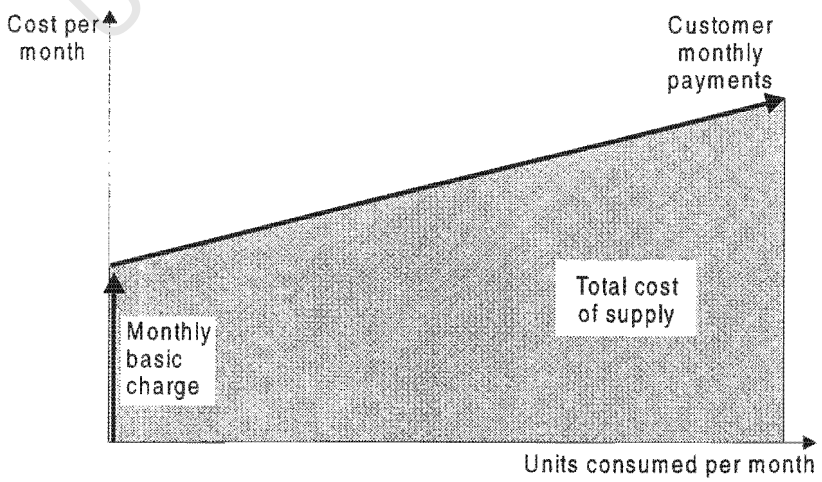

FIGURE 4.1: The two-part tariff

Cross-subsidisation can be done by allowing high-demand customers to be served at price close to marginal cost (while paying a substantial fixed charge) at the same time as low-demand customers pay a price well above marginal cost (while paying little or no fixed charge). This is a combination of tariffs. In this case allocative efficiency is not sacrificed too much as a result of the firm's break-even constraint (Armstrong *et al* 1994: 44).

Two-part tariffs have an advantage that (marginal) prices are no longer required to cover all costs, and fixed charge can be used to make up any shortfall in profits. The other advantage is that this tariff is usable in various utility industries such as telecommunication, gas and water industry. However, this fixed charge will cause low-demand consumers to drop out of the market, which is bad for allocative efficiency (Armstrong *et al* 1994: 44). As a solution to this problem consumers could be offered the choice between two tariff schemes. For instance, a two-part tariff with a low fixed charge and higher usage charge aimed at the low-demand end of the market together with a tariff with a higher fixed and lower usage charges for the consumers who wish for larger quantities of the product (Armstrong *et al* 1994: 20). By offering a menu of two-part tariffs, people could select the tariff that suits them best.

However, although this could allow low-consuming households to access small amounts of electricity at a cost which is below the actual costs of supply, it would not completely meet the specific objectives of a poverty tariff. One of these objectives is to allow very poor people to make more use of electricity. The higher unit costs for low-demand customers would still be unaffordable to the very poor, even though they pay little or no fixed charge.

Dingley (1996) points out some more general limitations of the two-part tariff. First, it may lead to increased consumption. The average price per unit consumed decreases as consumption increases, which does not provide an effective signal to consumers to conserve electricity. Second, there is now a trend towards prepayment metering in all areas, which may make implementing a two-part tariff more problematic than in the case of credit metering systems. Third, it does not discourage users from using electricity during peak hours. In this respect, two-part tariffs provide distorted pricing signals since there is no incentive to customers to reduce usage at the time of the system peak.

4.4.3 The inclining block tariff

The objective of this tariff structure is to achieve a cross subsidy to low-consumption households and also to penalise households with very high levels of consumption in order to send them a signal that electricity is a resource that should be conserved. According to Barnard (1999) the inclining block rate is characterised by: 1) potentially large subsidies to

low-use users, 2) high costs for high-use users, 3) stagnant consumption and 4) difficulties in using pre-payment technology.

The essential characteristic of an inclining block tariff is that it does not charge only one rate, rather it charges a lower rate for the first 'block' of energy. For instance, the first 100 kWh per month could be charged at a lifeline tariff of say 10c/kWh and everything above 100 kWh at a rate of say 26c/kWh. Figure 4.2 illustrates this further.

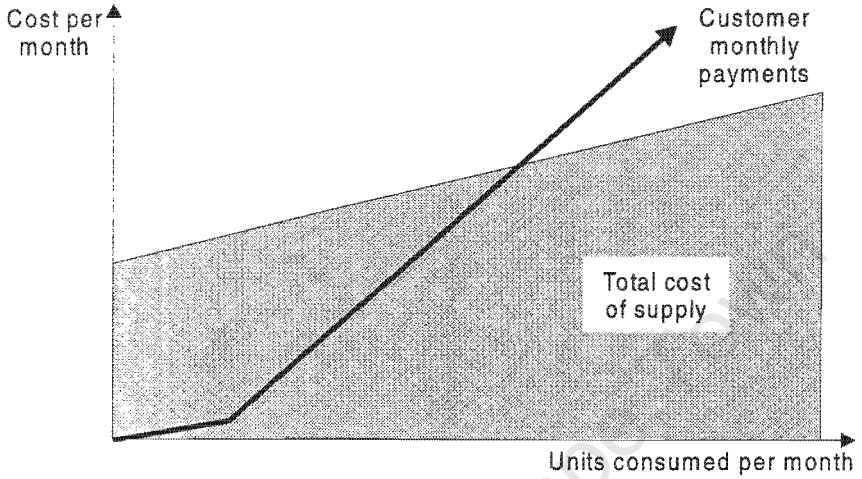

FIGURE 4.2: The inclining block tariff (two blocks)

There is another option with the inclining block tariff structure, which is to have a third 'block' of energy as shown in Figure 4.3. With the inclining block tariff (three blocks) the price level would rise twice as households consume more electricity. The inclining block tariff could be promoted on the basis that it fosters distributive equity by forcing rich households to cross-subsidise poor households.

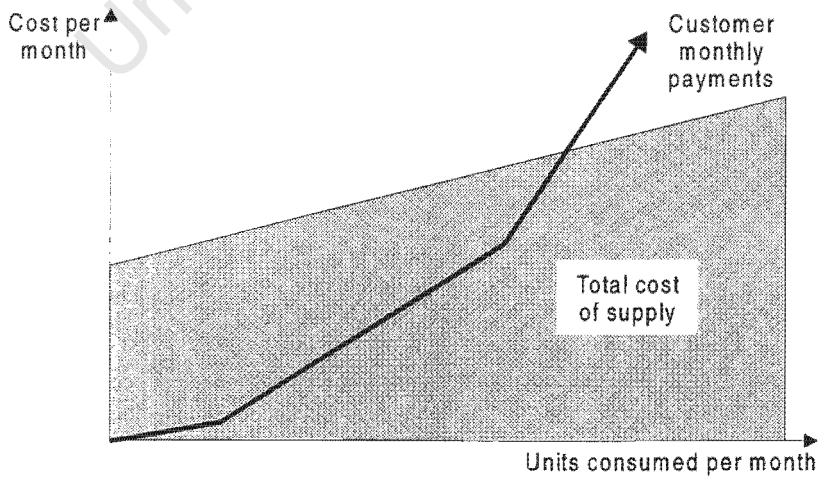

FIGURE 4.3: The inclining block tariff (three blocks)

Van Horen and Davis (1996) point out that the tariff is crude for redistribution since all consumers benefit from the subsidised first block, even high-level consumers. This tariff structure does not fulfil the criterion of being fair in that it deliberately fails to allocate costs equitably. The other setback is the question of its viability due to its complexity, more especially when there are more than two blocks of energy charged at different rates. This complexity can lead to confusion among consumers as the tariff structure is more complicated than many of the other options. There could also be a problem of inconsistency due to political interference with the decision-makers, whereby over time either the size or rate of the low rate block is increased or decreased. Consequently there would be a need for a strong and independent price regulatory system, which keeps political influence at sufficient arms length (Pickering 1994).

