

Raising electricity service levels in the National Infrastructure Plan: financial and economic implications

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Executive summary

The South African government released its National Infrastructure Investment Plan in mid-1995 and, subsequently, policy options within that framework have been further developed. In that context, the main aim of this report is to investigate alternative policy options and, in particular, whether electricity service levels and cross-subsidisation levels higher than those proposed in the original plan are justifiable on financial and economic grounds. These questions have been addressed using the framework of cost-benefit analysis (CBA). Although CBA suffers from some data and other limitations, it is a useful analytical framework in which to consider not only the direct financial impacts of electrification but also the non-financial economic impacts which influence society's overall level of welfare.

A range of tariff options exists for electricity services, with five main structures being discussed in this report: a two-part tariff, a single energy rate, an inclining block tariff, a time-of-use tariff and a flat monthly charge. Current tariff practices in South Africa remain highly fragmented, because of the large number of electricity distributors. Although an inclining block tariff is nominally the most progressive, it suffers from a number of other disadvantages which render it less practical than other options, notably the single energy rate and flat monthly charge.

In the light of the fact that the electrification programme is generating financial deficits, a high level of cross-subsidisation currently occurs in the industry. At present, the effective subsidy is around R3 500 per new consumer, or R1.6 billion per annum. This cross-subsidy comes mostly from non-domestic consumers, although, with tariffs undergoing some rationalisation, it appears that higher-income domestic consumers are contributing more to this subsidy. If the entire financial deficit from electrification is to be financed by other consumers (as it is at present), this represents an increase in prices of about 8% if all consumers carry the cross-subsidy burden, or 35% if only domestic consumers pay. The financial analysis has modelled the effect of consequent decreases in consumption on industry revenues.

Using the electrification scenarios outlined in the Reconstruction and Development Programme and National Electrification Forum (and adopted by the industry), a financial analysis was undertaken of the electrification programme for three service levels: 'basic' which involves a 5 Amp supply to each household, with a flat monthly charge; 'intermediate' which is a 20A supply, with consumers paying a single energy rate tariff; and 'full' services which entail a 60A supply to the household, also with a single energy rate tariff. The analysis also made a number of estimates for input data such as consumption levels, losses, capital costs, operating costs, tariff levels, and price elasticities of demand; all of these are detailed in the body of the report.

The results of the financial analysis are summarised in the table below, showing the net present value (NPV, in 1996 Rands), over ten years at a real discount rate of 8%, of the two upgrading scenarios for both rural and urban households.

	Rural	Urban	Total
Basic to intermediate	(R 379 m)	R1 500 m	R1 121 m
Intermediate to full	(R1 341 m)	(R366 m)	(R1 707 m)

Financial results of upgrading scenarios (NPV over 10 years, 8% discount rate)

It is apparent that only one of the four cases produces a positive financial result, namely the upgrade from basic to intermediate supplies in urban areas. All other cases are non-viable in financial terms.

Consistent with the CBA methodology, account was also taken of several economic factors, namely: consumer surplus effects, environmental and health effects, multiplier effects especially on small, medium and micro enterprises (SMMEs), and productivity improvements from higher services levels. By its nature, economic quantification of these non-financial effects is difficult, but estimates were made in this study of the consumer surplus and environmental effects. Full details are provided in the report, but essentially, the consumer surplus is the difference between the price a consumer actually pays (say 25 c/kWh) and the amount that person would have been willing to pay for electricity (its 'true' value). The environmental effects of higher electricity service levels include the benefits, amongst others, of reduced air pollution from coal and wood (although these benefits are small), reduced paraffin poisoning cases in infants, and reduced fires and burns caused by candles and paraffin. On the other hand, increased electricity use will cause additional environmental costs through the generation of electricity by the country's coal power stations, although these additional costs are more than offset by the environmental gains occurring in newly-electrified households.

By incorporating the consumer surplus and environmental effects into the CBA framework, an economic net present value was calculated. This is shown in the table below.

	Financial NPV	Consumer surplus	Environmental benefits	Economic NPV
Basic to intermediate				
Rural	R (379 m)	R 320 m	R 318 m	R 260 m
Urban	R 1 500 m	R 224 m	R 1 319 m	R 3 042 m
Total	R 1 121 m	R 544 m	R 1 637 m	R 3 302 m
Intermediate to full				
Rural	R (1 341 m)	R 60 m	R 6 m	R (1 276 m)
Urban	R (366 m)	R 84 m	R 144 m	R (138 m)
Total	R (1 707 m)	R 144 m	R 150 m	R (1 414 m)

Financial and economic impacts of the upgrading scenarios (NPV over 10 years, discount rate 8%)

It is evident that the introduction into the equation of the consumer surplus and environmental factors changes the results, and in one case, changes the sign of the net present value from negative to positive. The rural intermediate scenario changes from an NPV of negative R379 m to positive R260 m over the ten year period, whilst the urban intermediate supply becomes more strongly positive (from R1 500 m to R3 042 m), and the urban and rural full supplies become less strongly negative. Full service levels in rural areas appear to be completely unviable, even when considering indirect economic benefits, while full services in urban areas are marginally negative.

It must be emphasised that there is far greater uncertainty attached to the economic adjustments than there is to the financial analysis, and the result should therefore be treated with caution. Certainly, further analysis would be required before the course of investment decisions is fundamentally changed. Nonetheless, conceptually, it is unambiguous that those economic adjustments do represent real economic impacts - it is only their exact monetary scale which is uncertain.

The unquantified effects of electrification on SMMEs can be placed into context by posing the question: is the value of a full electricity supply (as opposed to an intermediate one) in terms of SMME growth high enough to outweigh the negative economic NPVs reported above? In other words, could this factor tilt the balance of the economic impact from a negative to a positive? This question has not been answered here, but it helps to focus the issue for decision-makers.

The report outlines a number of policy implications of the analysis, one of which relates to the relative neglect of solar home systems and other non-grid electrification technologies. In principle, solar home systems are broadly similar to 'basic' grid services, but are often considerably cheaper in remote rural areas. It is important, therefore, that these be considered as one of the technical supply options, alongside the various grid options.

1 Introduction

In 1995 the government released a series of documents describing its plans to improve infrastructure services in low-income urban and rural areas. Together with other services such as water, sanitation, roads, and solid waste removal, investment scenarios were developed for electricity services, and the financial impacts of various service levels were modelled. Subsequently, the Infrastructure Programme has been further developed and refined. In this context, a number of parallel investigations are underway to explore policy options around various service levels.

This report has been produced on commission from Peter Vaz on behalf of the RDP/ODA Provincial Support Programme, and has as its main aim the investigation of alternative policy options within the Municipal Infrastructure Investment Framework (MIIF). In particular, two issues stand out: first, the possibilities for greater cross-subsidisation of poor consumers through the electricity tariff system, and second, the implications of investing in higher electricity service levels as part of the electrification programme. The main objective of the report is to assess whether service and cross-subsidisation levels higher than those proposed in the original MIIF are justifiable on financial and economic grounds. Put differently, the question is whether higher electricity service levels and a greater measure of cross-subsidisation are the most efficient means of using limited resources in the context of the government's growth and development goals, or whether there are other, more productive, uses for those resources.

The approach taken in addressing this question is to investigate the main costs and benefits of higher service and cross-subsidy levels. The main elements of this analysis have been quantified where possible, and placed in the framework of a cost-benefit analysis (CBA). The building blocks of a CBA include both the direct financial effects and the indirect economic, social and environmental effects of the strategy. The following main elements (which are consistent with the Terms of Reference for the study) are addressed in this report:

- consideration of current and possible electricity tariff systems;
- the financial costs and revenues of moving from basic to intermediate and full service levels, including higher cross-subsidisation levels;
- the social, environmental and economic costs and benefits of moving from basic to intermediate and full service levels, including higher cross-subsidisation levels.

Aggregating all of these effects over the relevant time period (in this case ten years) yields an economic net present value which, if positive, suggests that embarking on those strategies will produce a net benefit for the country. Although CBA is a widely-utilised tool to assist in public policy-making, it is also prone to a number of limitations in practice, notably around data availability and difficulties in placing economic values on some environmental and social impacts of projects. These difficulties have been addressed directly in this report wherever they have arisen.

The next section of the report addresses the tariff system and the question of cross-subsidisation, including some details about the status quo. The main costs and benefits, both financial and non-financial, are addressed in the sections which follow, before the final section brings together all these components.

2 Electricity tariffs

2.1 Possible electricity tariff systems: an overview

There are two dimensions to an electricity tariff system: the *structure* of the tariff applying to any one consumer group, and the way this is put together into an *overall system* (in terms of the choices consumers may have, and variations from one region to another). For present purposes, five tariff structures are relevant, each of which is summarised briefly below (for more details on the first four of these, see Pickering (1994)).

2.1.1 The two-part tariff

This tariff has two elements: a fixed monthly charge (say R20 per month) and a variable energy rate (say 16 c/kWh). This tariff is broadly cost-reflective insofar as it aims to recover the utility's average costs of supply. It does not, however, take account of the marginal costs of supplying electricity at different times of the day, and is therefore not completely cost-reflective. Also, the average price per unit consumed decreases as consumption increases, thus providing no effective signal to consumers to conserve electricity.

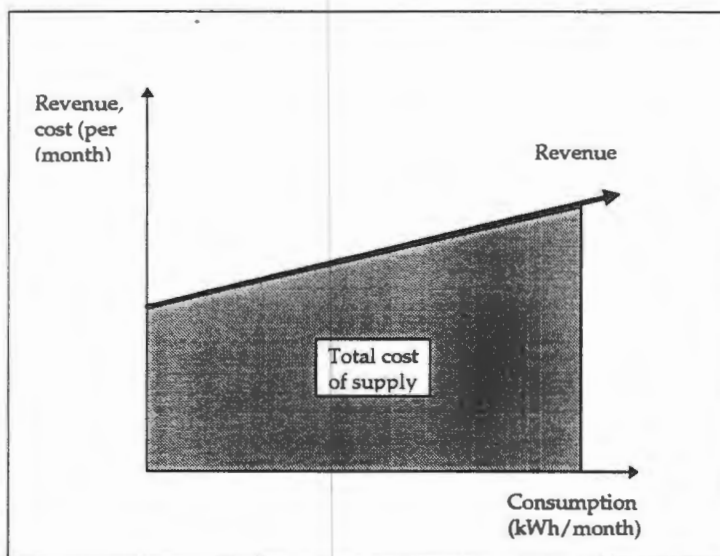


Figure 1 Monthly revenue from a two-part tariff

Historically, most long-electrified households in South Africa have paid a two-part tariff, which is generally based on a credit metering system.

2.1.2 The single energy rate

This tariff involves no fixed charge to the consumer, only a charge for the quantity of energy used (say 25 c/kWh). It is generally designed such that the average consumer would pay the full cost of supply each month. 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.