The inclining block tariff meets the objectives of a poverty tariff because it promotes distributive equity by forcing rich households to cross subsidise poor households. However, it could seriously distort pricing signals by imposing higher costs on increased levels of consumption, while the marginal costs of supplying these increased consumption levels are in fact falling. Thus, high-consuming customers might curtail their consumption in an economically inefficient manner (possibly by switching to other fuels). On the other hand, these distortions may not necessarily lead to significant departures from allocative efficiency if the demand among high-consumers is relatively price-inelastic (Teplitz-Sembitzky 1992: 85).

4.4.4 The straight-line tariff structure

The straight-line tariff structure is also known as the single energy rate tariff and has been implemented by Eskom in South Africa as the so called 'S' tariff. Figure 4.4 shows the straight-line tariff.

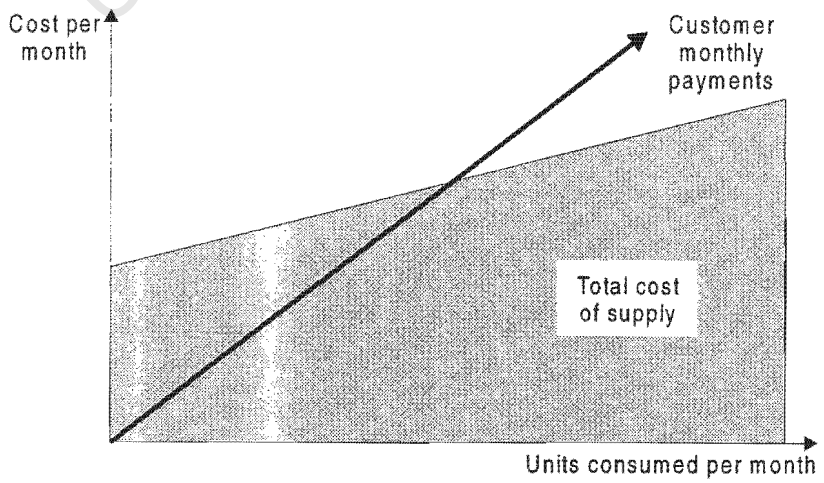

FIGURE 4.4: The straight-line tariff

This tariff entails no fixed charge to the consumer, only a charge for the quantity of energy used (say 26 c/kWh[19]). The straight-line tariff is designed such that the average consumer would pay the full cost of supply each month. Low users are subsidised however the subsidy is removed as consumption increases. Below the break-even point, consumers will receive an effective cross-subsidy, while those above the break-even point will be paying more than the average cost of supply (Van Horen and Davis 1996).

The straight-line tariff structure is less efficient and less fair than the two-part tariff but more efficient than the inclining block and more equitable as well. This is the simplest option, both to implement and to understand. Apparently this tariff satisfies the political legitimacy requirement. It reduces the barriers to entry posed by high connection costs; consumers pay only a nominal connection fee. In order to achieve this in a highly visible fashion every household can be charged exactly the same rate, for instance 26c per unit (Pickering 1994).

4.4.5 The fixed charge (with load-limited supplies) tariff

The fixed charge is also known as the lifeline supply. The price level of this structure is say R15/month for a fixed supply level, for example a 2.5A load limit. This fixed monthly charge is independent of the quantity of electricity consumed. Ultimately this means that low consumers are overcharged while high consumers are undercharged, which is a major problem.

Eskom has piloted this tariff in order to establish the rates to be charged and the implementation issues to be resolved. At Tambo village research revealed that 56% of the sampled households with 20A supplies (approximately 50% of the village) did not use more than 2.5A, with 70% not using more than 8A (James and Ntutela 1997).

The advantage of this structure is reduced costs, which allows people to select this low service level depending on their own expected usage rather than a top-down approach. On the side of the distributor when the usage goes up substantially in a certain area, the system can be upgraded by putting in more transformers. This approach of 'fit for purpose' reticulation makes economical sense and is technically feasible. Table 4.3 shows those appliances that can be used with 2.5A.

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[19] The figure of 26c/kWh does not reflect the latest cost of kWh. Rather it is estimated based on the NER database 1996.

Table 4.1: Appliances that can be used with 2.5A
Source: Hartog et.al. (1999: 61)

Need	*Electricity equivalent energy*	*Watts*	*Total kWh/month*
Lighting	5 lamps 60 Watt @ 4 hours	300	36
Radio	20 Watt @ 8 hours	20	5
TV	100 Watt @5 hours	100	15

The main disadvantage with 2.5A supplies is that people are unable to use thermal appliances, such as hotplates and stoves, which consume more than about 550 Watts. When too many appliances (lighting, TV and refrigerator) or appliances consuming too much electricity (space heater, cooker or boiler) are used, the system will trip. The limited number of appliances, which can be used with a 2.5A supply means that people cannot enjoy certain services that would be beneficial for other people. Another problem with this tariff is people find the process of upgrading similar to starting afresh. However, since implementation approximately 10% of the customers have upgraded (James and Ntutela 1997).

4.5 Conclusions

This chapter has outlined the possible electricity poverty tariff options for low-income consumers and the motives for an electricity poverty tariff. The chapter interrogated the debate on poverty tariffs in the light of the other existing tariffs designed to address issues of electricity equity and poverty. It is indisputable that a carefully designed tariff is needed, which would address the issue of affordable electricity prices for the poor. All tariff structures discussed come close to satisfying the criteria for a reasonable tariff structure (for example practical, implementable, fair to all parties and simple to understand) even though none of them come close to satisfy both criteria of efficiency and equity. However, there are a number of existing structures, which could be adjusted to suit the objectives of a poverty tariff. Finally, the best solution to which tariff is best for customers is to give them a package of tariffs to chose from depending on their income, their consumption and their technology. These possible poverty tariff structures need further investigation in order to test their financial implications and their sustainability. This is done in the following chapter.

CHAPTER FIVE:

FINANCIAL IMPLICATIONS OF THE POSSIBLE POVERTY TARIFF STRUCTURES

5.1 Introduction

Chapter four discussed five different tariff structures, and it concluded by recommending that these tariffs need further investigation. Those tariffs are the income-related rebate, the two-part tariff, the inclining block tariff, the straight-line tariff and the fixed charge tariff. This chapter is dedicated to testing the financial implications of the possible poverty tariff options. The aim is to examine the practicality and sustainability of these different poverty tariff structures.

In order to test the financial implication of these tariffs, section 5.2 provides the framework by examining household income levels and corresponding levels of electrification. Households are grouped according to five different categories of income ranging from very low- to high-income households. Section 5.3 focuses on the costs of supplying electricity to the above categories of households. Estimates of the approximate monthly cost of supplying electricity to these households are made based on Eskom's costs of supply and estimated typical electricity consumption figures. Section 5.4 considers the financial viability of the different tariff options. It also explores the need for cross subsidisation and the sustainability of each of the tariff options. Section 5.5 discusses the methods of financing the poverty tariff, which include cross-subsidy from within the domestic customer group, cross-subsidy from other customer groups such as industrial customers channelled through Eskom, and from government as grants or vouchers. Section 5.6 concludes the chapter.

5.2 Household income and electrification

This section discusses households' income according to five different categories and relates these categories to levels of electrification. The income categories considered are very low-income, low-income, middle-income, upper-middle-income and high-income. The purpose of this section is to determine the number of households in each income category and to express this as a percentage of the total number of households in South Africa. Then to examine the data on electrification and establish what percentage of households in each

income category are electrified. This builds a framework for the analysis of the financial implication of the possible poverty tariffs. Table 5.1 presents this information.

Table 5.1: Household income categories and electrification
Source: Eskom's SA to Z (1996)[20]

Households' (hhds) income categories	*No. of hhds (000's)*	*% hhlds*	*Hhds with grid electricity (000's) (1995)*	*% electrified (1995)*	*Hhds with grid electricity (000's) (1998)*	*% electrified (1998)*
Total numbers (000's)	**8 260**	***100***	***3 820***	***46***	***4 923***	***60***
Very low-income hhds (0-499/month)	2 466	30	395	16	740	30
Low-income hhds (R500- **799/m)**	1 251	15	313	25	563	45
Middle-income hhds (R800- 1 399/m)	1 432	17	559	39	859	60
Upper middle-income hhds (R1 400- 3 999 /m)	1 597	19	1 069	67	1277	80
High income hhds (R4 000/month +	1 514	18	1 484	98	1 484	98

Table 5.1 shows that 30% of all households in South Africa, or some 2.4 million households fall into the very low-income category, i.e. households with earnings less than R500 per month in 1996 terms. According to the NER's proposal for a poverty tariff these households would qualify to get electricity free or at a lower rate by virtue of earning less than R500 monthly income. The estimated number of households with grid electricity in this income category was still relatively low in 1998 at 740 000 households or 30 percent of the households in the very-low income category. One of the aims of the poverty tariff proposed by the NER is to encourage these households to get access to electricity by making it more affordable. However, affordability is only one barrier, physical access to the grid is in reality far more important, especially in rural areas.

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[20] The information used is based on the 1996 edition of Eskom's SA to Z, which explains why the total number of households is not 9 059 571 as reflected in the census 1996. The numbers of households with grid electricity in 1998 and their percentages have been estimated based on the status of electrification in the NER's Annual Report 1997/98. Percentages do not always add up to 100% due to rounding.

5.3 Cost of supplying individual households with electricity

In order to do a financial analysis of the poverty tariffs, assumptions are made regarding the cost of supplying households and their electricity consumption. The cost of supplying individual households is based on Eskom's cost of supply and not municipalities' cost of supply, and on the kWh consumed by each household. The household categories noted above are used for this purpose. Estimates of typical monthly electricity consumption, for each category of household, were made in the following way. The main data source, Eskom's SA to Z (1996), provides average monthly reported electricity bills for each of these household income categories. These monthly bills, in rands, were divided by an average electricity price to give approximate consumption levels, in kWh per month, which were then rounded. However, the base consumption used is 100kWh for a very low-income household. While acknowledging the fact that many very low-income households on pre-paid metering systems consume less than 100kWh, this assumption was made because the purpose of the NER poverty tariff proposed was to allow such households to consume at least 100kWh per month in an affordable way.

Table 5.2 presents this information. This table shows the assumed electricity consumption of households in the different income categories and the total cost of supplying a typical household in each category with electricity. The cost of supply consists of three elements:

(i) the repayment of capital,

(ii) service costs, and

(iii) energy costs (kWh consumed multiplied by c/kWh).

The importance of table 5.2 is to lay the basis for the analysis of the financial implications of each of the tariff structures on individual households in different income categories. This framework is used to explore whether high-income households cross-subsidise very low-income households or vice versa, and whether such subsidies are sustainable within the domestic customer base, a topic which is discussed further in section 5.4.5.

Table 5.2: Households' income, consumption and the costs of supply

Household income category	*Household consumption (kWh)/month*	*Elements of cost of supplying electricity*			
		Repayment of capital (R)	*Service costs (R)*	*Cost of electricity per unit (c/kWh)*	*Total (R)*
Very low income	100	35	25	16	76
Low income	300	35	25	16	108
Middle income	500	35	25	16	140
Upper middle income	700	35	25	16	172
High income	1200	35	25	16	252

5.4 Financial implications of the possible poverty tariffs

This section examines the financial implications of the possible poverty tariffs discussed in chapter 4. These tariffs are the income-related rebate, the two-part tariff, the inclining block tariff, the straight-line tariff and the fixed charge tariff. These tariffs are first compared for individual households in each income category, based on the assumptions set out in Table 5.2 above. Further tables then show the estimated aggregated effects. This aggregation makes use of the data and estimates contained in Table 5.1 above, and is conducted for three levels of overall household electrification, namely 46% (as of 1995), 60% (as of 1998) and 100%, in order to show trends, which accompany increasing levels of electrification. Finally, this section presents the financial implication of each tariff structure considering their level of subsidy and the overall financial sustainability of the domestic customer group with such tariffs.

Assumptions made for the purpose of costing the different poverty tariffs options include:

- Standard price of electricity: at 26c/kWh
- Cost of supplying a very-low income household with 100 kWh electricity is R76 as shown in Table 5.2, serves as the base cost for households in other income categories to which their monthly consumption of electricity is added.

5.4.1 The income-related rebate

The fundamental basis of the income-related rebate tariff is that people who earn less than a certain level (for example R500 per month) should receive small amounts of electricity free, or at least at a reduced rate. In the present modelling exercise we assume that the first

100kWh per month are free for households this category. Households in income categories that exceed R500 per month are charged at 26c/kWh.

Table 5.3 shows different households' income categories, their monthly electricity consumption in kWh, the assumed cost of supplying those different households, the monthly payment according to the tariff structure and the resulting subsidy or surplus.

Table 5.3: Impact of the income-related rebate tariff

Category of household	*Household Consumption (kWh per month)*	*Cost of supply (R per month)*	*Monthly payments. Standard charge 26c/kWh (see note) (R per month)*	*Subsidy (-) Or Surplus (+) (R per month)*
Very low-income households	100	76	0	-76
Low income households	300	108	78	-30
Middle income household	500	140	130	-10
Upper middle income households	700	172	182	10
High income household	1200	252	312	60

Note: Very low-income households are fully rebated for up to 100kWh

Table 5.4 shows total subsidy or surplus required for electrification at different levels. Obviously the income-related rebate tariff fulfils the objective of a poverty tariff because it subsidises the very low-income households. However it also subsidises the low-income and the middle income households, which fall out of the cut-off point of R500 income per month.

Table 5.4: Approximate total monthly financial impacts of the income-related rebate tariff

Category of households	*Households with electricity 1995 (000's) 46%*	*Households with electricity 1998 (000's) 60%*	*Total no. of households (000's) 100%*	*Subsidy/ Surplus for individual households [R]*	*Total subsidy/ surplus for electrified households [R 000's] 46%*	*Total subsidy/ surplus for electrified households [R 000's] 60%*	*Total subsidy/ surplus for electrified households [R 000's] 100%*
Very low-income	395	740	2 466	-76	-30020	-56240	-187416
Low income	313	563	1 251	-30	-9390	-16890	-37530
Middle income	559	859	1 432	-10	-5590	-8590	-14320
Upper middle income	1 069	1277	1 597	10	10690	12770	15970
High income	1 484	1 484	1 514	60	89040	89040	90840
Extent of subsidy/surplus for domestic customer group					54730	20090	-132456

Table 5.4 shows that this tariff is sustainable when electrification is at 46% and at the current level of 60%. However, it would approach to show a deficit of R132.456 million per month, when electrification approaches 100%, that amounts to about R1.6 billion per year.

5.4.2 Two-part tariffs

The main objective of a two-part domestic tariff is to reflect more accurately what it costs to supply electricity to a household monthly. In a simple two-part domestic tariff, customers pay a fixed monthly charge as well as for kilowatt-hours consumed. The fixed charge represents the relatively constant costs of supply, such as capital repayment, servicing and billing; the energy charge for kWh consumed represents the variable costs. Some assumptions are made in order to analyse the financial implications of the two-part tariff. In the first analysis of a two-part tariff, the following assumptions will be made:

- Monthly fixed charge is equal to R60 (covering R35 capital and R25 service costs, as shown in Table 5.2) and is paid by all customers.
- The energy charge is set at 26c/kWh.

Table 5.5 presents this.

Table 5.5: Impact of two-part tariff

Category of household	*Household consumption (kWh per month)*	*Cost of supply (R per month)*	*Monthly payment @ 26c/kWh and R60/month (R per month)*	*Subsidy (-) or surplus (+) (R per month)*
Very low-income	100	76	86	10
Low income	300	108	138	30
Middle income	500	140	190	50
Upper middle income	700	172	242	70
High income	1200	252	372	120

A single two-part tariff based on the assumptions above does not require any subsidy. Even households in the very-low income category will be required to pay R10 more than the estimated cost of supply. In other words the electricity distributors make a profit from all households. This is because the fixed monthly charge of R60 already covers the distributors' fixed cost elements, while the assumed energy charge of 26c/kWh is 10c/kWh higher than the assumed cost per kWh (16c/kWh, as in Table 5.2). The profit level depends on the households' consumption. For instance, a very low-income household, which consumes 100 kWh per month, contributes a profit of R10 per month, while a high-income household, which consumes 1200 kWh per month contributes a profit of R120 per month.