This is the structure which has been applied to most households electrified by Eskom and local authorities since the commencement of the electrification programme in 1991. In order to reduce the barriers to entry posed by high connection costs, consumers pay only a nominal connection fee. Included in the energy charge is a component which aims to recover, over 15 years, the outstanding capital costs (in the region of R3 000 per household). Clearly, therefore, if consumption levels are lower than their expected levels, capital recovery will be incomplete, making this a risky tariff for the utility.

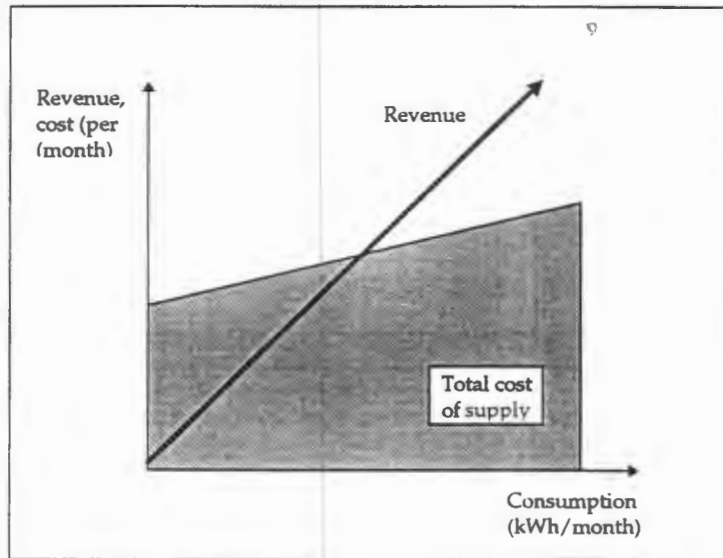


Figure 2 Monthly revenue from a single energy rate

2.1.3 The inclining block tariff

Like the single energy rate tariff, the inclining block tariff involves a measure of cross-subsidy to low-level consumers, although this is achieved by differentiating between various levels of consumption. Typically, there are two or three blocks of consumption, with increasing energy rates applicable to each. For instance, the first 100 kWh per month could be charged at a 'lifeline tariff' of, say, 10 c/kWh, and everything above 100 kWh at a rate of, say, 26 c/kWh.

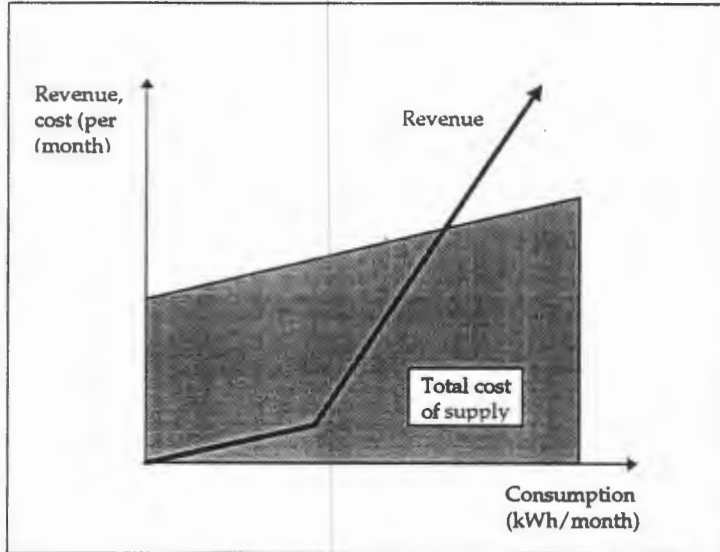


Figure 3 Monthly revenue from a two-step inclining block tariff

Although this is regarded as a progressive tariff system, it is also a rather crude mechanism for redistribution, since *all* consumers benefit from the subsidised first block, even high-level consumers. From a practical perspective, this structure would require considerable modification to the prepayment metering systems which do not at present contain timing devices.

2.1.4 The time-of-use tariff

Time-of-use (TOU) tariffs are the most cost-reflective in that they charge a different rate corresponding to the time of day, since the marginal cost of supplying electricity is highest

during peak hours. The rationale for using TOU structures is that consumers are given accurate signals as to the real costs of supplying electricity, which should encourage them to shift their demand patterns, as far as possible, to off-peak hours. TOU tariffs are generally targeted at high-level consumers who have large loads and the flexibility to shift their demands (for example, for end-uses such as washing machines, dishwashers, pool pumps).

Typically, each day is divided into three periods with their own tariff level, for example:

peak	(06h00-09h00, 18h00-20h00)	30 c/kWh
normal	(09h00-18h00)	20 c/kWh
off-peak	(20h00 - 06h00)	10 c/kWh.

The principles behind the TOU tariff are similar to the pricing structure for domestic telephone calls.

2.1.5 The flat monthly charge

In this case, the household consumer pays a fixed amount (say R15) each month, regardless of the quantity of electricity consumed. This tariff system is normally used with a basic supply, such as a 2.5A, 5A or 8A service, which is sufficient only for lighting, television, radio and one or two small appliances. Generally it is used in remote rural areas, where the costs of installing a 20A or 60A service are very high, and where demand for electricity is relatively low.

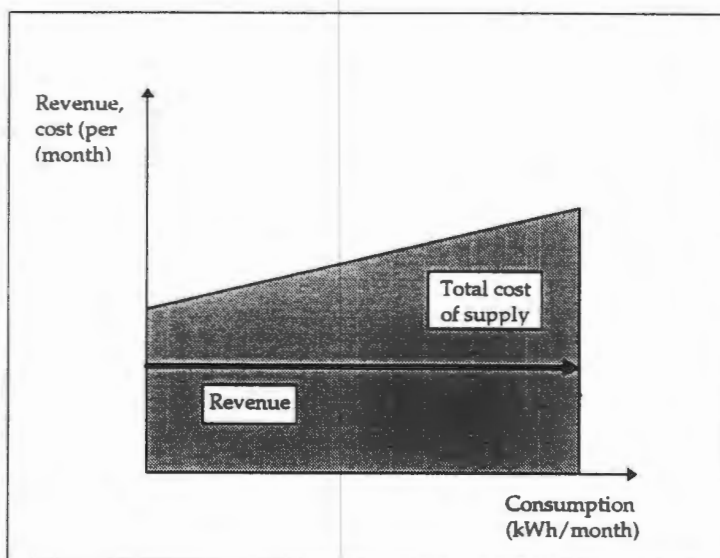


Figure 4 Monthly revenue with a flat monthly charge

2.1.6 Overall tariff systems

There is clearly a wide range of choices for domestic tariff structures (not to mention non-domestic options). In practice, these structures can be combined in a number of ways, from the simplest, where consumers are offered no choice and all pay according to the same tariff structure and level, to more complex systems where consumers can choose between different tariff structures, often related to their choice of technology option. Moreover, tariff levels (in c/kWh) can vary, depending on factors such as the desired degree of cross-subsidisation, and the extent to which capital costs must be recovered through the tariff.

In the section which follows, the historical and current tariff systems in South Africa are summarised.

2.2 Current tariff systems in South Africa

A consequence of the fragmented structure of the distribution industry is a proliferation of domestic and non-domestic tariffs in South Africa. There are approximately 400 distributors

in the country, each of which charges its own set of tariffs, with the result that tariffs vary by over 200% in all tariff categories, as shown in Table 1.

Category	Minimum	Maximum	Mean	Range ÷ mean
Domestic	9	48	17	230%
Mining	6	33	12	230%
Industrial	4	52	13	360%
Commercial	8	48	17	240%

Table 1 Tariff range by consumer category [c/kWh - 1994]
(Source: EWG 1996)

Apart from the institutional fragmentation in the distribution industry, tariff variations are also a result of the financial dependence of many municipalities on electricity revenues to cross-subsidise other services. Further, distributors have historically had monopoly status without any effective regulatory governance of their tariff policies.

In addition to this, electricity distributors have different cost-structures (refer to Figure 5). Bulk supply costs vary considerably, mainly as a function of the size of electricity demand. Figure 5 also shows that there is a wide variation in other costs, with the evidence indicating that smaller municipalities (measured in terms of GWh sales) fail to achieve the economies of scale possible in electricity distribution.

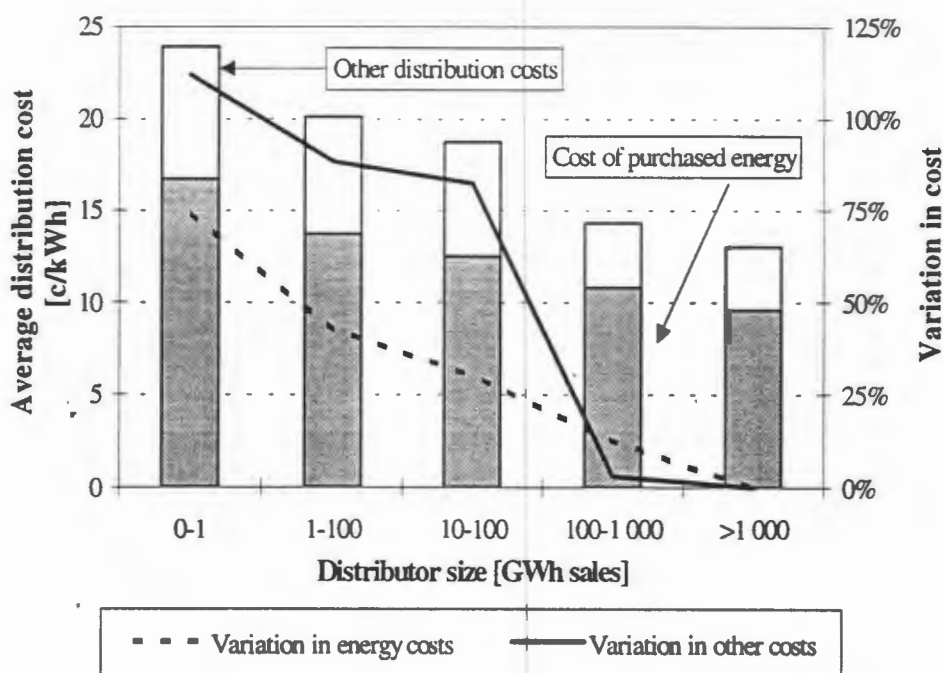


Figure 5 Average distribution cost by distributor size
(Source: EWG 1996)

Eskom, as the largest distributor in the country, has a strong influence on national tariff policy as well as the practices of municipal distributors. Eskom offers consumers a range of choices regarding tariffs, with the two most commonly chosen being the single energy rate tariff and the two-part tariff.

Figure 6 compares costs and revenues for these two tariffs, using data from Eskom in 1995.