The information in table 5.5 is used to analyse the financial implications of using the two-part tariff in different scenarios of electrification, as demonstrated in Table 5.6. This table shows the total amount of surplus when electrification is at the different levels of 46%, 60% and 100% electrification.

Table 5.6 shows that the low-income households get no subsidy, instead the distributor would make a profit from these households. With current electrification at 60%, distributors would make a monthly profit of R7.4 million from low-income households, on such a two-part tariff. This is likely to be about R24.6 million when electrification reaches 100%.

Table 5.6: Approximate total monthly financial impact of a two-part tariff

Category of households	*Hhds with electricity 1995 (000's) 46%*	*Hhds with electricity 1998 (000's) 60%*	*Total no. of hhds (000's) 100%*	*Subsidy/ surplus for individual hhds (R)*	*Total subsidy/ surplus for electrified hhds (R000's) 46%*	*Total subsidy/ surplus for electrified hhds (R000's) 60%*	*Total subsidy/ surplus for electrified hhds (R000's) 100%*
Very low income	395	740	2 466	10	3950	7400	24660
Low income	313	563	1 251	30	9390	16890	37530
Middle income	559	859	1 432	70	27950	42950	71600
Upper middle income	1 069	1277	1 597	100	74830	89390	111790
High income	1 484	1 484	1 514	150	178080	178080	181680
Extent of subsidy/surplus for domestic customer group					294200	334710	427260

This form of a two-part tariff would not fulfil the objective of the poverty tariff to subsidise very low-income households.

However, two-part tariffs can be used for cross-subsidisation, by utilising combinations of tariffs, which would partly meet the objectives of a poverty tariff. This can be done by allowing high-demand customers to be served at a price close to marginal cost (while paying a substantial fixed charge) but giving low-demand customers the option to pay a price well above marginal cost (while paying little or no fixed charge).

This can have the effect of cross-subsidising the very low consumers of electricity, while also providing cost advantages for high consumers. An example of this kind of combination will be analysed below. In this example, the main tariff assumptions are:

- Tariff (a) for low consumers has no fixed charge, and an energy charge of 30c/kWh
- Tariff (b) has a fixed monthly charge of R60, and a unit energy charge of 20c/kWh
- Customers choose the option, which is more economical for them.

On these assumptions, a household consuming less than 600 kWh/month (break-even point) would find that Tariff (a) is cheaper. Above 600 kWh/month, Tariff (b) would be the more economical choice. Accordingly, Table 5.7 shows very low and low-income households using Tariff (a) and other households using tariff (b).

A combination of tariffs like this would seem to meet the objective of heavily subsidising the lowest-income group, yet not excluding the next 'low-income' category of household from also receiving a smaller degree of subsidy as shown in Table 5.7 below.

Table 5.7: Double two-part tariff

Category of households	*KWh /month*	*Cost of supply*	*Monthly payment*		*Subsidy(-)/ Surplus(+)*
			Tariff (a)	*Tariff (b)*	
Very low-income	100	76	30		-46
Low income	300	108	90		-18
Middle income	500	140		200	60
Upper middle income	700	172		260	88
High income	1200	252		360	108

This could be seen as going some way towards social equity although there is still the serious problem that very poor households would probably not decide to consume much electricity at 30ckWh, even though the actual supply costs have been heavily subsidised. Secondly in terms of "fairness" it could be argued that any household has the option to choose either tariff, and in this sense every household has an equal opportunity to benefit from the tariffs offered. In terms of economic efficiency, this tariff structure would not be ideal, but should be better than some of the other tariff options. The marginal cost of electricity used for high consumers (that is their energy charge of say 20c/kWh) is more than the actual marginal cost of supply. However, it is closer to the marginal supply cost than is the case with a straight-line tariff (section 5.4.4) or an inclining block tariff (section 5.4.3). The absence of a time-of-use price signal is a drawback in terms of economic efficiency, because there are no incentives to cut back on electricity consumption during peak load times. However, the tariffs would be fairly easy to implement assuming low-demand (Tariff a) customers mainly use pre-payment meters, and all Tariff b customers use credit-meter billing, where it is easy to add in the fixed monthly charge.

Table 5.8: Approximate total monthly financial impact of a double two-part tariff

Category of households	*Hhds with electricity 1995 (000's) 46%*	*Hhds with electricity 1998 (000's) 60%*	*Total no. of hhds (000's) 100%*	*Subsidy/ surplus for individual hhds (R)*	*Total subsidy/ surplus for electrified hhds (R000's) 46%*	*Total subsidy/ surplus for electrified hhds (R000's) 60%*	*Total subsidy/ surplus for electrified hhds (R000's) 100%*
Very low income	395	740	2 466	-46	-18170	-34040	-113436
Low income	313	563	1 251	-18	-5634	-10134	-22518
Middle income	559	859	1 432	60	33540	51540	85920
Upper middle income	1 069	1277	1 597	88	94072	112376	140536
High income	1 484	1 484	1 514	108	160272	160272	163512
Extent of subsidy/surplus for domestic customer group					264080	280014	254014

Table 5.8 shows that this tariff subsidises the very low-income households and the low-income households that fall above R500 income per month. Nonetheless the distributor is still able to recover its costs because even when electrification reaches 100%, the distributor will still make a profit. Basically this tariff structure would partially meet the distributional goal without a significant loss of economic efficiency, but there would still be concerns that electricity is not affordable to lower income households.

5.4.3 The inclining block tariff

An inclining block tariff charges a lower rate for the first 'block' of energy, and higher rates for subsequent blocks. Two options will be examined, with two blocks and three blocks respectively. This tariff structure achieves cross subsidy to low-income consumers.

5.4.3.1 The inclining block (two blocks)

The main assumptions here are the first 100 kWh per month is charged at a lifeline tariff of say 10c/kWh and everything above 100 kWh at a rate of 26c/kWh. It is assumed that there is no monthly fixed charge. Table 5.9 presents this.

Table 5.9: Impact of inclining block (two blocks) tariff

Category of household	*Household consumption (kWh per month)*	*Cost of supply (R per month)*	*Monthly payments @10c/kWh for the first 100kWh and the rest @ 26c/kWh(R per month)*	*Subsidy (-) or surplus (+) (R per month)*
Very low-income	100	76	10	-66
Low income	300	108	62	-46
Middle income	500	140	114	-26
Upper middle income	700	172	166	-6
High income	1200	252	296	44

Table 5.10 shows that the inclining two blocks tariff subsidises the very low-income and by default the low-income households until the upper middle income, which is indicated by the negative signs in the subsidy/surplus column.

The inclining (two blocks) tariff fulfils the objectives of the poverty tariff because it subsidises the very low-income households. This tariff shows a deficit at the current level of electrification (60%) and the same will apply at 100% electrification. Consequently this tariff is unsustainable if the resources have to be generated from within the domestic customer group.

Table 5.10: Approximate total monthly financial impacts of the inclining block tariff (two blocks)

Category of households	*Hhds with electricity 1995 (000's) 46%*	*Hhds with electricity 1998 (000's) 60%*	*Total no. of hhds (000's) 100%*	*Subsidy/ surplus for individual hhds (R)*	*Total subsidy/ surplus for electrified hhds (R000's) 46%*	*Total subsidy/ surplus for electrified hhds (R000's) 60%*	*Total subsidy/ surplus for electrified hhds (R000's) 100%*
Very low-income	395	740	2 466	-66	-26070	-48840	-162756
Low income	313	563	1 251	-46	-14398	-25898	-57546
Middle income	559	859	1 432	-26	-14534	-22334	-37232
Upper middle income	1 069	1277	1 597	-6	-6414	-7662	-9582
High income	1 484	1 484	1 514	44	65296	65296	66616
Extent of subsidy/surplus for domestic customer group					3880	-39438	-200500

5.4.3.2 The inclining block (three blocks)

The main assumptions are, the first 100 kWh per month is charged at a lifeline tariff of say 10c/kWh, at a rate of 26c/kWh between 101kWh and 500kWh and the rest at 36c/kWh. Table 5.11 presents this.

Table 5.11: Possible parameters for a three block inclining block tariff

Monthly consumption (kWh per month)	*Price per unit*
0-100	10c/kWh
101-500	26c/kWh
701+	36c/kWh

Table 5.12: Impact of inclining block (three blocks) tariff

Category of household	*Household consumption (kWh per month)*	*Cost of supply (R per month)*	*Monthly payments @10c/kWh for the first 100kWh; @ 26c/kWh from 101-500 and the rest @36c/kWh (R per month)*	*Subsidy (-) or surplus (+) (R per month)*
Very low-income	100	76	10	-66
Low income	300	108	62	-46
Middle income	500	140	114	-26
Upper middle income	700	172	186	14
High income	1200	252	366	114

The three-block subsidises the very low-income households, however it also subsidises low-income and the middle-income households.

Table 5.13: Approximate total monthly financial impacts of the inclining block tariff (three blocks)

Category of households	*Hhds with electricity 1995 (000's) 46%`*	*Hhds with electricity 1998 (000's) 60%*	*Total no. of hhds (000's) 100%*	*Subsidy/ surplus for individual hhds (R)*	*Total subsidy/ surplus for electrified hhds (R000's) 46%*	*Total subsidy/ surplus for electrified hhds (R000's) 60%*	*Total subsidy/ surplus for electrified hhds (R000's) 100%*
Very low-income	395	740	2 466	-66	-26070	-48840	-162756
Low income	313	563	1 251	-46	-14398	-25898	-57546
Middle income	559	859	1 432	-26	-14534	-22334	-37232
Upper middle income	1 069	1277	1 597	14	14966	17878	22358
High income	1 484	1 484	1 514	114	169176	169176	172596
Extent of subsidy/surplus for domestic customer group					129140	89982	-62580

Like the inclining two blocks tariff the inclining three blocks tariff fulfils the objectives of the poverty tariff because it subsidises those who earn less than R500 per month, the very low-income households. However the distributor still gets surplus at the current level of 60%

electrification. When electrification reaches 100% the tariff starts to produce an overall deficit for the domestic customer group, as show in Table 5.13.

5.4.4 The straight-line tariff

The straight-line tariff is designed such that the average consumer would pay the full cost of supply each month. Low users are subsidised, however the subsidy is removed as consumption increases. The main assumption is the monthly payment at 26c/kWh. Figure 5.1 demonstrates this.

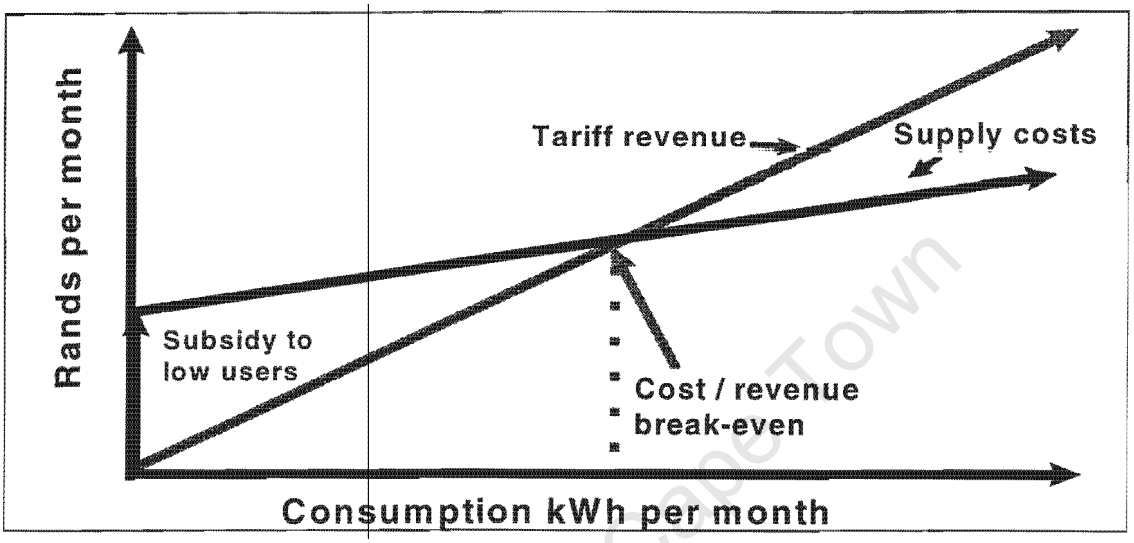

FIGURE 5.1: Comparison of supply costs and revenue with a single energy rate tariff

Figure 5.1 shows that below the break-even point, consumers will receive an effective cross-subsidy, while those above the break-even point will be paying more than the average cost of supply.

Table 5.14 below presents the level of subsidy or surplus for different households' income categories using the straight-line tariff. This tariff subsidises the targeted very low-income category. This tariff also subsidises the low-income households (those with an income of more than R500 monthly) and the middle income households.

Table 5.14: Impact of the straight-line tariff

Category of household	*Household consumption (kWh per month)*	*Cost of supply (R per month)*	*Monthly payments @ 26c/kWh (R per month)*	*Subsidy (-) or surplus (+) (R per month)*
Very low income	100	76	26	-50
Low income	300	108	78	-30
Middle income	500	140	130	-10
Upper middle income	700	172	182	10
High income	1200	252	312	60

The straight-line tariff fulfils the objectives of the poverty tariff by subsidising households with less than R500 monthly income. At the current level of electrification of 60% the subsidy for both very low-income, the low-income and the middle income households amounts to a deficit of about R62 million per month, while at 100% electrification it would rise to R175 million per month. Nonetheless at 60% electrification distributors will still manage to recover their costs from the surpluses contributed by high-demand consumers, whereas at 100% electrification the distributor would make a loss.

Table 5.15: Approximate total monthly financial impact of the straight-line tariff

Category of households	*Hhds with electricity 1995 (000's) 46%*	*Hhds with electricity 1998 (000's) 60%*	*Total no. of hhds (000's) 100%*	*Subsidy/ surplus for individual hhds (R)*	*Total subsidy/ surplus for electrified hhds (R000's) 46%*	*Total subsidy/ surplus for electrified hhds (R000's) 60%*	*Total subsidy/ surplus for electrified hhds (R000's) 100%*
Very low income	395	740	2 466	-50	-19750	-37000	-123300
Low income	313	563	1 251	-30	-9390	-16890	-37530
Middle income	559	859	1 432	-10	-5590	-8590	-14320
Upper middle income	1 069	1277	1 597	10	10690	12770	15970
High income	1 484	1 484	1 514	60	89040	89040	90840
Extent of surplus or subsidy for domestic customer group					65000	39330	-68340

5.4.5 The fixed charge tariff

The fixed charge tariff is normally used with a load-limited supply, for example a 2.5A load limit. Households pay a fixed amount of say R15 monthly, irrespective of the quantity of electricity consumed. This means that very low consumers are overcharged while high consumers are undercharged. Figure 5.2 illustrates this argument and shows one of the main disadvantages of this form of tariff, in that the very low consumers could be worse off than if they were paying a straight-line tariff.

In order to test the financial viability of the fixed charge tariff, the following assumptions are made:

- Only the very low-income households get the fixed charge tariff, at a rate of R15 per month.
- All others pay 26c/kWh.