It can be seen that the utility breaks even for customers on the two-part tariff at a consumption of just less than 200 kWh/month. For customers on prepayment meters paying the single energy rate, consumption must reach 350 kWh/month before the utility breaks even. From the customer's perspective, electricity bills will be lower on the single energy rate if consumption is less than 550 kWh/month.

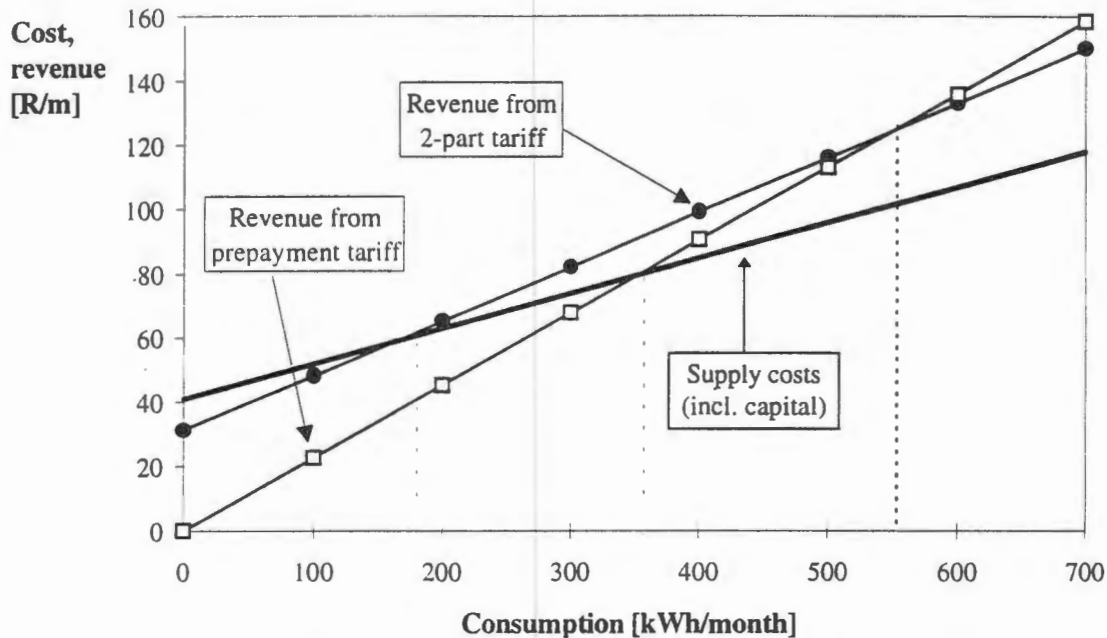


Figure 6 Costs and revenue for Eskom domestic customers in 1995
(costs include the redemption of R3 000 in capital over 15 years at 15% interest)
(Data adapted from Barnard & McDougall 1995)

2.3 Cross-subsidies to domestic customers

In calculating cross-subsidies, a distinction must be made between incremental and average costs. Certain costs, such as those associated with the operation of a head-office, are not substantially increased as a result of embarking on electrification, i.e. the incremental cost is small. From an economic viewpoint, it is the marginal or incremental costs of given strategies which are relevant. From an accounting perspective, however, it is fair to divide these overheads equitably between all customers, in which case these fixed costs may be substantial. If average rather than incremental fixed costs are used, then the calculation of cross-subsidies is likely to be higher.

Based on Eskom's cost data and domestic tariff policies, it is clear that electrification customers are heavily subsidised. Since most are on single energy rate tariffs, the calculation of the extent of cross-subsidisation is dependent on future consumption growth - a parameter notoriously difficult to estimate. Since consumption in newly electrified households is expected to grow over time as households acquire more appliances and become more dependent on electricity, cross-subsidies (per household) in the earlier years of the programme are likely to be higher. Further, financial analyses of electrification show that the overall net present value is largely driven by capital costs (Davis 1996; Van Horen 1994). Hence, the extent of cross-subsidisation will be influenced by factors such as distance from the existing grid, settlement size and density, and topography.

Figure 7 shows the cross-subsidy required, expressed as a figure per customer per month, as a function of both capital costs and electricity sales. It can be seen that for capital costs of R5 000 and sales of 100 kWh/month (a scenario not uncommon in rural areas), the required level of cross-subsidisation is as much as R50 per month.

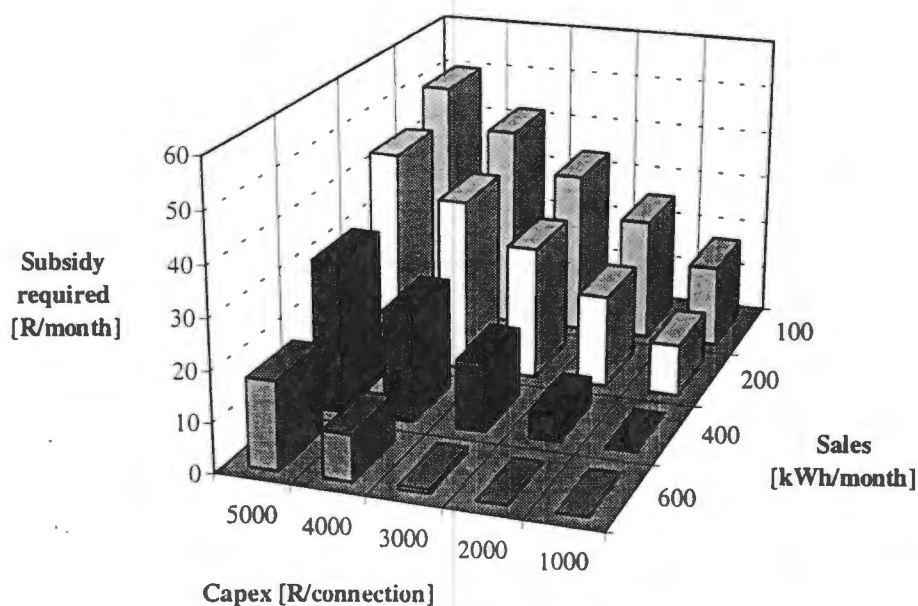


Figure 7 Cross-subsidies required

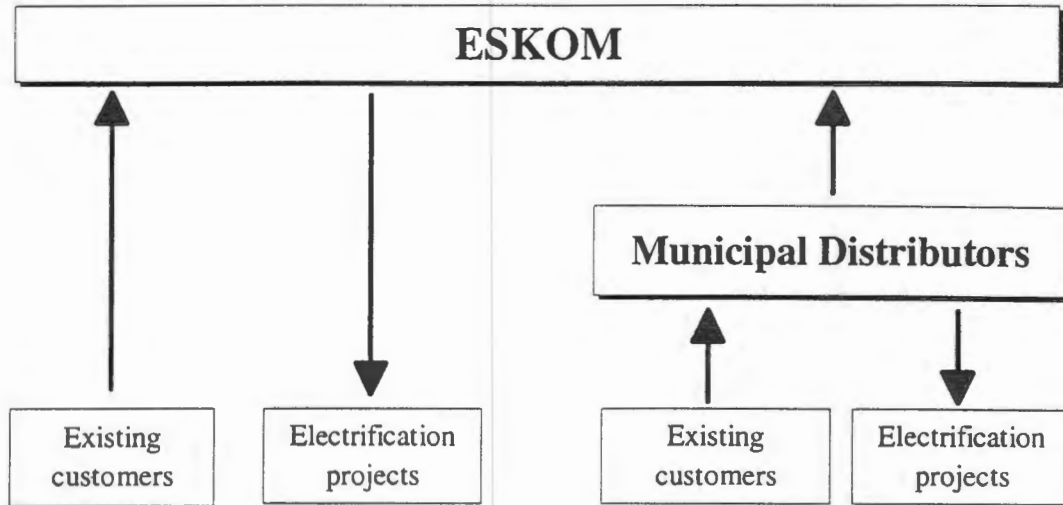
A financial analysis of the electrification programme reveals that, under current conditions, there are large cross-subsidies. Davis (1996) has estimated that the net present value of the electrification programme over 20 years is in the region of negative R21 billion, or negative R3 500 per customer. Since these losses are currently covered by cross-subsidies, this represents an average annual transfer of around *R1.6 billion per annum* from other consumers to the electrification programme.

At present, subsidies for electrification come almost exclusively from within the electricity industry, i.e. as cross-subsidies from other electricity consumers. Given the fragmented nature of the distribution industry, cross-subsidies have largely been kept within each distributor. However, since Eskom acts both as a bulk 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. This means that Durban municipality's consumers, for example, cross-subsidise electrification in Durban as well as Eskom's electrification projects in other, mostly rural, areas. This is illustrated in Figure 8.

Two exceptions to this system have been (1) the incentive scheme whereby Eskom provided a rebate on a portion of municipal electrification costs (this scheme was scrapped in 1995), and (2) the recent announcement that Eskom will provide R300 million towards the costs of non-Eskom electrification projects next year.

Should the electricity distribution industry be restructured into a set of regional electricity distributors (REDs), as proposed by the Electricity Working Group (EWG 1996), cross-subsidy flows between REDs will have to be managed. At present Eskom acts to redistribute resources for electrification from urban areas (mainly Gauteng) and commercial/industrial consumers to rural areas. If independent REDs are established, it is likely that a number of REDs will be unable to raise the necessary cross-subsidies from their own customer bases and that transfers between REDs will be required.

Another implication of the restructuring of the distribution industry will be the rationalisation of domestic tariffs. Should all domestic tariffs converge towards those of Eskom, it is likely that long-established domestic customers will experience real tariff increases. An effective price of around 23 c/kWh is some 35% above the average of 1994, and will yield substantial revenue increases from the domestic sector.



Arrows denote subsidy flows

Figure 8 Cross-subsidisation within the electricity supply industry

Without more detailed information on the costs of supply to each consumer category, it is difficult to ascertain how consumer groups share the R1.6 billion annual burden of cross-subsidies to electrification. Given the disparity in tariffs around the country, it is likely that this burden is shared in a different way for each distributor. However, since domestic consumption makes up only 15% of total electricity consumption, it is likely that non-domestic consumers currently provide most of the cross-subsidies.

2.4 Redistribution through electricity tariffs

Two issues are relevant in considering the potential for more progressive redistribution within the electricity industry: first, possibilities around tariff structures such as the inclining block tariff, and second, possibilities around cross-subsidisation of new customers by existing consumers.

With regard to the inclining block tariff, there are few benefits which it brings which cannot be achieved with alternatives such as the single energy rate and the flat monthly charge. All three of these structures entail a subsidy to low-level users, the amount of which depends, in each case, on the tariff level in relation to supply costs. On the other hand, though, the inclining block tariff suffers from several disadvantages. Firstly, it is not technically possible to implement it without undertaking modifications to the prepayment metering systems currently in use. Given that there are more than one million of these already in the market, the conversion costs would be considerable. Secondly, there is little basis for arguing that a certain amount of electricity is a basic right and that a 'lifeline' should be provided at a subsidised rate. In fact, if anything is a right, it would be a basic minimum amount of *energy*, to be used for cooking and heating. In practice, electricity is often not the most effective way of meeting these particular energy needs and, indeed, even in electrified households, other fuels such as coal and paraffin are often used for cooking and heating.