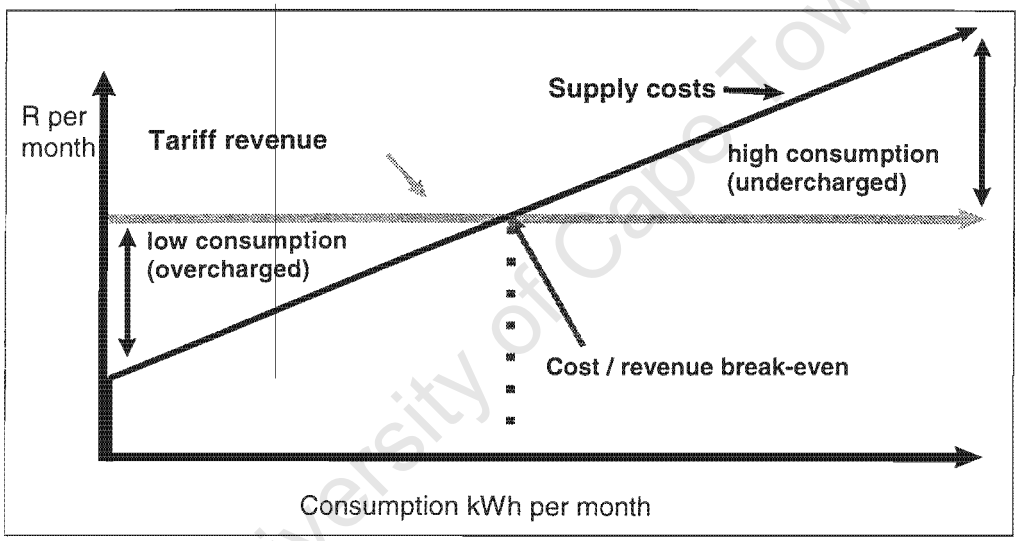

FIGURE 5. 2: Comparison of supply costs and revenue with a fixed charge tariff

Table 5.16: Impact of the fixed charge tariff

Category of household	*Household consumption (kWh per month)*	*Cost of supply (R per month)*	*Monthly payments @ R15/month for the "first 100kWh" for the "first income group" and the rest at 26c/kWh*	*Subsidy (-) or surplus (+) (R per month)*
Very low-income	100	76	15	-61
Low income	300	108	78	-30
Middle income	500	140	130	-10
Upper middle income	700	172	182	10
High income	1200	252	312	60

Table 5.16 shows that the very low-income to the high-income to middle-income households are subsidised, as with the straight-line tariff, but the subsidy for very low-income households is somewhat greater. However, Table 5.16 assumes the same costs of supply which have been used elsewhere. One purpose of a load-limited supply is to strive to reduce the supply costs, so the subsidy for the very low-income households may be exaggerated.

On the present assumptions, Table 5.17 shows overall subsidies/surpluses, and indicates that such a scheme could be viable at a 60% level of electrification, but not in a 100% electrification scenario.

Table 5.17: Approximate total monthly financial impact of the fixed charge tariff

Category of households	*Hhds with electricity 1995 (000's) 46%*	*Hhds with electricity 1998 (000's) 60%*	*Total no. of hhds (000's) 100%*	*Subsidy/ surplus for individual hhds (R)*	*Total subsidy/ surplus for electrified hhds (R000's) 46%*	*Total subsidy/ surplus for electrified hhds (R000's) 60%*	*Total subsidy/ surplus for electrified hhds (R000's) 100%*
Very low-income	395	740	2 466	-61	-24095	-45140	-150426
Low income	313	563	1 251	-30	-9390	-16890	-37530
Middle income	559	859	1 432	-10	-5590	-8590	-14320
Upper middle income	1 069	1277	1 597	10	10690	12770	15970
High income	1 484	1 484	1 514	60	89040	89040	90840
Extent of surplus or subsidy for domestic customer group					60655	31190	-95466

5.5 Methods of financing the poverty tariff

The methods of financing the poverty tariff, which will be described, include cross-subsidy from within the domestic customer group, cross-subsidy from other customer groups such as industrial customers channelled through Eskom, and directly from government as grants or vouchers.

The cost of a poverty tariff considering the conditions and features laid down by the NER is estimated at about R1.6 billion per year.

5.5.1 Cross-subsidy from within the domestic customer group

The foregoing discussions about different tariff structures and their financial implications have shown that there are some structures that can be financially viable for a poverty tariff when electrification is at 60% level. However, this would change when electrification approaches 100%. These are the income-related rebate, the inclining (three blocks) tariff, the straight-line tariff, and the combined fixed charge load-limited supply coupled with a straight-line tariff. On the assumptions used, the double two-part tariff is the only tariff that appears to be sustainable at all levels while it still subsidises the poor households. Tariffs

with deficits show that they are unsustainable if subsidy is from within the domestic customer group.

5.5.2 Cross-subsidy from other customer groups

It is relevant to ask what price rise will be used to recover the shortfall; and whether it would be recovered within the domestic sector or from the whole electricity sector. The electricity distribution industry needs a margin of profitability, not just to break even. Current margin (NER 1998) shows that the total cost is R32 619 million per year for all customers, total revenue from all customers is R35 064 million per year and the profit margin is 7%. Domestic customers pay a higher average price per kWh. In terms of revenue, the domestic sector contributes approximately 28% of the total revenue. If this shortfall of R1.6 billion/year (at 100% electrification) were recovered from within the domestic sector, the approximate price rise would be more than 20%. If this burden were spread evenly across all electricity consumers, the price rise would be less. In terms of kWh, domestic consumers account for 32 503 948MWh per year, which is 18.98% of the total electricity consumption [3]. If this shortfall (including 7% margin) is spread across all electricity consumers the approximate price rise would drop to just under 6%.

5.5.3 Cross-subsidy from government in a form of grant or vouchers

The approach that would come closest to the implementation of the poverty tariff that was proposed by the former Management Board of the NER is to provide a grant or voucher, distributed by the welfare agencies. This voucher would give the owner the right to collect a token from the vending stations for the pre-payment meter, which would be most fair and targeted.

The major setback would be to identify the really poor households and to prevent fraud, as poverty is not static and there is a problem of uncertain monthly income for many households. To implement this system would require significant extra administration. The only customers who would be on this system are those with a pre-payment metered connection.

5.6 Cross-subsidisation and tariff sustainability

This section addresses the question of the sustainability of the domestic customer group and cross-subsidisation from within it. In other words the high-income households subsidising the low-income households. Some of the tariff options discussed above are seen to be sustainable at the present level of electrification, and will continue to be sustainable when electrification reaches 100%. On the other hand some are not. Table 5.18 presents the relevant information.

Table 5.18: Different tariffs' sustainability and cross-subsidisation of the domestic customers

Tariff	*Subsidy @ 46% electrification*	*Subsidy @ 60% electrification*	*Subsidy @ 100% electrification*	*Sustainability*
	R000's/month	*R000's/month*	*R000's/month*	
Income-related rebate	54730	20090	-132456	This tariff is sustainable at the current level of electrification, but once it reaches 100% it will start to have a deficit. A lot of money will be required for subsidisation.
Two-part tariff (single)	294200	334710	427260	This tariff is sustainable at all the levels of electrification because it does not subsidise any household. This means it does not meet the objectives of a poverty tariff.
Two-part tariff (double)	264080	280014	254014	This option meets the objective of a poverty tariff by subsidising the poor households, and still recovers costs at all levels of electrification.
Inclining block tariff (two blocks)	3880	-39438	-200500	The inclining (two blocks) tariff shows deficits at the current level and when electrification reaches 100%, this deficit is likely to rise four times more. Therefore it is unsustainable from within the domestic customer group.
Inclining block tariff (three blocks)	129140	89982	-62580	At the current level of electrification this option is sustainable, however when electrification reaches 100% it is unsustainable.
Straight-line tariff	65000	39330	-68340	The straight-line tariff is sustainable at the current level of electrification. When it reaches 100% it shows a deficit.
Fixed charge load-limited tariff combined with straight-line	60655	31190	-95466	This structure would be sustainable at current levels, but not at 100% electrification, on the cost assumptions used.