Thirdly, if the rationale behind an inclining block tariff is to redistribute resources to the poor, then it is a very inaccurate means of doing so, because all consumers benefit from the lifeline subsidy, even the wealthiest. A more sophisticated mechanism for redistribution would be to focus on basic needs commodities which are consumed more exclusively by the poor (such as paraffin).

To summarise, an inclining block offers relatively little by way of social benefits which cannot be achieved by other tariff structures, and it would do so at a potentially high cost to society. There appears, therefore, to be little rationale for its introduction at this stage of the electrification programme.

Turning to the question of the scale of cross-subsidy which is required to finance the electrification of low-income households, the critical question is where the boundaries are drawn around those paying the subsidy. Although there is potential for increases in tariffs paid by high-level domestic consumers as the industry is rationalised, the effective price increase required to subsidise new consumers is high, at around 35% of current average prices (Davis 1996). Obviously this is an average, so there will be large deviations around this. On the other hand, if the subsidy requirement (effectively for an intermediate level of service) is to be carried by the entire consumer base, then the effective tax will be around 8% of current price levels. This lower rate stems from the fact that the domestic sector accounts for only about 15% of total consumption. Clearly, as the consumer base expands, this percentage tax will decrease, so that in 15 years time, all other things equal, the premium would be about 5% of current prices.

Three further factors come into play here. Firstly, such a price increase would also have some effect on consumption levels, since some consumers will be encouraged to conserve electricity, or switch away from electricity altogether. The extent of this consumption (and therefore revenue) loss will depend on the price elasticity of demand - an issue which is addressed in more detail in section 3.5. In that section of the report, the effects of cross-subsidisation in terms of lost revenue from those paying the subsidy are modelled in financial terms.

Secondly, a price increase of (say) 8%, which could be phased in over one or more years, would be offset against the ongoing price decreases which Eskom is currently bringing about, largely as a result of a real decline in capital expenditure levels (Van Horen 1996a). Between 1987 and 1994, Eskom was able to reduce the real price of electricity by 24%, and is aiming to reduce it by a further 15% by 2000. Any price increases to finance electrification have to be placed against this decline.

Thirdly, it is important to consider the long-term implications of cross-subsidising electrification investments which are financially non-viable. If revenues from new consumers are extremely low, they may not be sufficient to cover variable supply costs, let alone fixed supply costs and recovery of capital expenditure. At the very least, revenue levels from new consumers should be sufficient to cover the variable supply costs, if not the capital costs, otherwise the system will require an in-built and permanent operating subsidy to protect the financial viability of the industry. This is a potentially costly and long-term inefficiency, and runs counter to the widely accepted principle of subsidising capital costs and not ongoing operating costs. Adherence to this principle requires clear targeting of subsidy finance towards capital costs, and the setting of prices at levels sufficient to recover variable operating costs.

3 Financial costs and benefits of different service levels

In this section, the financial costs and benefits associated with various levels of electricity service are assessed, as experienced by the supply utilities. For simplicity's sake, no distinction is made between distributors, as if there was only one national utility, although in reality these costs and revenues would be spread amongst a number of utilities.

Three levels of service are considered in this analysis. These are similar to those in the MIIF, and are defined as follows:

- **Basic:** The provision of a 5A supply to each household, and of public lighting. Households would be charged a flat monthly rate for this supply.
- **Intermediate:** The provision of a 20A supply to each household, and of public lighting. Households would be charged a prepayment meter tariff for this supply.
- **Full:** The provision of a 60A supply to each household, and of public lighting. Households would be charged a prepayment meter tariff for this supply.

In the next section, common assumptions used in this financial analysis are outlined, after which the capital and operating costs as well as revenue impacts are estimated for each of the three service levels.

3.1 Common assumptions

3.1.1 Connection rates

The RDP targets and NEES¹ mid-range scenario connection rates are used. The split between urban and rural is calculated so that access to electricity in urban areas rapidly reaches 90% and additional connections are maintained to absorb new household formation in urban areas (assumed to be 3.5% per annum). The remaining connections are made in rural areas, where access reaches 50% by the end of the time horizon considered. Figure 9 shows the number of connections in urban and rural areas, together with the consequent household access to electricity in both urban and rural areas. Overall, the national access to electricity in 2005 will be about 75% if this connection profile is implemented.

It should be noted that this scenario is dependent on the removal of current restrictions related to the system of supply rights. The current system, whereby Eskom has most resources available for electrification but is restricted to operating in rural areas, biases the programme towards rural electrification. Should REDs be established, this would allow electrification funds to flow into urban areas unhindered by institutional considerations.

¹ National Electrification Economic Study (NEES 1993), conducted under the National Electrification Forum.

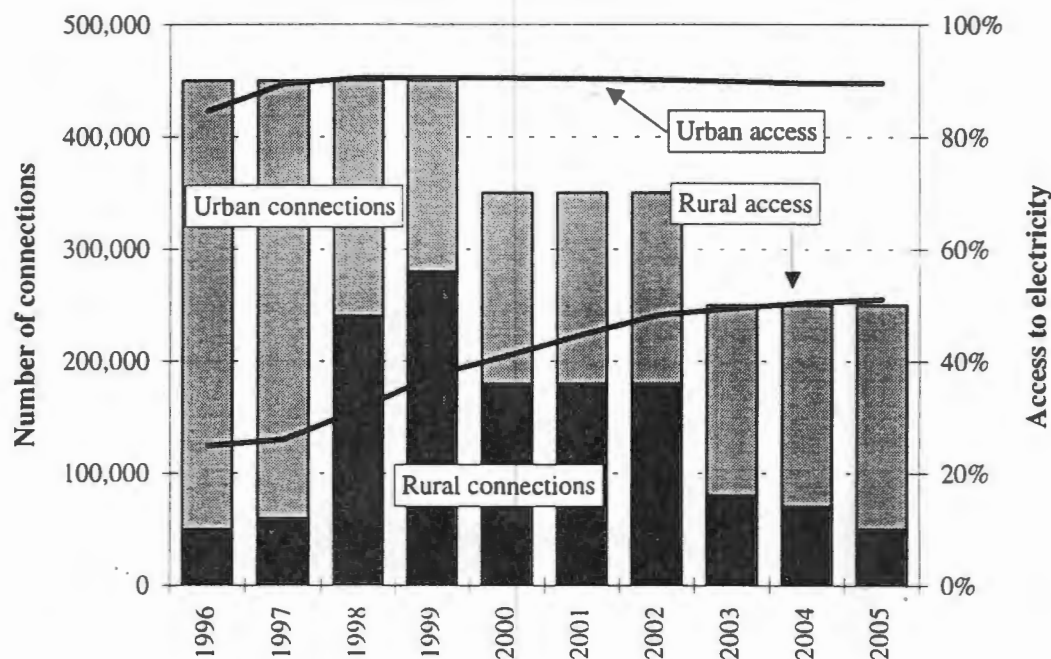


Figure 9 Connection rates, 1996 to 2005.

3.1.2 Electricity consumption and sales

Both revenues and operating costs are a function of electricity consumption. Growth in electricity consumption is difficult to predict far into the future with any accuracy. To date, experience with electrification projects has been that average consumption is low (in the order of 100 kWh/month), but that growth rates are relatively high (10% to 20% per annum). Table 2 shows average sales to electrification customers experienced by Eskom over the past four years for the five Eskom sub-regions. The NER (1996) reports that average consumption, as a function of time since connection, grows at an annual rate of 10%, reaching a level of 138 kWh/month by the fifth year from a starting consumption of 83 kWh/month. It is likely that urban sales will be higher than those in rural areas (most of Eskom's customers are rural); for example, Thorne and Qangule (1994) report that sales in Khayelitsha reached a level of 200 kWh/month two years after initial connection.

Eskom region	1992 (Dec)	1993	1994	1995
Bloemfontein	138	76	79	78
Cape Town	201	137	123	124
Durban	105	73	88	83
Johannesburg	53	70	67	83
Pretoria	32	51	55	59
Total	96	75	80	83

Sources: Eskom 1992, Eskom 1993, Eskom 1994, Eskom 1995

Note: Figures for 1992 are for December only, not averaged across the entire year. Since there is usually a December peak in sales, the 1992 figures may over-estimate the annual averages.

Note: Nationally, revenue losses have been found to be in the order of 34% of total consumption (Bezuidenhout 1995). Consequently, actual consumption has probably been in the order of 125 kWh/month.

Table 2 Eskom sales levels since 1992
(kWh/customer/month)

Geldenhuis (1996) has predicted consumption growth in urban and rural areas, assuming a 3.5% annual growth in household income. He estimated that, given no restrictions on the

supply type, rural sales would reach 180 kWh/month ten years after connection, and that urban sales would reach 280 kWh/month.

Figure 10 shows the assumptions used in this report for electricity sales for the three levels of service. The 5A limit of the basic level of service constrains the range of appliances which can be used - effectively precluding the use of kettles, hotplates, heaters and other appliances with heating elements - and so consumption is limited to below 100 kWh/month. The 20A limit allows these appliances to be used, although not all simultaneously. Thus consumption for the intermediate level of supply is estimated to be larger than that for the 5A limit, and not much less than that for the 60A limit.