5.7 Conclusions

This chapter has outlined the financial implications of the five tariff structures, focussing on the subsidy for the customers and the surplus for the distributors. The purpose being to

assess whether the income-related rebate can be introduced now or these other already existing tariffs could be adjusted to address the objectives of a new proposed poverty tariff. While the calculations of the total cost of supply (repayment of capital, service costs and energy cost) were made with relative confidence (except in the case of load-limited supplies), the same does not apply to the monthly payments (the monthly household payments) for each tariff structure because they are based on about household consumption levels. Furthermore, they have not taken "non-technoical losses" (principally non-payment) into account.

NER estimated that 1.9 million households would qualify for the income-related rebate tariff. To subsidise this scale from within the domestic customer group may not be possible. This scale raises the question of sustainability of the income-related rebate tariff. The estimated annual cost of electrification is in the region of R1.6 billion. Electrification costs are expected to increase as electrification gets to more remote rural areas that are far from the national grid and have lower settlement densities. To supply these 1.9 million very low-income households, mostly characterised by low usage of electricity, which leads to low returns on the capital invested, militates against the idea of introducing a new subsidy on such a large scale. And importantly, the timing for introducing a new poverty tariff seems to be inapproriate at this stage of EDI restructuring, tariff system and price levels rationalisation, and the electrification programme.

CHAPTER SIX:

CONCLUSIONS AND RECOMMENDATIONS

This thesis investigated the possibilities and the practicalities of the new proposed electricity poverty tariff (income-related rebate) in South Africa for the low-income domestic customers. The study found that three mutually inclusive issues still pose policy emptiness. Those are, the electricity pricing, the electrification financing and the restructuring of the EDI. To have a tariff system and price level that fit into the regulation system, a viable EDI and a sustainable electrification programme these major obstacles need to be disentangled. By filling this policy void, it will be easier to address issues of affordability of electricity prices for the poor, which is the backbone of the proposed poverty tariff. Besides, this will result in improved equity through widening access to electricity services, which will ultimately bring some socio-economic relief to the people who face the hardships of poverty.

Electricity pricing should be reactive to socio-political priorities, economic policies and industry governance. Basically, these three issues are prevalent in South Africa's electricity industry. During the apartheid era the political and economic policies were not meant to bring about socio-economic development for all but for the white minority. The majority of the black population were excluded from electricity services. On the other hand it is clear that the industry ownership, which led to a huge price variation, to a large extent determines the current pricing. In this vein the question of price regulation is crucial for the South African electricity supply industry, which will ultimately address the issues of allocative efficiency, productive efficiency and distributional equity.

6.1 Conclusions

From this study the following conclusions were drawn.

- *The trade-off between pricing for distributional equity versus pricing for economic efficiency is critical*

Chapter two, which is the basis upon which the body of the thesis is built, attempted to establish a theoretical framework for electricity pricing. The chapter discussed the general guidelines in the pricing of electricity. The general guidelines and the issue of pricing for economic efficiency versus pricing for distributional equity are the crux of the matter in this chapter. The underlying argument from the general guidelines in the pricing of electricity is that the price of electricity should be based on the cost of supply while fulfilling certain

additional objectives or criteria. Distributional equity, which is the central issue of the new proposed poverty tariff is one of those objectives: however in striving for distributional equity the economic efficiency goal should not be compromised.

Prices that reflect economic costs are an essential part of a policy to achieve economic efficiency in the electricity supply industry. The new proposed poverty tariff needs a thorough investigation since its funding would have to be made available to the municipalities by the government or Eskom. Eskom is committed to meet customers' electricity needs in the most cost-effective way subject to resources constraints and in the national interest. On the other hand, a poverty tariff over and above the present cross-subsidised tariffs might impair the intention of providing all South Africans with electricity. The price options considered should not be detrimental to the overall strategy of getting electricity to as many people as possible in South Africa. To strike the balance between pricing for economic efficiency and pricing for distributional equity should be the ultimate goal

- *The need to streamline the current tariff system and to narrow the vast price variation*

Chapter three reviewed the current tariff system and the price levels with special attention on the domestic electricity tariffs. It was shown that electricity pricing is characterised by some glaring contradictions among about 400 distributors. The size of the distributor and the province where the distributor is situated has a major influence on the price paid by the customers. For instance, Gauteng has many big distributors and few small ones, which means consumers in Gauteng pay lower electricity prices compared to those consumers served by the small distributors in other provinces such as Eastern Cape and Northern Province. The skewdness on the location of the large and small distributors poses a problem to the electrification programme. Most of the small distributors are not financially viable and at the same time they have to serve low-income households, often without a strong non-domestic customer base. In other words there is a problem of unlevelled playing fields, with some municipalities better positioned to recover their purchase costs than others. A well positioned and wealthy municipality (with a lot of industry and commerce) like Springs in Gauteng has industrial customers who are responsible for approximately 70% of the load. Basically some municipalities are financially viable whereas a large number of them are not.

The National Electrification Forum (NELF) was established in 1994.to try and address the problem of tariff variation and to ensure necessary flow of funds from Eskom to all electricity distributors implementing poverty tariff. NELF proposed a national domestic tariff structure, which is still unresolved. It also recommended financial transfers between

distributors faced with different costs and different revenues on the basis of a national formula.

In 1995 the National Electricity Regulator (NER) was set up as a successor to the Electricity Control Board charged with the duty to issue licences and control electricity prices of all electricity undertakings in the country. This marked the implementation of a new policy of regulation in the industry, subjecting Eskom and municipal distributors to regulatory oversight for the first time. Acknowledging the difficulties of encouraging competition, which is what government intends to turn towards as an alternative to regulated monopolies price regulation continues to be an important element of the industry. The principal objectives of price regulation are allocative efficiency (prices reflect marginal costs), productive efficiency (incentives to minimise costs) and distributional equity (no "excess" profits). The NER is still in the process of streamlining the tariff structures and narrowing the vast differences in prices. This is in order to ensure that customers are provided with adequate reliable services at prices that are affordable and reflect acceptable levels of efficiency on the part of the distributor.

It is also envisaged that the proposed rationalisation of the industry will have positive impacts on prices by solving price variation. Three benefits will be realised as argued by Davis (1999). Firstly, the distribution sector will have economies of scale, which will affect the costs of distribution excluding the costs of power purchase. Secondly, within each regional distributor there will be cost sharing effectively providing cross-subsidies from larger centres to smaller centres. Prices will be set on the basis of the average costs of power purchases rather than the costs within each locality. Thirdly and lastly is the uniformity in transfers to local authorities and the rate-of-return earned. Consequently prices in some areas will decrease, whereas those in other areas will increase.

Mossel Bay municipality was presented as a case study. It demonstrated that electricity creates significant revenue for such municipalities. Most importantly is that the municipality is implementing a distributional equity tariff, in the form of a breadline of poverty tariff. This tariff is implemented for those customers who are on pre-paid metering. The poor customers can consume up to 200kWh per month at a lower rate of about 23c/kWh. Above 200kWh customers pay about 30c/kWh, which subsidises the poor consumers with low consumption. A huge number of consumers use pre-paid metering (8,321) and they contribute R7 million per year as an income. The municipality makes further income (R10 million) from credit metering, which is used by 5,639 consumers. These customers pay 19c/kWh plus the basic monthly charge of about R54. Noteworthy from this case study is that a municipality can implement a distributional equity tariff and still manages to make a profit. However this poverty tariff is different from the one proposed by the NER.

- *Poverty tariffs for socio-economic development*

The fourth chapter discussed the possible poverty tariff structures. It started by agitating the motive of the proposed poverty tariff followed by the views of the stakeholders on the issue. The views of other interested stakeholders/individuals from different disciplines were considered as well. The income-related rebate tariff is found to be exceptional because of its basis that people who earn less than a certain level (for example, R500 per month) should receive small amounts of electricity for free, or at a reduced rate. In principle, Eskom supports the introduction of measures to bring socio-economic relief to the people of South Africa. However, they argue that the introduction of such measures should be consistent with government policies and initiatives.