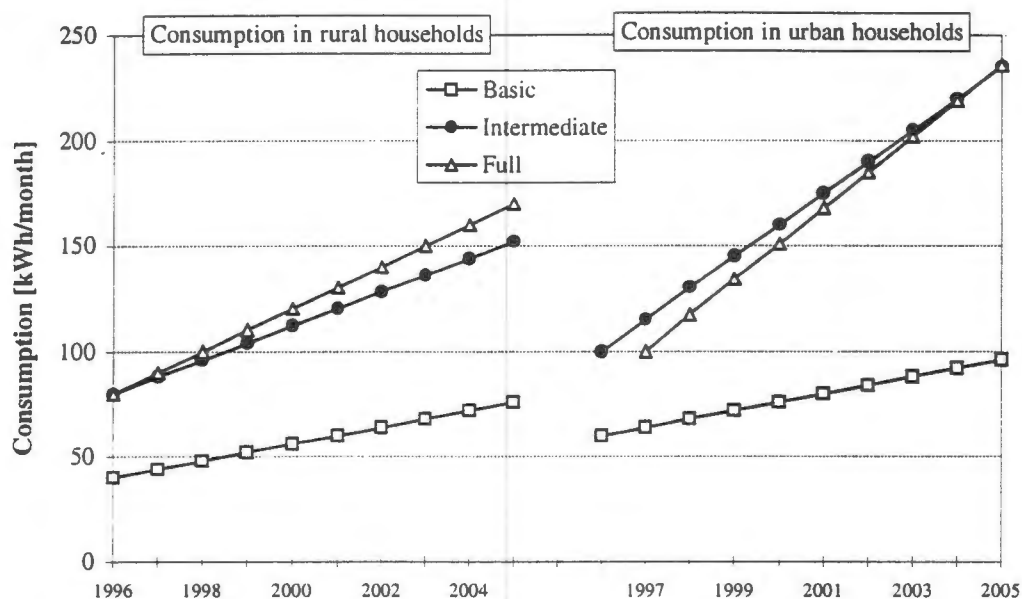


Figure 10 Monthly electricity sales per household

3.1.3 Electricity losses

It should be noted that electricity consumption will be higher than sales due to losses. Bezuidenhout (1995) has found that, for Eskom, these have been particularly high at around 34% of total consumption. In the present analysis, losses were assumed, on average, to be lower than this, on the basis that long-term levels will be lower than those currently experienced. Urban losses were assumed to be slightly higher than in rural areas, and losses for basic services were assumed to be higher than for other levels of service, due to the tendency for restrictive supplies to be by-passed. Table 3 shows the assumptions used for losses.

	Basic	Intermediate	Full
Rural	30%	25%	25%
Urban	25%	20%	20%

Table 3 Electricity losses (% of consumption)

3.2 Capital costs

Capital costs vary for these three levels of supply. The figures used in the analysis are shown in Table 4. It can be seen that in rural areas substantial additional costs are incurred in upgrading the level of service beyond a basic level. This is largely due to the additional costs incurred in upgrading the distribution line extension to rural settlements as well as the types

of reticulation designs used. In urban areas, the density of settlement patterns generally means that incremental capital costs are relatively small, both for bulk supply and for reticulation designs.

It is assumed that basic household connections are not metered, but that a current-breaker is installed and households are charged a flat monthly fee. This means that additional costs associated with the installation of a prepayment meter are incurred for intermediate and full service levels.

	Rural	Urban	Real escalation p.a.
Basic	R2 500	R2 200	0%
Intermediate	R3 500	R2 500	0%
Full	R5 000	R2 800	0%
Basic to Intermediate (% increase)	R1 000 (40%)	R300 (14%)	
Intermediate to full (% increase)	R1 500 (43%)	R300 (12%)	

Table 4 Capital costs per connection

Using these unit connection costs, together with the estimations of future connection rates, it is possible to project future capital expenditure for the three levels of service. Figure 11 shows the capital expenditure profiles for both urban and rural electrification. It can be seen that upgrading the service levels has significant implications for the capital costs of rural electrification, but less significant effects in urban areas.

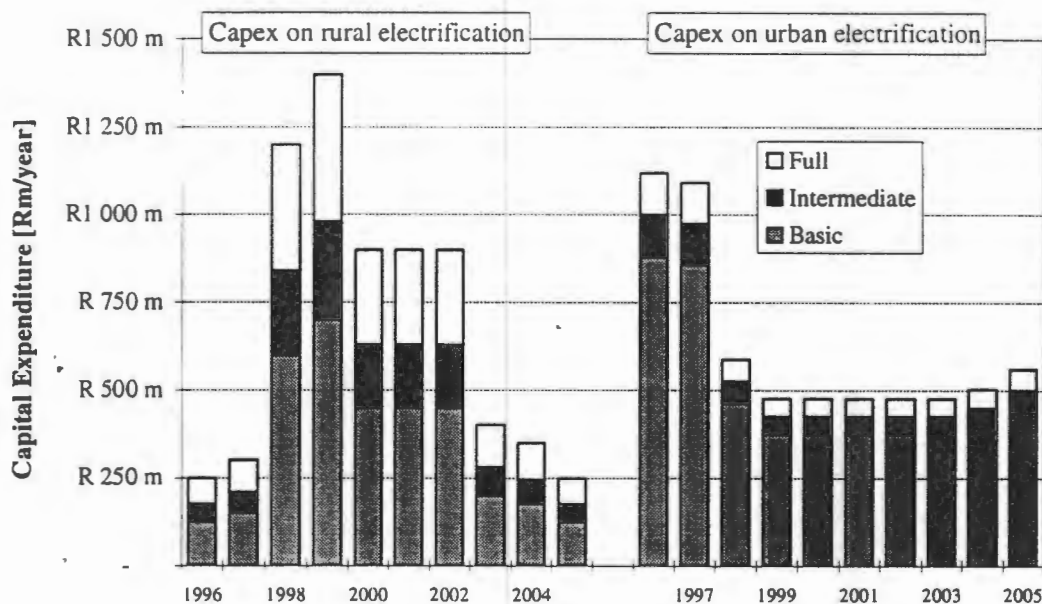


Figure 11 Capital expenditure for rural and urban electrification

3.3 Operating costs

Operating costs include both fixed costs (expressed as a cost per customer per month) and variable costs (a function of electricity consumption). The assumptions used in the analysis are shown in Table 5.

			Basic	Intermediate	Full
Rural	Fixed costs	[R/cust/month]	R25	R25	R25
	Variable costs	[c/kWh]	11	11	11
Urban	Fixed costs	[R/cust/month]	R20	R20	R20
	Variable costs	[c/kWh]	11	11	11

Table 5 Parameters for operating costs

Using these assumptions, together with estimates of consumption growth and household connection rates, it is possible to calculate the total operating costs incurred. These are shown in Figure 12.

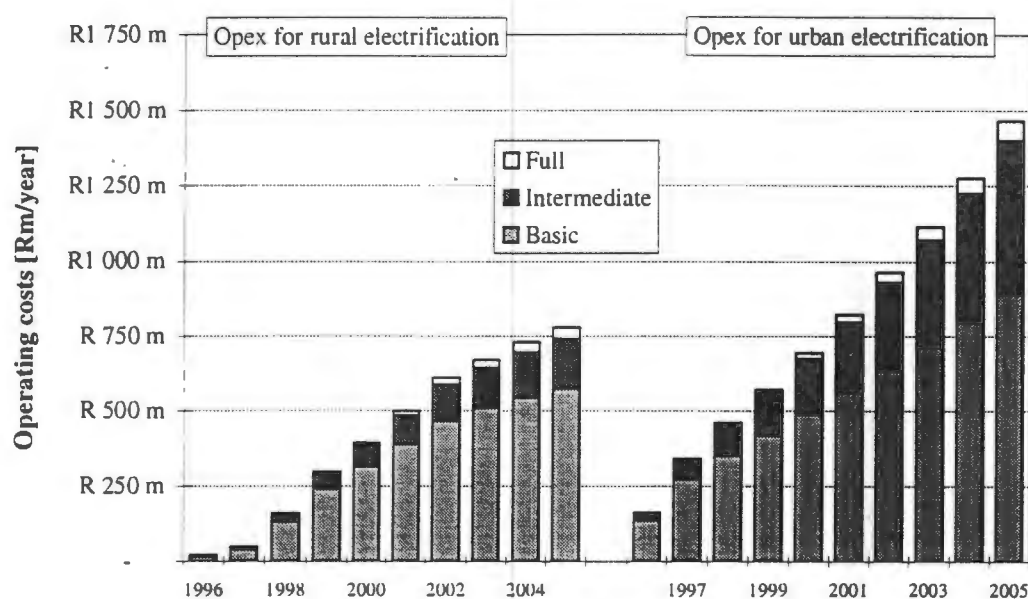


Figure 12 Operating costs for rural and urban electrification

3.4 Revenue from electricity sales

It is assumed that customers supplied with a basic level of service are charged a small fixed monthly fee, whereas those on intermediate and full levels are charged a single energy charge using a prepayment meter. The figures used in the analysis are shown in Table 6.

	Monthly fee	Energy charge	Real annual increase
Basic	R15	0c/kWh	0%
Intermediate	R0	25c/kWh	0%
Full	R0	25c/kWh	0%

Table 6 Tariffs used in the analysis

Combining the tariff assumptions with estimates of consumption and growth in the number of connections, it is possible to calculate the revenue for the three levels of supply. This is shown in Figure 13.

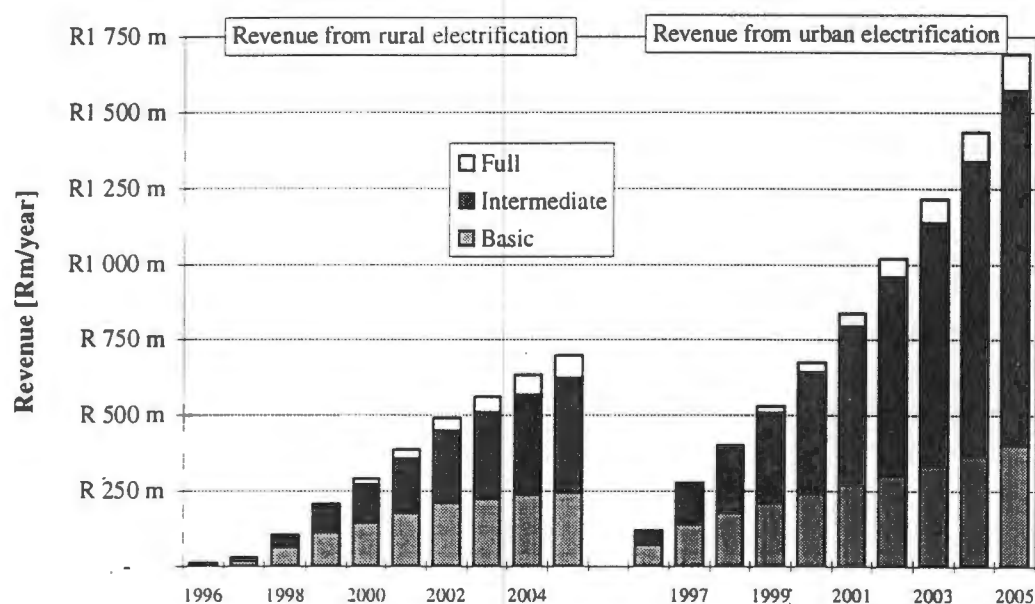


Figure 13 Revenue from rural and urban electrification

3.5 Lost income from other electricity consumers

Where electrification results in financial losses for the utility making the investments, and where there is no external subsidy from government, these losses have to be met through cross-subsidies from other consumers. This can be achieved through any combination of tariff structures (as described in section 2). Increased cross-subsidisation necessarily implies price increases for those consumers paying the subsidy. Electricity is not an 'essential good', and so price increases can be expected to cause electricity demand to fall by some amount. The scale of this decrease in demand will depend upon the price elasticity factor.

It is likely that the burden of cross-subsidisation is, and will be, shared unequally between domestic and non-domestic customers. This is because there is more scope for domestic price increases as a result of tariff rationalisation than for industrial and mining customers. It is assumed that the percentage price increase for domestic consumers will be double that of non-domestic users. Based on the modelling undertaken for this study, the maximum price increase for non-domestic users would have to be 5.5%, 6%, and 8% above 1995 prices for the basic, intermediate and full levels of services respectively. For domestic customers, the maximum price increases would be double these.

Using estimates of price elasticity of demand, it is possible to calculate the level of revenue loss which will result from cross-subsidisation. Data on price elasticities are relatively scarce, although one study indicated a short-run price elasticity of 0.097 and a long-run price elasticity of 1.01 (Pouris 1986). It is assumed that cross-subsidy effects are not permanent and will be significant primarily during the first five to ten years of the electrification programme, and consequently an elasticity of 0.1 is used here.

Figure 14 shows the income which would be foregone as a result of price increases. The lost income is largely a function of the financial losses of electrification, which itself is a function of connections rates in urban and rural communities, the tariff used and the growth in consumption, all mediated by the elasticity factor.

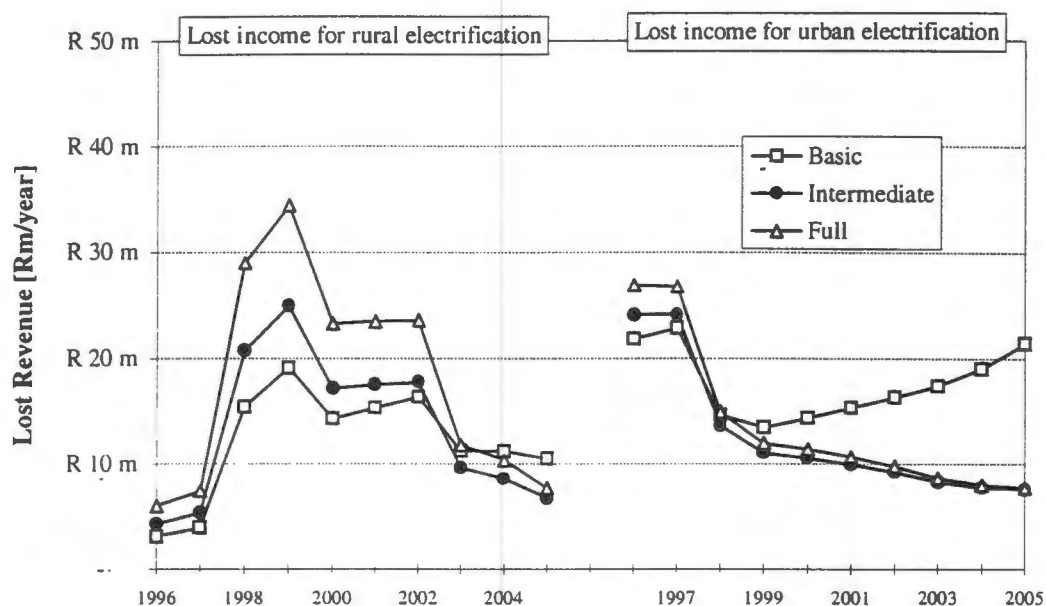


Figure 14 Lost revenue due to price increases

3.6 Results of financial analysis

Before incorporating the incremental social costs and benefits of higher levels of service, it is possible to examine the financial results of service upgrades; that is, from the utility's perspective, are there net benefits to improving service levels? This question can be answered by aggregating the capital costs, operating costs, foregone revenues and actual revenues, and calculating their net present value (NPV) over ten years for each of the basic, intermediate and high service scenarios. Comparison of the scenarios yields the incremental effects of moving from one service level to another.

With a financial NPV greater than zero, the utility experiences net financial benefits from upgrading, whereas if the NPV is negative, the utility experiences additional losses and hence there are financial disincentives to upgrading service levels. A real discount rate of 8% is used.

	Rural	Urban	Total
Basic to intermediate	(R 379 m)	R1 500 m	R1 121 m
Intermediate to full	(R1 341 m)	(R366 m)	(R1 707 m)

Table 7 Financial results of upgrading scenarios (NPV over 10 years, 8% discount rate)

It can be seen from Table 7 that the utility has financial incentives to upgrade from basic to intermediate services in urban areas only. This is not surprising, as current practice is, in fact, to install intermediate services in urban areas. On the other hand, there are no financial incentives to upgrade from intermediate to full levels of service in either rural or urban areas.

4 Social costs and benefits of higher service levels

Public policy-making should be informed not only by the direct financial effects of infrastructure delivery on the supply authority (although clearly these are critical), but also by the overall impacts of programmes on the national economy. In other words, account should be taken, in addition to the financial NPV, of positive and negative effects experienced by other groups in society. In this section, four such effects are considered:

- consumer surplus effects,
- environmental and health effects of greater electricity use,
- multiplier effects of greater electricity use, and
- productivity improvements resulting from higher service levels.

4.1 Consumer surplus

The concept of consumer surplus embodies a number of important benefits which consumers perceive electricity as bringing. Essentially, the consumer surplus is the difference between the price a person actually pays (e.g. 25 c/kWh) and the amount that person would have been willing to pay for electricity. Generally, a person values the first units of electricity (normally used for lighting) most highly, and incremental units thereafter less highly. Since electricity prices are generally fixed at one level, or decline slowly, there is often a transfer of value to consumers for which they are not paying. Since this represents real economic value, it should, in principle, be included in a CBA.

In practice, measurement of the consumer surplus is difficult. However, proxies can be usefully employed. Electricity usually displaces more expensive lighting fuels, the price of which is a proxy for consumers' willingness to pay for that service. Consequently, the difference between household fuel expenditure on those services before and after electrification represents part of the consumer surplus. This corresponds with the area marked B in Figure 15. Likewise, if consumption increases as a result of electrification, then an additional benefit accrues to the consumer (area C in the Figure).

The willingness to pay for electricity may be greater than avoided energy expenditure due to the added convenience which electricity provides; that is, the consumer surplus would be greater than the two components just described. However, these qualitative differences are difficult to calculate.

The methodology described by Davis and Horvei (1994) is used here to calculate the consumer surplus. It is a function of the unit price paid for displaced fuels, the quantity of fuels displaced, the price of electricity and the consumption of electricity. The areas denoted B and C in Figure 15 represent the consumers' surplus. The area marked A represents the direct financial revenue from electricity consumption.

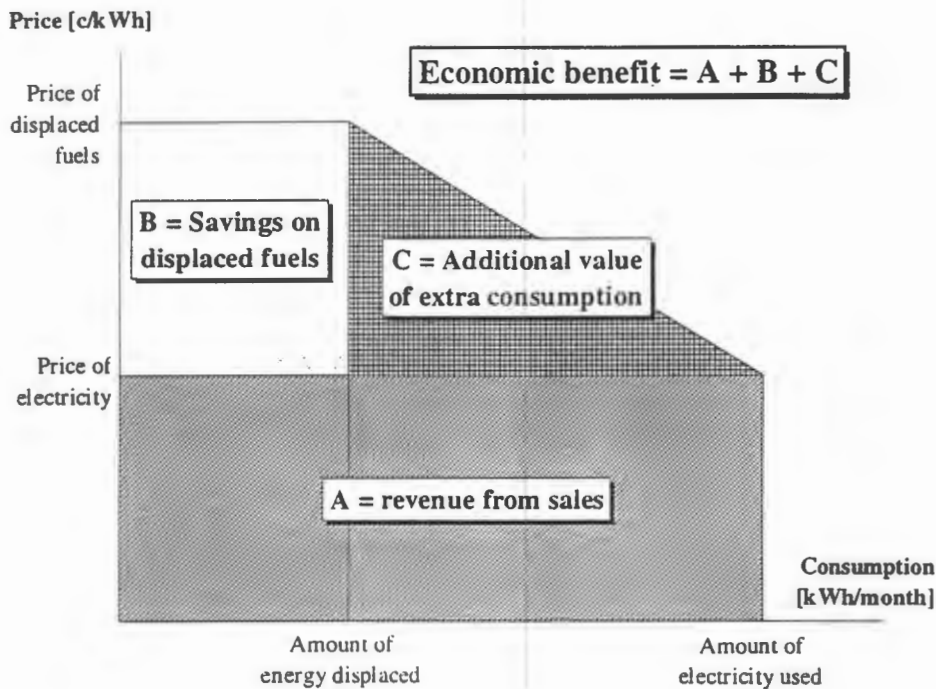


Figure 15 Calculation of consumers' surplus

Although crude, an analysis of the differences in energy consumption and expenditure between electrified and unelectrified households, based on an extensive survey conducted by the Project for Statistics on Living Standards and Development (SALDRU 1995), allows an estimation of urban and rural households' willingness to pay for small amounts of electricity. These results are shown in Table 8.

	Energy displaced [kWh/month]	Equivalent price [c/kWh]	Monthly saving [R/month]
Rural household	60	40	R24
Urban household	70	38	R27

Note: these results are based on an analysis of extensive survey data (SALDRU, 1995). As households use electricity for more end-uses (i.e. as energy displaced increases), so the equivalent price decreases.

Table 8 Energy savings in electrified households

Using this methodology, it is possible to calculate the consumer surplus for all three levels of service.

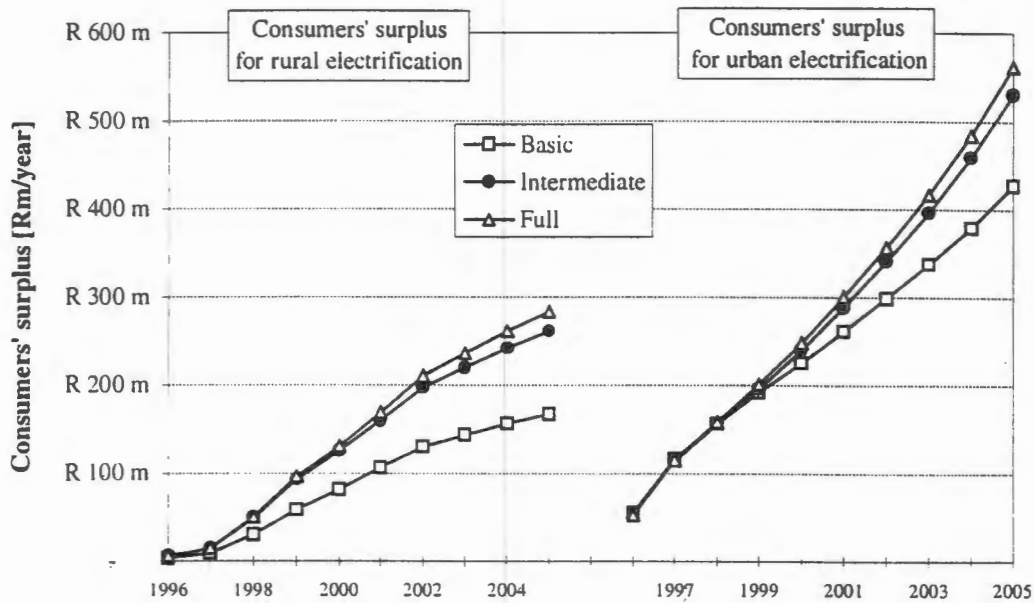


Figure 16 Consumer surplus

Figure 16 shows that the consumer surplus increases fairly significantly when the level of service is increased from basic to intermediate, but increases only slightly when service levels are increased further.