Eskom also tried to raise some areas of concern in relation to the income-related rebate tariff, which involves the difficulties of managing this tariff. This has to do with the increased administration burden imposed on utilities as well as the political sensitivity of implementing this structure. Another concern is determining who is eligible for the tariff as well as trying to police it. Having raised these, the principal remaining concern is the cost which would be incurred when considering the scale of the people who might qualify for the tariff. Both the NER and the government agreed to put the issue of a poverty tariff on hold pending further investigations and proper consultation with all the major stakeholders.

The chapter then discussed five possible electricity poverty tariff options, which include the income-related rebate tariff (the new poverty tariff proposed by the NER), a two-part tariff, the inclining block tariff, the straight-line tariff and a fixed charge tariff with load-limited supply. The main focus was on how each structure works, the key features of the structure, the advantages and the disadvantages and finally how well these structures meet the objectives of a poverty tariff.

- *The importance of the possible poverty tariffs' financial viability and sustainability*

The last and the most important chapter of the body, chapter five, interrogated the issue of financial viability of all the possible poverty tariff structures discussed in chapter four. The main focus was on the level of subsidy to the customers and the surplus for the distributors. The chapter begins by giving the profile of households' income relating that to the level of electrification at three different scenarios (46%, 60% and 100% electrification). Assumptions were made about the cost of supplying a household and their average consumption, in order to determine the total cost of supplying a household with electricity using different tariff structures.

Turning to the tariffs, a two-part tariff can be more cost reflective and avoids major cross-subsidies. Basically this structure tries to charge the household more exactly what it costs to

supply electricity to that household every month. However this tariff structure can be changed into a double two-part tariff, which could subsidise the poor households and still be sustainable at all levels of electrification. The inclining block tariff was examined, both with two blocks and three blocks. With both options the first block needs to be set at such a level that the basic electricity needs of the poor would be met. The mechanism for recovering part of this subsidy is to charge higher prices for the subsequent blocks, to try to cross-subsidise lower usage households from higher usage customers so that the utility achieves its revenue requirement. The two blocks cannot be sustainable at both 60% and 100% level of electrification, whereas the three blocks cannot be sustainable at 100% level of electrification, according to the price assumptions that were used.

The straight-line tariff structure achieves a cross subsidy from the high-level wealthy consumers to the low-level poor consumers, however, without guaranteed recovery of the fixed costs for Eskom at low consumption levels. At 100% level of electrification this tariff cannot be sustainable (according to the price assumptions used).

With the fixed charge structure, for a load-limited supply, both the fixed and variable costs are recovered by way of the fixed charge independent of consumption. This means the low-income households with very low electricity usage are overcharged those with higher electricity usage may be undercharged. The analysis showed that if very low-income households were on such a fixed-charge tariff, and other households on the straight-line tariff, this could be financially viable at current electrification levels, but not in a 100% electrification scenario (according to the price and cost assumptions used in the analysis)

The current estimated annual cost of electrification is R1.6 billion and the number of households without electricity is about 3.4 million (about 37%). Out of this 3.4 million, about 1.9 million households are in the very low-income category, which means they would qualify for a poverty tariff, under the NER's 1998 proposal.

6.2 Recommendations

Based on the above conclusions, the following recommendations are put forward.

- *No need for a new poverty tariff now*

The primary objective of a poverty tariff is to get rid of barriers to entry and to address the key issue of affordable electricity pricing for the poor. The logic behind this is to redress the past exclusion of the majority black population and improve equity through widening access to electricity services and to bring socio-economic relief to the people of South Africa.

Given these objectives and all the debates for electrification for all, it is very tempting to jump to conclusions about the need for a poverty tariff. When considering the past imbalances perpetuated by the apartheid regime with regard to service rendering (electricity being one of them), it makes more sense politically to argue that a poverty tariff is needed. In other words if it was a notorious apartheid policy that excluded the majorities of black people from the electricity service, therefore it should be again a deliberate policy to redress that exclusion. The South African government is committed to equity, which seems to take a central stand in the constitution and most of the policies. Government is committed to reduce poverty and achieve equity in all the spheres of life. Nonetheless, the question still remains to be answered: can the new proposed electricity poverty tariff address poverty and electricity equity in South Africa? This is a very sensitive political question, which can see one being labelled as "politically insensitive'" or on the other hand win more economists' friends as well as the management of Eskom in South Africa. However it is proposed that there is no need of a new poverty tariff at the moment since significant subsidised tariffs for low-income households are already in place. The main reason to argue against the introduction of a new poverty tariff is the question of economic efficiency, which seems to be ignored whenever people talk about electricity equity.

The announcement of the poverty tariff was premature. There was not enough consultation with all the major stakeholders, it lacked details (for example, the administrative burden and the capital cost that go with implementing the tariff) and its timing conflicted with the restructuring of the ESI and the EDI as well as the electrification programme. South Africa is a developing country, which is not an exception from all other developing countries, in that it is also facing the problem of unlimited needs, which need to be satisfied with limited resources. It is not only electricity that is needed and it may not be the priority on the needs list. To invest the few limited resources that are available in electricity might not be a wise investment. Instead, it is argued that the proposed electricity poverty tariff in a country like South Africa is not possible and practical, more especially when considering the question of how many people would qualify for the tariff. This scale would make the income-related rebate tariff unsustainable.

Eskom's reaction following the announcement of the introduction of the poverty tariff has shown the lack of consultation. The DME distanced itself from the debate. The new NER, after the resignation of the former Chairman (who was also the CEO) together with some members, put the poverty tariff on hold. This was not welcomed by a number of trade unions. The National Union of Metalworkers (NUM) in Business Day, July 2 1999, said that by shelving the poverty tariff it was clear that the regulator wanted to embark on measures that would support gradual steps towards a competitive electricity market. The

union believes a special lifeline tariff should be introduced for poor customers and those wealthy customers should pay more so that those poor customers could afford electricity.

However, such increased subsidisation of the operational costs of supplying electricity to low-income households could be in conflict with expanded electrification. There is no guarantee that the introduction of a poverty tariff will ensure that poor remote rural areas will get electricity. It is estimated that to electrify those remote rural areas will triple the present operational losses, which are between R0,5 and R1 billion rands per year. Since 1992 about R10 billion has been invested in capital expenditure on electrification and the consumption per connection is very far short for the scheme to be financially viable.

- *Adjust the existing tariffs to make electricity more accessible*

This discussion has shown that there are a number of possible tariffs that could address the objectives of a poverty tariff while coming close to achieving the trade-off between pricing for distributional equity and economic efficiency. A two-part tariff acombined with a straight-line tariff option can be adjusted to meet the distributional equity criterion, by allowing high-demand customers to be served at a unit price close to marginal cost (while paying a substantial fixed charge) at the same time as low-demand customers pay a unit price well above marginal cost (while paying little or no fixed charge). Other structures like the straight-line tariff and the inclining three blocks tariff would need some adjustments in order to be sustainable at all the levels of electrification. Adjusting the existing tariffs can be cost-effective and cause no administrative dilemmas as in the case of the new proposed poverty tariff.

- *REDs debate must be finalised and be implemented*

Research done to date on REDs shows that REDs would bring significant benefits, which led government to decide on taking that route. The benefits of REDs include balancing the need to capture economies of skill and scale with the need for local input and ownership of the distribution industry, facilitating more transparent performance standards between distributors, and preparing the industry for customer choice. Distribution restructuring will necessarily entail price reform, which will address the problem of more than 2000 tariffs.

The main determinants of financial viability of the REDs are the electrification responsibilities placed on distributors and the electrification funding arrangements. Separate electrification funding arrangements will increase the number of viable distributors. The government indicated that it intends to centralise electrification funding through the establishment of an electrification fund (possibly sourced through levies) for the centralised allocation of resources to new electrification projects. Davis (1999) argues that this system will effectively act as a cross-subsidisation mechanism between different

consumer groups and will benefit those distributors responsible for the large rural populations of Kwazulu/Natal, Eastern Cape and Northern Province. While acknowledging the difficulties (such as rationalising the 400 municipal distributors into five REDs and the issue of demarcation of the REDs) this new REDs structure needs to be put in place for the sake of the electrification programme.

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