4.2 Health and environmental benefits of electrification

A range of environmental and health costs arise from the production of electricity and from the consumption of other forms of energy in unelectrified households. Of relevance for present purposes, are the *incremental* benefits and costs resulting from increased electricity service levels. On the one hand, there are likely to be incremental benefits in the form of avoided costs of using non-electric forms of energy. The latter 'external costs' include: air pollution from coal and wood fires, poisoning in infants who accidentally ingest paraffin, social costs of wood collection in rural areas, and fires and burns caused by candles and paraffin. On the other hand, increased electricity service levels may cause additional costs due to the generation of electricity to meet additional demand. For purposes of this analysis, therefore, environmental and health costs which are the same under both scenarios are not relevant; rather, the incremental effects need to be estimated.

These incremental effects can be assessed only with an understanding of fuel switching processes at the household level. Based on the experience accumulated since Soweto was electrified in the 1980s, and in the first five years of the accelerated electrification programme, there is reasonable clarity about the end-uses for which electricity is the most effective means of satisfying demand. Most important is the fact that the provision of an electricity connection does *not* necessarily lead to the use of electricity for the more energy-intensive end-uses. Rather, the substitution effect is most pronounced for the higher-value services such as powering lights, radios, televisions and small appliances. This is summarised in an aggregated fashion for low-income households in Table 9.

Energy service	Electricity service level			
	None	Basic	Intermediate	Full
Cooking	wood, coal, paraffin	wood, coal, paraffin	electricity, wood, coal, paraffin	electricity, wood, coal
Space heating	wood, coal, paraffin	wood, coal, paraffin	wood, coal, paraffin	wood, coal
Water heating	wood, coal, paraffin	wood, coal, paraffin	wood, coal, paraffin	wood, coal
Refrigeration	none	none	none, electricity	none, electricity
Appliances	none	none, electricity	electricity	electricity
Radio, TV	batteries	electricity	electricity	electricity
Lighting	candles, paraffin	electricity	electricity	electricity

Table 9 Expected substitution effects of electricity in low-income households

Life-cycle cost analyses show that electricity is the most cost-effective means of meeting demand for lighting services, for powering small appliances such as radios, televisions and kettles or irons (Thorne 1996). For the more energy-intensive applications, however, such as cooking, space heating and water heating, electricity is more expensive than alternatives such as coal, wood and paraffin. Hence the substitution effect following electrification is most significant in the case of lighting and least significant in the case of heating. The consequent environmental and health effects are thus limited primarily to those services for which substitution takes place.

The incremental effects of moving from one service level to the next can be summarised as follows:

- *No service to basic service:* electricity will replace the use of candles and paraffin for lighting, and batteries for small appliances. Generally, there will be no cooking or space heating with a basic service.
- *Basic to intermediate service:* additional electricity use is likely to occur for some cooking, use of small appliances and perhaps a refrigerator (depending on household income).
- *Intermediate to full service:* the extent of additional electricity use is highly dependent upon household income, and on the economics of different appliance-fuel combinations; for most low-income households, additional electricity use will be negligible. A very small proportion of households is likely to install hot water geysers which will substantially increase electricity consumption and replace other means of water heating.

From this, it is evident that the environmental improvements associated with moving from one level of service to another are fairly modest. Nonetheless, it is possible to make some monetary estimates of the incremental benefits of moving to various service levels, based on a recent economic study of the above externalities (Van Horen 1996b). Table 10 summarises the data used in this study regarding the external costs of various environmental and health effects, as well as the abatement effect caused by electrification.

Externality	External costs (R per h/h per year)	% Abatement		
		Basic	Intermediate	Full
Air pollution: coal	307	0%	25%	30%
Air pollution: wood	944	0%	5%	5%
Paraffin poisoning	90	25%	50%	55%
Fires & burns	491	60%	75%	75%
Fuelwood collection	291	0%	5%	5%

Table 10 External costs and percentage abatement under various scenarios
(Source: external costs from Van Horen 1996b)

The abatement percentages in Table 10 are subjective judgements based on a range of studies undertaken of newly-electrified households around the country (refer to Simmonds & Mammon (1996) for a review of these). In view of the fact that there is nothing predetermined about the extent of fuel switching and electricity use, these percentages are unavoidably crude proxies for actual substitution effects, but nevertheless constitute reasonable average values.

The estimates of external costs are based on the opportunity costs of the various externalities, in particular their health effects. The study from which these values are drawn (Van Horen 1996b), derived a range of estimates for these health externalities (and others) based on the average opportunity costs for these effects. In the case of morbidity, costs included transport costs, medication, lost production, and costs of treating in- and out-patients. For mortality, valuation estimates from a range of international studies were used and adjusted to take account of South African income levels. This is a methodologically complex area, and thus valuation estimates were conservative. A fuller discussion of this issue can be found in Van Horen (1996b).

Figure 17 shows the estimated *net* benefits - in the form of avoided environmental costs - from the various electrification scenarios. These net effects include not only the avoided environmental costs from household consumption, but also an estimate of the additional environmental costs of electricity generation by Eskom to supply these customers. The externalities do not include, however, damage cost estimates from greenhouse gas emissions, as these are associated with too much uncertainty to be included in the analysis. Nor do they include non-health environmental effects, such as effects on biodiversity, aesthetics or visibility.

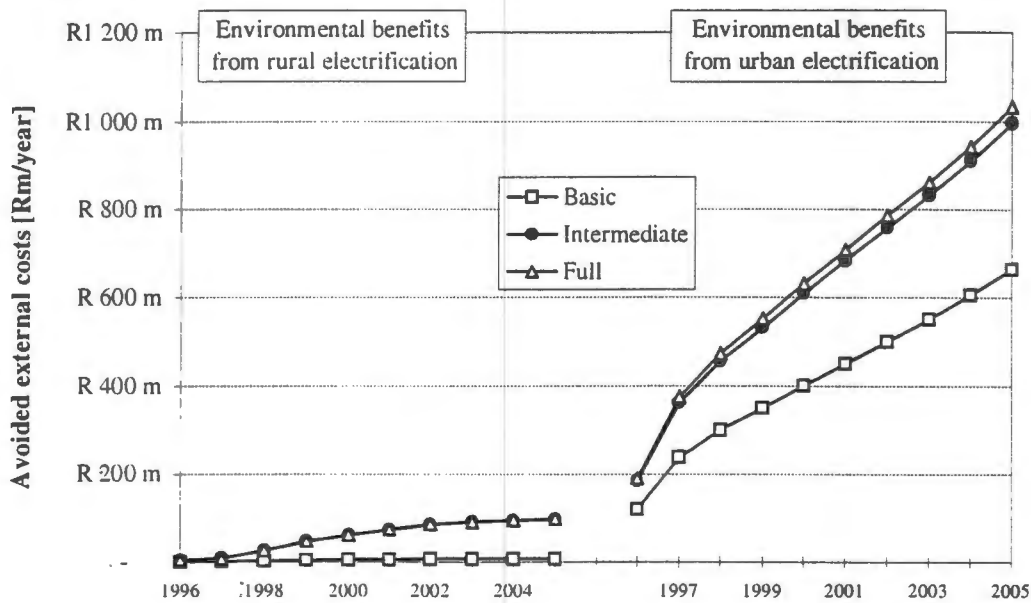


Figure 17 External benefits (avoided environmental costs) of rural and urban electrification

It is evident from the figure that electrification produces net environmental benefits in all cases, although these effects are considerable smaller in the case of the rural programme than in the urban programme.

4.3 Multiplier effects of electrification, including impacts on SMMEs

The commonly-held view is that infrastructure services in general, and electricity in particular, are important contributory factors for the growth of SMMEs. This assumption underlay many countries' electrification programmes in the 1960s and 1970s, with the expectation that economic activity would be greatly stimulated in poorly-serviced areas.

Practical experience with the role of electricity in supporting SMMEs, however, is far from conclusive. It is frequently stated that electrification is a 'necessary, but not sufficient condition' for economic growth. The rationale for this is that the growth of business activities in relatively poor areas requires a range of inputs, one of which may be electricity. Other important pre-requisites for the growth of small businesses include access to communications, roads, transport, credit, and markets. Where electrification is accompanied by investments in these areas, the developmental benefits will be significantly enhanced. Without access to credit, markets, and communication, however, it is very unlikely that electrification alone, even at a very high level of service, will bring about any significant increase in SMME activity. Some would even argue that it is not electricity *per se* which is required, but adequate energy services, and these could be provided by, for example, gas supplies.

Against this background, it is notoriously difficult to quantify the multiplier effects of electrification. Econometric estimates of the multiplier effects of expenditure on electrification are usually highly generalised and subject to great uncertainty. Early econometric studies of electrification in South Africa produced extremely large values, which have subsequently been shown to be completely implausible. In one study, for instance, De Wet et al (1990) estimated that between 700 000 and 1 000 000 new jobs would be created in the first ten years of the programme, and that the effect on GDP would be +11% in cumulative terms. Actual experience suggests that these modelling results are unrealistic.

Based on its experience since the launch of the electrification programme in 1991, Eskom estimates that for every 100 households which are connected, between 10 and 20 new economic activities are started (Eskom 1996). Data are not readily available, however, on the average value added by those enterprises, nor on the representivity of Eskom's sample, and so it is not possible to quantify these effects in monetary terms. Moreover, it is highly unlikely that this ratio can be generalised across rural and urban areas throughout South Africa, and it probably represents an optimistic view of SMME growth. Furthermore, many of these 'economic activities' are very small in scale, representing minor income generation opportunities for household members and no-one else. As noted before, there is nothing pre-determined about the effect of electricity on SMMEs.

One of the impacts of electrification which is reported in the literature is that there is often an increase in economic activities which depend on refrigeration. Although, in principle, fridges can be powered by gas, electrical fridges are often acquired by small traders to store drinks and perishable goods. For example, in the recently electrified Loskop area in rural Kwazulu-Natal, of the 23 operational enterprises in the area (as of June 1996), all but two used electrical refrigerators to store produce, meat and drinks for sale (Annecke et al 1996). Again, although the effect of electrification in Loskop was positive, it is not possible to quantify the value added in terms of additional SMME income. In any event, drawing generalised conclusions on the basis of a few studies such as this one would be questionable.

Notwithstanding this uncertainty and the difficulties inherent in quantifying SMME growth, it is clear that the *direction* of change is positive: in other words, SMME activity is enabled by the provision of electricity supplies, especially where the other necessary conditions are met.

It is important for present purposes to consider the incremental effects of moving from basic to intermediate and full service levels. Significantly, it is probable that the benefits of moving from basic to intermediate levels are larger, since the basic 5 Amp level of supply represents a significant barrier on future demand growth. With an intermediate 20A supply, by contrast, it is possible to power appliances such as refrigerators and small motors. Only for heavier duty applications - such as welding or carpentry - is a higher level of service required (60A, 3 phase). An important factor in this regard is not so much the level of service in the household itself, as the capacity for the bulk connection system (that is, the medium-voltage distribution lines and transformers) to accommodate upgraded reticulation systems should those be demanded by (albeit a small percentage of) consumers.

For purpose of this analysis, it can be stated that electrification generally has a positive effect in terms of growth of SMMEs, but it is not possible to quantify the size of this impact. The latter depends, in particular, on the presence of other pre-requisites for SMME growth such as roads, telecommunications, markets and credit. This question will be considered again in the conclusion of the report.

4.4 Improved labour productivity and study conditions

The use of electricity in a household can have several effects on the productivity of inhabitants. Firstly, improved lighting, as well as access to television, bring about considerable improvements to the quality of the working environment of students and scholars. The ability to study at home, although also dependent on other factors such as the number of people in the household and the number of rooms available, is certainly enhanced through electrification.

Secondly, improved lighting and air quality (to the extent that the latter occurs) can also increase the quality of life of inhabitants and this has a positive effect on their productivity in places of employment or income generation.

On the other hand, increased access to electricity and television can also bring about negative effects, such as exposure to advertising and films which encourage the consumption of unhealthy commodities. It has been suggested that consumer demand patterns may change for the worse in terms of their public health effects, and that

electrification and consequent increased television viewing can contribute to this (MRC 1995).

The quantification of these effects in economic terms is difficult or impossible. However, in this study this is not necessarily a problem, since some of these effects will already be reflected in consumers' willingness to pay (WTP), and are therefore at least partially accounted for in the consumer surplus. Consumers are aware of the fact that electricity is a superior means of meeting their energy needs than alternatives, and that it is cleaner and less hazardous, and so their WTP already embodies some or all of these effects. The same applies to the improved environmental and health effects of electrification - in the present analysis, these have already been (at least partially) accounted for in the consideration of environmental externalities. It is unlikely that additional benefits over and above those already addressed earlier, would be highly significant in relation to other effects.

5 Conclusions and net effects

5.1 Net economic effects

By aggregating the financial results with the economic adjustments described in the previous sections - consumer surplus and environmental benefits - it is possible to assess the economic impact of the two upgrading scenarios. Table 11 summarises these effects in terms of net present values expressed in 1996 Rands, based on a ten year time horizon and a real discount rate of 8%.

	Financial NPV	Consumer surplus	Environmental benefits	Economic NPV
Basic to intermediate				
Rural	R (379 m)	R 320 m	R 318 m	R 260 m
Urban	R 1 500 m	R 224 m	R 1 319 m	R 3 042 m
Total	R 1 121 m	R 544 m	R 1 637 m	R 3 302 m
Intermediate to full				
Rural	R (1 341 m)	R 60 m	R 6 m	R (1 276 m)
Urban	R (366 m)	R 84 m	R 144 m	R (138 m)
Total	R (1 707 m)	R 144 m	R 150 m	R (1 414 m)

Table 11 Financial and economic impacts of the upgrading scenarios
(NPV over 10 years, discount rate 8%)

It is evident from the table that, on the basis of the direct financial impacts of electrification to the utility, only one of the four categories is financially attractive, namely the upgrade from basic to intermediate levels in urban areas (NPV of R1 500 m). This result is not surprising since, in reality, distributors are supplying most urban customers with an intermediate supply (the readyboard and prepayment systems). The fact that the rural intermediate level delivers a financial NPV of negative R379 m is also consistent with the actual trend of rural suppliers to cut back on capital connection costs by using a more basic level of supply.

The introduction into the equation of the consumer surplus and environmental factors, however, changes the results considerably. The rural intermediate scenario changes from an NPV of negative R379 m to positive R260 m over the ten year period, whilst the urban intermediate supply becomes more strongly positive (from R1 500 m to R3 042 m), and the urban and rural full supplies become less strongly negative. Full service levels in rural areas appear to be completely unviable, even when considering indirect economic benefits, although full services in urban areas become marginally negative.

As noted earlier, the economic adjustments are less sophisticated and more crude than the financial results, and should therefore be treated with a measure of uncertainty. Conceptually, however, it is unambiguous that those adjustments do represent real economic impacts - it is only their exact monetary scale which is uncertain.

A useful way of dealing with the unquantified effects of electrification on SMMEs is to relate these two sets of information. The question could be posed: is the value of a full electricity supply (as opposed to an intermediate one) in terms of SMME growth high enough to outweigh the negative economic NPVs reported above? In other words, could this factor tilt the balance of the economic impact from a negative to a positive? This is a question which cannot be answered here, but at least helps to focus the issues for decision-makers.

5.2 Policy conclusions

The analysis in this report confirms that the direct financial impacts of electrification for supply authorities are negative in the case of full supplies for both urban and rural areas, but positive for intermediate supplies in urban areas. This accords with actual trends in the industry.

From a national perspective, it makes sense - although fairly marginally - to invest in an intermediate level of supply in rural areas. This is because of the additional benefits which accrue, both to consumers and to their health/environments. From a policy perspective, it is critical that, if a higher level of service is to be pursued than makes financial sense for a utility, that government compensates the utility for its financial losses. Moreover, this transfer payment should be subject to standard fiscal control, rather than being a hidden, internal transfer. This would necessarily bring subsidies for electrification into competition with other pressing social needs. Unless government compensates utilities for their financial losses, up to the additional value to the economy (and no more than this), utilities will rapidly encounter financial problems, and these will, in turn, undermine their long-term viability.

With regard to tariff issues and cross-subsidisation, it was pointed out earlier that the status quo entails an effective cross-subsidy of about R1.6 billion per annum, from (mostly) non-domestic consumers to newly-electrified customers. Policy trends in the industry are, if anything, to reduce or at least make more explicit those transfers, and to bring them under the more direct control of public policy-makers.

Finally, this report has not mentioned non-grid electrification options such as solar home systems. The latter are broadly similar to a 'basic' grid electricity connection insofar as they can meet the same energy demands, although often at lower cost, especially in more remote rural areas where grid extension costs are prohibitive. Thus, from an infrastructure planning point of view, it is important that solar home systems are considered as one of the technical supply options, alongside various grid electrification options.

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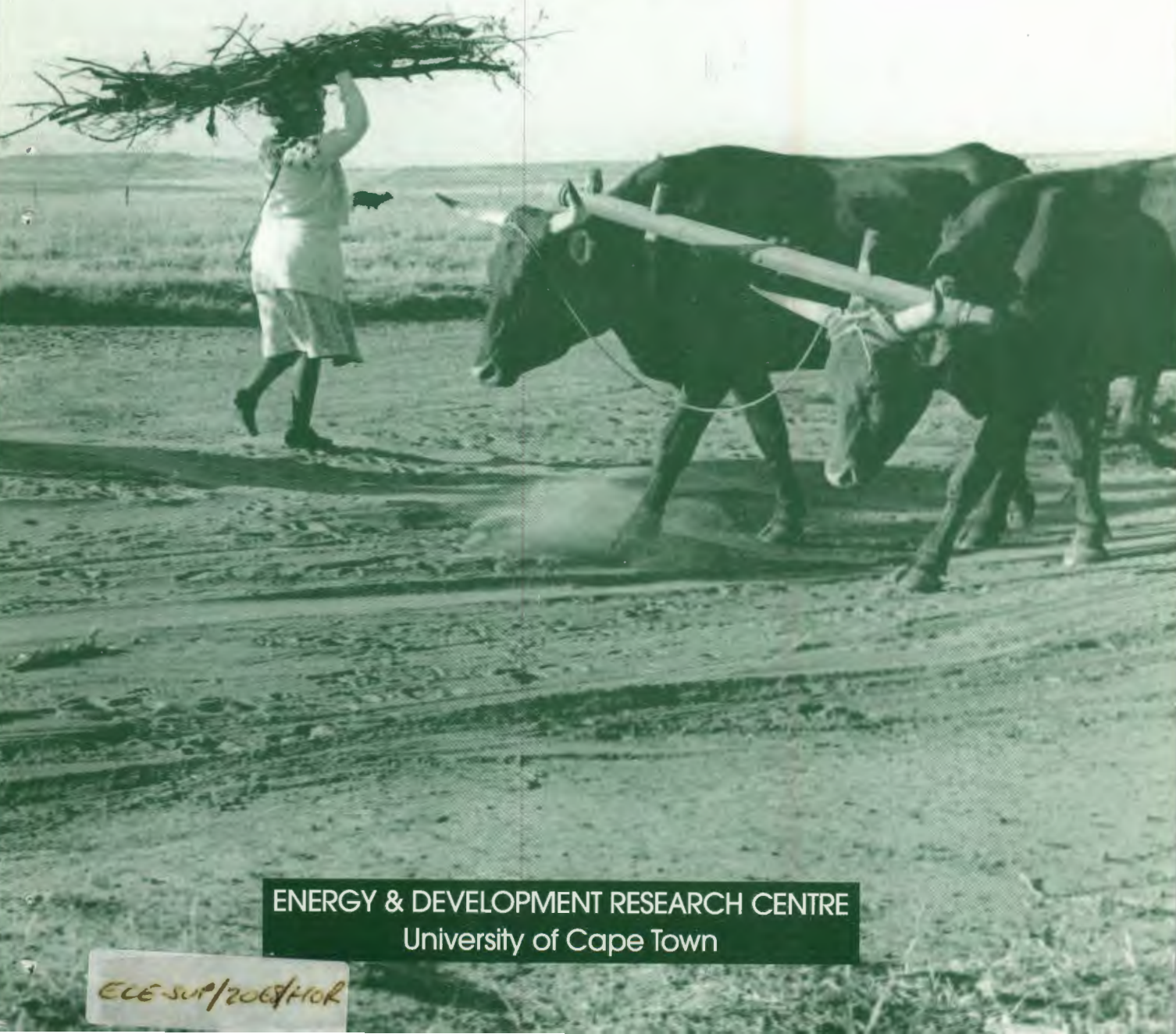
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